

The Town of Amherst

Natural Hazard Mitigation Plan Update



Adopted by the Town of Amherst on

Prepared by:
The Amherst Hazard Mitigation Planning Workgroup

And

The Pioneer Valley Planning Commission

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Chief Tim Nelson, Emergency Manager

Guilford Mooring, P.E.
Superintendent, Department of Public Works

David Ziomek, Interim Town Manager

Scott Livingstone, Police Chief

Chris Brestrup, Interim Planning Director

Douglas Slaughter, Selectboard

Capt. Jeff Olmstead, Fire Department

The Town of Amherst offers thanks to the Massachusetts Emergency Management Agency (MEMA) for developing the Commonwealth of Massachusetts Natural Hazards Mitigation Plan (www.state.ma.us/dem/programs/mitigate/index.htm), which served as a model for this plan. In addition, special thanks are extended to the staff of the Pioneer Valley Planning Commission for professional services, process facilitation and preparation of this document.

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1: PLANNING PROCESS

Introduction

The Federal Emergency Management Agency (FEMA) and the Massachusetts Emergency Management Agency (MEMA) define Hazard Mitigation as any sustained action taken to reduce or eliminate long-term risk to people and property from natural hazards such as flooding, storms, high winds, hurricanes, wildfires, earthquakes, etc. Mitigation efforts undertaken by communities will help to minimize damages to buildings and infrastructure, such as water supplies, sewers, and utility transmission lines, as well as natural, cultural and historic resources.

Planning efforts, like the one undertaken by the Town of Amherst and the Pioneer Valley Planning Commission, make mitigation a proactive process. Pre-disaster planning emphasizes actions that can be taken before a natural disaster occurs. Future property damage and loss of life can be reduced or prevented by a mitigation program that addresses the unique geography, demography, economy, and land use of a community within the context of each of the specific potential natural hazards that may threaten a community.

Preparing a hazard mitigation plan before a disaster can save the community money and facilitate post-disaster funding. Costly repairs or replacement of buildings and infrastructure, as well as the high cost of providing emergency services and rescue/recovery operations, can be avoided or significantly lessened if a community implements the mitigation measures detailed in the plan. FEMA requires that a community adopt a pre-disaster mitigation plan as a condition for mitigation funding. For example, the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance Program (FMA), and the Pre-Disaster Mitigation Program are programs with this requirement.

Hazard Mitigation Workgroup

Beginning in 2015, the Town of Amherst completed an update of their 2008 Hazard Mitigation Plan, in collaboration with the Pioneer Valley Planning Commission. All portions of the plan were reviewed and updated as necessary. Planning for hazard mitigation in Amherst involved a 6-member workgroup:

- Chief Tim Nelson, Fire Chief
- Christine Brestrup, Interim Director of Planning
- Guilford Mooring, P.E.
Superintendent, Department of Public Works
- David Ziomek, Interim Town Manager
- Scott Livingstone, Police Chief
- Douglas Slaughter, Selectboard
- Capt. Jeff Olmstead, Fire Department

The natural hazard mitigation planning process for the Town of Amherst included the following tasks:

- Reviewing and incorporating existing plans and other information
- Identifying the natural hazards that may impact the community.
- Conducting a Vulnerability/Risk Assessment to identify the infrastructure at the highest risk for being damaged by the identified natural hazards, particularly flooding.
- Identifying and assessing the policies, programs, and regulations the community is currently implementing to protect against future disaster damages.
- Identifying deficiencies in the current strategies and establishing goals for updating, revising or adopting new strategies.
- Adopting and implementing the final Hazard Mitigation Plan.

The final product of this process is the development of an Action Plan with a Prioritized Implementation Schedule.

Workgroup Meetings

Meetings of the Hazard Mitigation Committee, all of which took place at the Amherst Town Hall, were held on the dates listed below. Agendas for these meetings are included in Appendix D.

December 21, 2015, 3:00 p.m.

Work group meeting included hazard mitigation planning overview, identify and organizing of the planning team, identifying critical facilities, and an initial discussion of hazard identification and risk assessment.

January 26, 2016, 3:00 p.m.

Work group revisited critical facilities list, discussed existing hazard mitigation strategies, and list of future mitigation strategies to be implemented.

February 18, 2016 3:00 p.m.

Work group reviewed list of current mitigation strategies undertaken by the Town and draft of prioritized list of mitigation strategies, based on conversation at previous meeting. Work group reviewed revised vulnerability assessment, reviewed map of location of critical facilities and natural hazards, prioritized the identified mitigation strategies, defined plan implementation process and discussed public outreach process.

Agendas and sign-in sheets for each meeting can be found in Appendix D. While not all members of the Hazard Mitigation Workgroup were able to attend each meeting, all members collaborated on the plan and were updated on progress by fellow Committee members after meetings occurred as necessary.

Participation by Public and Neighboring Communities

Participation by Stakeholders

A variety of stakeholders were provided with an opportunity to be involved in the update of the Amherst Hazard Mitigation Plan. The different categories of stakeholders that were involved, and the engagement activities that occurred, are described below.

Local and regional agencies involved in hazard mitigation activities and surrounding community engagement and input

The Pioneer Valley Planning Commission is a regional planning agency for 43 towns and cities in Massachusetts' Hampden and Hampshire Counties. PVPC regularly engages with the Town of Amherst as part of its regional planning efforts, which include the following:

- Developing the Pioneer Valley Regional Land Use Plan, Valley Vision 2, which advocates for sustainable land use throughout the region and consideration for the impact of flooding and other natural hazards on development.
- Developing the Pioneer Valley Climate Action and Clean Energy Plan, which assesses the impact that climate change will have on the region and recommends strategies for mitigation that can be implemented by local municipalities and businesses.
- Collaborating with state agencies, such as the Department of Conservation and Recreation, to maintain inventories of critical infrastructure throughout the region.

All of these PVPC initiatives considered the impact of natural hazards on the region and strategies for reducing their impact to people and property through hazard mitigation activities. The facilitation of the Amherst Hazard Mitigation Plan by PVPC ensured that the information from these plans was incorporated into the Hazard Mitigation Planning process.

In addition, the Pioneer Valley Planning Commission is actively involved in the Western Region Homeland Security Advisory Council (WRHSAC). WRHSAC, which includes representatives from Western Massachusetts municipalities, Fire Departments, Public Works Departments, Police Departments, area hospitals and regional transit from throughout the four counties of western Massachusetts, is responsible for allocating emergency preparedness funding from the US Department of Homeland Security. The representatives of these disciplines who serve on the WRHSAC are charged with sharing the information discussed at meetings with their colleagues at their regular meetings. PVPC attends all WRHSAC meetings and all WRHSAC members are aware of the fact that Amherst was updating its Hazard Mitigation plan. Meetings of WRHSAC regularly involve discussion about how to improve emergency preparedness in western Massachusetts, and hazard mitigation activities are included in this discussion.

For the update of this Hazard Mitigation Plan, PVPC provided feedback from WRHSAC on regional mitigation activities and natural hazards pertaining to Amherst. This was the method through which WRHSAC was engaged in the planning process.

In addition, PVPC staff regularly present to their Executive Committee and Commission (representatives from the 43 cities and towns that comprise the Pioneer Valley, when new projects are launched and when funding opportunities are available). As result, all the communities in the region were informed of Amherst's Hazard Mitigation Plan update process and encouraged to comment.

PVPC staff included a summary article on the status of Hazard Mitigation planning in the region in the quarterly Regional Reporter that is mailed to area Chambers of Commerce, all member municipalities, area colleges and universities and other key stakeholders in the region. In this way, businesses, educational institutions and other key stakeholders were educated about and informed of Amherst's hazard mitigation planning work

Participation by the Public, Businesses, and Neighboring Communities

Two public planning sessions were held as part of the development of the Amherst plan – on January 26, 2016 and March 29, 2016. Both meetings occurred after the Hazard Mitigation Committee had provided input on hazards and mitigation strategies relevant to the community. Notice of both public meetings was posted at Amherst Town Hall in compliance with the Commonwealth of Massachusetts' open meeting law. Public meeting agendas and notices can be found in Appendix D.

On December 17, 2015 the Town of Amherst posted on their website that that the hazard mitigation planning process would commence with a meeting of the hazard mitigation update committee on December 21, 2015. All public meetings were posted at the Town Hall, on PVPC's website, and through media releases in compliance with the Commonwealth of Massachusetts' open meeting law.

On January 12, 2016, the Pioneer Valley Planning Commission sent a press release to relevant media outlets to announce that there would be a first public outreach meeting about the plan on January 26, 2016. This release was sent to those media identified by the Hazard Mitigation Committee as most relevant to the development of the plan. A copy of the press release can be found in Appendix D.

On March 16, 2016, PVPC sent out a press release indicating that a second public outreach meeting would take place on March 29, 2016, and also to inform the public that a draft of the Amherst Hazard Mitigation Plan had been placed on PVPC's website. A copy of the press release can be found in Appendix D. The release also indicated that hard copies were available at PVPC's offices and at Amherst Town Hall, and that all residents, businesses and other concerned parties of Amherst were encouraged to comment on the plan by e-mailing or calling staff contacts at PVPC or the Town.

The Hazard Mitigation Committee determined that the most effective outreach strategy for engaging with the public, businesses and neighboring communities was through the media, and so this was the outreach strategy employed for reaching out to all three groups of stakeholders. The press release indicated that residents of Amherst were invited to attend the event, which was also intended to include representatives of businesses in Amherst and residents of neighboring communities.

Businesses and neighboring communities were also provided with an opportunity to provide feedback through the Pioneer Valley Planning Commission. PVPC is regularly involved in land use, transportation, and environmental planning initiatives in Amherst and surrounding communities. Regular feedback received from these other initiatives were incorporated into the hazard mitigation planning process.

Additional outreach to surrounding communities occurred through the regular quarterly newsletter that PVPC sends out to its member communities about its recent activities. In these articles, adjacent municipalities were encouraged to reach out to PVPC about hazard mitigation plans by e-mailing or calling staff contacts at PVPC.

No feedback was received from the public, businesses, or neighboring communities during the planning process. Any future input received from the public, as well as any other stakeholders, will be incorporated into the plan during future regular updates. Public participation will be a critical component of the Hazard Mitigation Plan maintenance process. The Hazard Mitigation Committee will hold all future meetings in accordance with Massachusetts open meeting laws. In addition, the public will be invited to provide comments through e-mail. The comments will be reviewed by the Hazard Mitigation Committee and incorporated as appropriate.

Select Board Meeting

In 2013, the Select Board agreed to begin the process of developing a revised Hazard Mitigation Plan. Once the plan was provisionally approved by FEMA, the Select Board held a public hearing on the plan on _____ and adopted it.

2: LOCAL PROFILE

Community Setting

The Town of Amherst has maintained its small-town atmosphere even as it has evolved from its earliest beginnings as an agricultural college community to a major educational and employment center with 37,819 residents (2010 Census). Comprised of almost 28 square miles, the Town is located east of the Connecticut River on the northern edge of Hampshire County in western Massachusetts. It is bordered by Hadley on the west; Sunderland and Leverett on the north, Shutesbury, Pelham, and Belchertown on the east; and Granby and South Hadley on the south. It is 23 miles from Springfield, 50 miles from Pittsfield, and 87 miles from Boston.

Named for Lord Jeffery Amherst, British general of the French and Indian War, Amherst is home to the oldest college in Western Massachusetts, Amherst College, which opened in 1821. In 1867, the former Massachusetts Agricultural College opened its doors as a land grant college and the only exclusively agricultural college in the country. In the last fifty years, “Mass Aggie” evolved to become the University of Massachusetts, one of the region’s largest employers and one of the leading research institutions in the nation. Hampshire College, the Town’s newest college, was founded in 1970.

Amherst has a thriving central business district with a broad array of shops, restaurants, cafes, and book stores. There are a variety of housing choices and a growing number of technology-based companies.

The Dickinson House, home to 19th century poet Emily Dickinson, is a National Historic Landmark, and is owned by Amherst College. The Jones Library contains special collections of Dickinson and poet Robert Frost, who once taught at Amherst College. The Pratt Museum of Natural History holds one of the world’s finest collections of dinosaur tracks, fossils, and meteorites. The town plays host to craft fairs, farmer’s markets, and the biennial New England Artist’s Festival and Showcase.

Amid a vibrant housing market, Amherst has worked to maintain its characteristic New England village landscape, with the majority of the Town remaining as either undeveloped or agricultural lands.

Government

The Town of Amherst was incorporated in 1759 and is governed by a Representative Town Meeting. Acting as the legislative branch of local government, the 240 elected Town Meeting members - 24 each from 10 precincts plus 14 *ex officio* members - enacts bylaws, appropriates the operating budget, and makes other important decisions about the Town’s resources and services. An elected five-member Selectboard acts as the Town’s chief executive officers. A Town Manager appointed by the Selectboard supervises the day-to-day municipal services and activities of Town staff. A variety of appointed volunteer committees are responsible for budget preparation, policy development, town bylaws, state codes and regulations, and advisory responsibilities.

Population Characteristics

There are currently 37,819 residents according to the 2010 US Census, in approximately 9,300 occupied housing units. The median family income is \$51,273, with 10.5 percent of residents living below the poverty level. To illustrate, according to Amherst Town staff, as of 2015 approximately 42% of Amherst

elementary students qualified for free or reduced lunch, while approximately 27% qualified in the middle and high schools.

Development Patterns and Trends

Topography and history have been the major factors in the development of Amherst's landscape. The Town's fertile soils, scenic vistas, and an evolving academic "industry" supported the community's economic and cultural base. In the 1960's, however, the local "industry" began an exponential growth rate with continuous expansion at the University of Massachusetts and the founding and flourishing of Hampshire College. Since then the community has studied, debated, and over time agreed to contain a strong housing market's physical incursions into the landscape. Seeing that market forces were also changing the social landscape through elevated housing prices, the community also worked to maintain community diversity through diverse housing types, including affordable options. Residents have consistently provided financial support through Town Meeting for the plans, programs, land acquisitions, and facilities needed to pursue development and conservation goals.

Since the last plan update, most of the Town's development is occurring in the following areas:

- Compact and clearly defined Downtown and Village Centers, each with its own characteristic mix of land uses;
- Large blocks of outlying, still-developable open space, featuring farm fields, orchards, water resource areas, and the forested expanse of the Mount Holyoke Range;
- Large landholdings of Amherst College, University of Massachusetts, and Hampshire College, each with its own plan of academic buildings and outlying open space; and,
- Tracts of forested land in North Amherst, where developable.

Recent development patterns have not resulted in increased vulnerability of populations, as Amherst has worked to protect land in floodplain areas.

Economy

The employment base of Amherst is stable, but relatively narrow compared to the rest of the Pioneer Valley and Massachusetts. Employment is concentrated primarily within educational services, including the University of Massachusetts, Hampshire College, and Amherst College. Of the 17,624 jobs in Amherst in 2010, 58.2 percent of them were in educational services. UMass Amherst is the second largest employer in western Massachusetts, with about 5,500 employees, and over 1,500 of those employees live in Amherst. The retail sector within Amherst is extremely reliant upon expenditures from the students, faculty, and staff at the University and Colleges.

The jobs that exist within Amherst, specifically those related to educational services, are relatively stable and grow during times of political consensus on the value of higher education (such as the UMass 250 Plan). Recently there has been startup and internet-based businesses locating in Amherst, particularly at Kendrick Place at East Pleasant and Triangle Streets. But other job sectors in Amherst, particularly traditional businesses such as retail and service businesses, are disproportionately small for a community this size, and are much more vulnerable to economic down-cycles. Despite the recent growth in information-based business and consultancies, the relative shortage of non-academic job opportunities and growth limits the opportunity for college and high school alumni to stay in the community following graduation.

The educational institutions in Amherst are tax-exempt; with relatively static commercial development, the fiscal burden for providing municipal services rests heavily upon the Town's residential property owners.

Zoning and Planning

In addition to other factors, zoning and other land use regulations constitute Amherst's "blueprint" for its future. Land use patterns over time will continue to look more and more like the town's zoning map until the town is finally "built out" — that is, there is no more developable land left. Therefore, in looking forward over time, it is critical that the town focus not on the current use and physical build-out today, but on the potential future uses and build-out that are allowed under the town's zoning map and zoning bylaws. Zoning is the primary land use tool that the Town has to manage development and direct growth to suitable and desired areas while also protecting critical resources and avoiding exacerbating the effects of natural hazards.

In its current zoning, Amherst has sixteen base zoning districts and seven overlay districts. The base districts define the allowed uses and dimensional requirements in all parts of the Town, while the overlay districts provide for additional restrictions in certain areas.

Although appropriate zoning is all relevant to protecting the health and safety of the Town residents, Amherst has several zone districts which are specifically relevant to natural hazard mitigation. They are outlined here:

- Flood-Prone Conservancy (FPC) - The FPC District consists of those geographical areas which by virtue of their relationship to components of the natural hydrology of the Town of Amherst, have substantial importance to the protection of life and property against the hazards of floods, erosion, and pollution and in general are essential to the public health, safety, and welfare. To this end, the number and types of uses allowed are restricted.
- Watershed Protection (WP) - The WP District is an overlay district intended to provide additional protection to those lands which by virtue of their location, slope and soils, make up the watersheds of the public water supply.
- Aquifer Recharge Protection (ARP) - The ARP District is an overlay district intended to provide additional protection to those lands, which by virtue of their location, slope, soils, sub-surficial geology and water tables, constitute the recharge area for Zones I, II and III of the public water supply wells of the Town of Amherst within the Lawrence Swamp Aquifer.

The Zoning Bylaw also establishes a Site Plan/Special Permit Approval procedure for specific uses and structures within Amherst. This review allows the Special Permit granting authority the ability to review development to ensure that the basic safety and welfare of the people of Amherst are protected, and includes several specific evaluation criteria that are relevant to natural hazards.

Climate

Amherst is located in eastern Hampshire County, where annual rainfall averages 46 inches (source: City-Data.com, 2015) and is distributed throughout the year. Precipitation is usually adequate for all types of crops in New England; however, brief droughts occasionally occur in sandy soils with lower water capacity. In addition to rain, snowfall averages 41 inches per season. Prevailing winds from the south (and from the north/northwest, to a lesser extent) reach their highest average speed during the month of April.

In the past few decades, Amherst and all of New England have seen an increase in the number of extreme precipitation events, usually defined as large amounts of rain in a short period of time (an inch or more in a 24-hour period). In Massachusetts, the increase in these types of events since 1948 has been 81% (Environment America Research & Policy Center, 2012). Notable among these events in the region was Tropical Storm Irene in late August 2011, and the “Snow-tober” snow and ice storm of October 30, 2011.

Extreme rainfall is a cause of flooding, which is a major concern of this plan. In the last five years, there has also been an increased occurrence of tornadoes and large storms that generate strong wind gusts.

Land Use Summary

The majority of Amherst’s 17,758 acres is undeveloped land, totaling nearly 8,400 acres. Residential land is the second most prolific land use, at approximately 4,000 acres, followed closely by agricultural land at approximately 3,660 acres. Land characterized as urban open/public land constitutes 892 acres throughout Town. The Town also boasts 444 acres of outdoor recreational land. The rest of Amherst is comprised of a mix of commercial and industrial land, as well as 48 acres of water.

Through existing zoning and other land use regulations, development in Amherst is strongly encouraged to seek areas where the environmental conditions and existing public utilities support such development. Setting aside conservation land and farmland in outlying areas of Town is one aspect of Amherst’s long-established planning goal: to direct new growth toward existing developed centers. This preserves Amherst’s historic pattern of development (village centers separated by open land), reduces the need for continual expansion of expensive systems of public utilities and services, and discourages development pressures in areas of higher risk for natural hazards, such as flood zones and steep slopes.

TOWN OF AMHERST, MA ZONING MAP



Legend

Zoning Districts

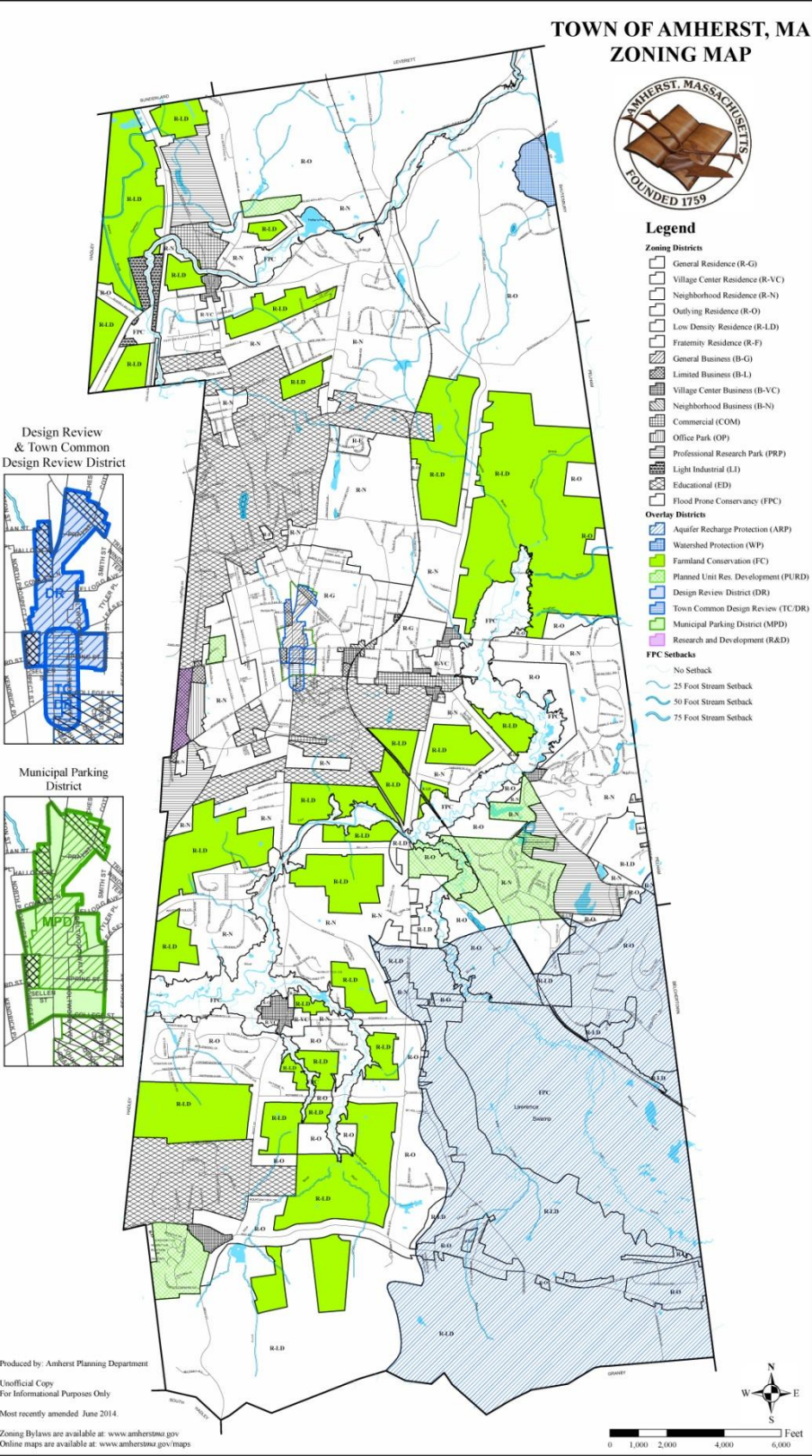
- General Residence (R-G)
- Village Center Residence (R-VC)
- Neighborhood Residence (R-N)
- Outlying Residence (R-O)
- Low Density Residence (R-LD)
- Fraternity Residence (R-F)
- General Business (B-G)
- Limited Business (B-L)
- Village Center Business (B-VC)
- Neighborhood Business (B-N)
- Commercial (COM)
- Office Park (OP)
- Professional Research Park (PRP)
- Light Industrial (LI)
- Educational (ED)
- Flood Prone Conservancy (FPC)

Overlay Districts

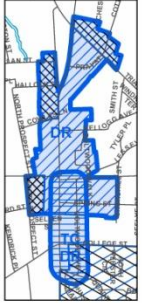
- Aquifer Recharge Protection (ARP)
- Watershed Protection (WP)
- Farmland Conservation (FC)
- Planned Unit Res. Development (PURD)
- Design Review District (DR)
- Town Common Design Review (TC/DR)
- Municipal Parking District (MPD)
- Research and Development (R&D)

FPC Setbacks

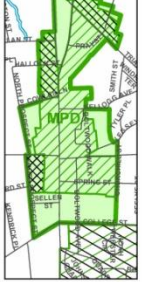
- No Setback
- 25 Foot Stream Setback
- 50 Foot Stream Setback
- 75 Foot Stream Setback



Design Review & Town Common Design Review District

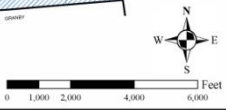


Municipal Parking District



Produced by: Amherst Planning Department
Unofficial Copy
For Informational Purposes Only
Most recently amended June 2014.

Zoning Bylaws are available at: www.amherstma.gov
Online maps are available at: www.amherstma.gov/maps



Infrastructure

Roads and Highways

Downtown Amherst is centered on the intersection of Route 116 (north-south) and Route 9 (east-west). Route 9 is the main corridor to the Town from Interstate 91, traveling through Hadley. Other key routes include North and East Pleasant Street, University Drive, Amity Street and Main Street, and North Hadley Road. There are approximately 125 miles of road in Amherst.

Public Transportation

Both the Pioneer Valley Transit Authority (PVTA) and the Franklin Regional Transit Authority provide bus service in and out of Amherst. UMass Transit operates PVTA bus routes around the Amherst area and among the five colleges. Because of the large amount of students in Amherst, there is a higher amount of population dependent on public transportation and campus transit during the academic year. A private commuter bus service also travels to Worcester.

Rail

The Amherst Amtrak station closed in 2014 with the advent of re-routed Vermonter service along the Connecticut River. The nearest Amtrak station is now located in Northampton.

Schools

Amherst is serviced by Amherst-Pelham Regional Schools (grades 7-12), which draw students from the towns of Amherst, Pelham, Leverett and Shutesbury. The elementary schools educate children from preschool through grade 6.

The school system educates approximately 3,000 students, including native speakers of more than 25 languages. Three elementary schools are located in the town of Amherst, and these include Crocker Farm Elementary, Fort River Elementary, and Wildwood Elementary School. The middle school is Amherst Regional Middle School, and the high school is Amherst Regional High School. The central office for the district is located in the middle school building at 170 Chestnut Street in Amherst.

Water Infrastructure

The Town currently provides public water and sewer service to the majority of residents (6,000 customers). The Water Department has seven sources that contribute to meeting demand: Atkins Reservoir, the Pelham Reservoir System, the South Amherst Wells (#1 & #2), The Brown Well (#3), the Lawrence Swamp Well (#4) and the Bay Road Well (#5). Both surface water supplies, Atkins and Pelham, and Wells 1, 2 & 3 are used year-round to satisfy the required demands. These five sources supply approximately 90% of the total water produced. Wells #4 and #5 operate during high demand periods.

Wastewater

The Town has a Wastewater Treatment Facility located on Mullins Way, on the University of Massachusetts campus, and its mission statement is “to develop, treat, and distribute quality water to

meet the needs of Amherst residents and to do so through a user fee-based revenue system.” The northeast section of town is served by private septic systems. Five-thousand five hundred sewer customers are currently (as of 2015) being added to the sewer system through extensions to Pelham and the Amherst Woods development.

Stormwater Management

Stormwater policies and practices in Amherst are driven by state and federal regulations, including the National Pollutant Discharge Elimination System (NPDES) program.

Solid Waste

The Town of Amherst operates a Transfer Station and Recycling Center at 740 Belchertown Road, which serves as a collection point for trash and recyclable items for authorized residents of Amherst, Pelham, and Shutesbury. All items accumulated at the Transfer Station are moved to other locations such as the materials recycling facility in Springfield, a local landfill, or a licensed hazardous waste disposal facility. To access the Transfer Station and Recycling Center, residents must purchase an annual Vehicle Sticker. Certain materials require an additional fee to cover a portion of the disposal or recycling cost.

Energy

Solar energy is increasing in Amherst. There is ground-mounted solar array currently proposed for the now-closed landfill, and Hampshire and Amherst College are currently pursuing solar arrays.

Communications

Communication towers for emergency response are located in Pelham, with backup located on the North Amherst fire station and the UMass library.

There is fiber optic broadband internet for the five college area and townwide. Emergency response servers are provided through contractual services, and backup servers are located in the Town Hall, police station, and middle school.

Natural Resources

Amherst is situated in a valley plateau, surrounded by hills, with the Holyoke Range forming the southern border. Agricultural land occupies much of the northern, eastern, and southern portions of town, continuing west into the Town of Hadley and northwest into the Town of Sunderland. The Mount Holyoke Range at the south end of town makes a natural barrier between Amherst and the towns of South Hadley and Granby. The Pelham Hills rise to the east toward the Quabbin Reservation, and the Leverett-Shutesbury hills rise to the north and northeast.

Amherst's undeveloped land and natural resources are essential to the Town's appearance, economy, and well-being. The Town recognizes that conservation land helps maintain the Town's rural atmosphere, provides adequate land area for traditional and modern forms of outdoor recreation, and protects important wildlife habitat for both game and non-game species.

Traditional resource-based economic activities such as agriculture and forestry, and traditional forms of recreation such as fishing and hunting continue to play major roles in Amherst. The Town's Open Space and Recreation Plan calls for the Conservation Commission and Conservation Department to continue to help keep those traditions and their associated cultural practices viable by working closely with farmers and farmland owners, encouraging the farm economy, carrying out ecologically sound forest and open land wildlife habitat management on Town watershed lands in four towns, and renting out fields for farm production and community gardening.

Amherst is tremendously diverse in its flora, landscapes, wildlife, and land use. The Town works to protect a full range of types of open space and farmland in order to help maintain that diversity in the face of mounting development pressures.

The Conservation Department is the main Town body that manages the area's natural resources. The Department manages 1,965 acres of conservation land, including more than 40 open fields. It also maintains some 80 miles of foot trails throughout the Town, and in cooperation with the Department of Public Works, carries out a forest management program on 2,500 acres of Town watershed land in Shutesbury, Pelham, Belchertown, and Amherst. The Conservation Department has also been involved in the acquisition of Agricultural Preservation Restrictions over 1,842 acres of farmland on 32 properties and an additional 157 acres covered by Conservation Restrictions. Amherst also boasts an active Town Community Garden program and the public Cherry Hill Golf Course.

Watersheds

Since 1940, the Town of Amherst has maintained significant watershed forest holdings to protect its reservoirs and underground water supplies. Watershed holdings total 2,662 acres, with approximately 690 acres in Shutesbury, 1,537 acres in Pelham, 140 acres in Belchertown, and 300 acres in the Lawrence Swamp in South Amherst. For many years the watershed forest has been under active management for water production, revenue from wood sales, and improvement of timber stands and wildlife habitat. Overall, the Pelham watershed totals approximately 3,950 acres of Town and private land, and drains into three small reservoirs with a combined surface area of about 18 acres. The 3,650-acre Shutesbury watershed feeds Atkins Reservoir, with a 51.5-acre surface area.

Rivers and Streams

The Mill River area in north Amherst runs through a natural greenbelt southwest to Hadley and the Connecticut River. Much of the flood plain is protected from development by FPC zoning restrictions, the Town Wetlands Protection by-law, and the Massachusetts Wetlands Protection Act. Fort River is the primary river that runs through central and south Amherst. Sections of the river are included on the Estimated Habitat Map of Endangered and Rare Wetland Wildlife Species published by the Massachusetts Natural Heritage and Endangered Species Program (NHESP). In response to this inclusion, proposed developments in east Amherst near Fort River have come under more detailed review by the Conservation Commission and plans to acquire conservation land in this area have been successful. Efforts to protect more land in this area, such as near the middle school, are ongoing.

A small portion of Adams Brook runs through the northeastern section of Town, while Plum Brook comes out of Fort River in the southern part of Amherst. Further along Fort River in the eastern section of Amherst, Hop Brook breaks off and runs in a southerly direction toward Lawrence Swamp.

Lakes and Ponds

Puffer's Pond is the largest open water body in Amherst and a prominent recreation area for fishing, birding, canoeing, picnicking and swimming. Located approximately three miles north of the town center, the pond is approximately 11 acres in size with an average depth of five feet and a maximum depth of more than 20 feet. The pond is also known as Factory Hollow Pond and is identified on some USGS maps by this name.

The pond's users and uses have changed over time and today it is the centerpiece of a greenbelt conservation area that stretches from Route 63 east to the Amherst Town line bordering Shutesbury and Leverett. This riparian corridor includes the Mill River Recreation Area; foot trails that meander through the floodplain of the Mill River below the Pond, Puffer's Pond; and Cushman Brook, which flows down from the hills of Shutesbury into the pond.

Plum Pond lies just south of Plumbrook Conservation area in the southern portion of town, while Echo Hill Pond and several other smaller bodies of water lie within Town limits.

In addition to these natural water bodies, the two reservoir systems, Atkins Reservoir and the Pelham Reservoirs, provide Amherst with approximately half its drinking water and form the Town's surface drinking water supply. Atkins Reservoir, located in northeast Amherst and Shutesbury, is the Town's largest surface water supply with a surface area of 51 acres, a capacity of approximately 200 million gallons of water, and a drainage area of 5.7 square miles. The Pelham Reservoirs are three individual water bodies formed by impounding streams draining into Amherst and with a combined surface area of about 18 acres. The drainage area of these reservoirs covers approximately 6.2 square miles with 18.5 miles of streams in the hills of Pelham east of Amherst.

Forest Land

The largest blocks of continuous forest in Amherst are as follows: (1) the north slopes of the Mount Holyoke Range in extreme southern Amherst (more than 1,000 acres adjoining an additional 5,000 acres in the three adjacent towns the Range occupies); (2) the Lawrence Swamp, comprised of 1,000 acres interspersed with scattered agricultural fields, marsh and open water; (3) the Mt. Boreas-Flat Hills area, with about 400 acres partially impacted by residential development along Flat Hills Road and Market Hill Road, and in the High Point Drive subdivision; and (4) Pulpit Hill, with some 300 acres between the New England Central Railroad and Route 63 consisting of about 50 percent open agricultural land and about 50 percent forested land and Christmas tree plantations. Smaller forested blocks are scattered throughout town.

Native woodlands are the principle vegetation type in Amherst. All told, woodlands cover 7,591 acres of Amherst, approximately 43% of the Town's land area. Types of woodlands in Amherst include hardwood forests, coniferous forests, and mixed woods, and they provide habitat for numerous wildlife species. In addition, a relatively large percentage (19%) of Amherst's land is pasture and cropland, totaling approximately 3,519 acres. These lands provide unique habitat as well as other environmental benefits.

Geology and Topography

The town lies on a valley plateau within a circle of hills. The north-south spine of hills running through the middle of Amherst is glacial drumlins that became the islands of ancient Lake Hitchcock, formed as glaciers receded and covered much of the region. This ancient lake bed and the floodplain of the Connecticut River provide the area with fertile farmland. The most distinguishing geological features are the Connecticut River to the west and the Holyoke Mountain Range, which borders Amherst on the south and defines the skyline from many locations within the Town. Both also provide many opportunities for recreational use.

Other important geological features include:

- The Eastern Border Fault, located in northeast Amherst. The up-thrust of the eastern side of this fault has eroded over time to create the Pelham hills.
- Rattlesnake Knob and Mt. Norwottuck trap rock (basalt—former volcanic) summits, Mount Holyoke Range
- Bare Mountain summit (1,014 feet) and trap rock (basalt) ledges, Mount Holyoke Range
- Mt. Pollux summit
- North East Street drumlin, north of North East Apartments
- Mt. Boreas – bedrock summit and adjacent slopes
- Pulpit Hill ledges
- Podick Conservation Area glacial outwash sand plain formation

Soils

The United States Soil Conservation Service has organized soils surveyed in Amherst into five different soil associations; each has a distinctive pattern of soils, topographic relief, and drainage.

Soils in the north section of Town fall primarily into three associations: Gloucester-Montauk-Paxton association, Hinkley-Merrimac-Windsor association, and Amostown-Scitico-Boxford association. The Gloucester association consists of low hills and ridges with rolling to steep topography. The soil substrate has been formed from glacial till, is sandy and loamy and varies from excessively well-drained to well-drained, and is able to support forest growth.

The Hinkley association consists of soils that are typically excessively drained, sandy and loamy soils formed in outwash deposits. Many areas are dissected by drainage ways that vary from rolling to steep.

Soils in the south of Amherst fall into the Gloucester and Hinkley groups, along with the soil association Rock Outcrop-Narragansett-Holyoke association of the Mount Holyoke Range.

Beaver Dams

Beaver dams are known to impact the bike path near Lawrence Swamp and Potwine Lane.

Wetlands

After centuries of filling and dredging wetlands for agricultural uses, the Lawrence Swamp in South Amherst is the largest remaining wetland complex in town. The Great Swamp in North Amherst covered an area including much of the UMass campus westerly along the Mill River and north into Sunderland, but was lost to development before wetland regulations were in place. Remnant stands of red maple swamp in the Podick Conservation Area allude to what the Great Swamp may once have been like. Much of the remaining wetlands today are found in the floodplains of the Fort River and smaller tributaries like the Plum and Hop Brooks.

Aquifers

There is a medium-yield aquifer on the eastern side of town, running from the agricultural fields north of Pelham Road south to the Atkins Flats Conservation Area and Water Department Lands north of Bay Road. Another smaller medium-yield aquifer is on the western edge of town, its path generally following the Fort River and Plum Brook.

Flood Zones

Flood zones in Amherst are generally found in the same areas as the aquifers. A 100-year flood zone is mapped in the area of Atkins Flats/Lawrence Swamp Conservation Areas and Hop Brook. Another 100-year flood zone, with base elevations established, is mapped along Hop Brook north of Station Road. Some 500-year flood zones are mapped in this area as well. A similar mixture of flood zones is found along the Fort River, the Mill River, and Cushman Brook. Development is located closest to the flood zones in the area of the Fort River and the Mill River on the western sides of town.

National Flood Insurance Program (NFIP)

The National Flood Insurance Program has produced maps that identify floodways across America. Amherst is a participating member of the National Flood Insurance Program, and had the following NFIP policy and claim statistics as of January 2016:

- Flood Insurance Maps (FIRMs) are used for flood insurance purposes and are on file with the Amherst Planning Department. The maps are also available via link on the Amherst Planning website.
- FIRMs have been effective since February 4, 1981 with the current map in effect since December 15, 1983.
- Amherst has 40 in-force policies in effect for a total of \$8,994,900 worth of insurance.
- There have been a total of 4 NFIP claims since 1978 for which \$15,469 has been paid.
- As of 2016, there has been no Repetitive Loss Properties in Amherst.

The Town will maintain compliance with the NFIP throughout the next 5-year Hazard Mitigation Planning cycle by monitoring its Flood Plain Conservancy District and ensuring that the district accurately reflects the 100-year flood plain and FEMA Flood Insurance Rate Map (FIRM). The Town is currently working with a consultant to re-map the 100-year floodplain, as FIRM and Flood Prone Conservancy District maps do not align.

3: HAZARD IDENTIFICATION & RISK ASSESSMENT

The following section includes a summary of disasters that have affected or could affect Amherst. Historical research, conversations with local officials and emergency management personnel, available hazard mapping and other weather-related databases were used to develop this list. Identified hazards are the following:

- Floods
- Severe snowstorms / ice storms
- Hurricanes
- Severe thunderstorms / wind / tornadoes
- Wildfires / brushfires
- Earthquakes
- Dam failure
- Drought
- Extreme Temperatures

Natural Hazard Analysis Methodology

This chapter examines the hazards in the Massachusetts State Hazard Mitigation Plan which are identified as likely to affect Amherst. The analysis is organized into the following sections: Hazard Description, Location, Extent, Previous Occurrences, Probability of Future Events, Impact, and Vulnerability. A description of each of these analysis categories is provided below.

Hazard Description

The natural hazards identified for Amherst are: floods, severe snowstorms/ice storms, hurricanes, severe thunderstorms / wind / tornadoes, wildfire/brushfire, earthquakes, dam failure, drought, and extreme temperatures. Many of these hazards result in similar impacts to a community. For example, hurricanes, tornadoes and severe snowstorms may cause wind-related damage.

Location

Location refers to the geographic areas within the planning area that are affected by the hazard. Some hazards affect the entire planning area universally, while others apply to a specific portion, such as a floodplain or area that is susceptible to wild fires. Classifications are based on the area that would potentially be affected by the hazard, on the following scale:

Location of Occurrence, Percentage of Town Impacted by Given Natural Hazard	
Location of Occurrence	Percentage of Town Impacted
Large	More than 50% of the town affected
Medium	10 to 50% of the town affected
Small	Less than 10% of the town affected

Extent

Extent describes the strength or magnitude of a hazard. Where appropriate, extent is described using an established scientific scale or measurement system. Other descriptions of extent include water depth, wind speed, and duration.

Previous Occurrences

Previous hazard events that have occurred are described. Depending on the nature of the hazard, events listed may have occurred on a local, state-wide, or regional level.

Probability of Future Events

The likelihood of a future event for each natural hazard was classified according to the following scale:

Frequency of Occurrence and Annual Probability of Given Natural Hazard	
Frequency of Occurrence	Probability of Future Events
Very High	70-100% probability in the next year
High	40-70% probability in the next year
Moderate	10-40% probability in the next year
Low	1-10% probability in the next year
Very Low	Less than 1% probability in the next year

Impact

Impact refers to the effect that a hazard may have on the people and property in the community, based on the assessment of extent described above. Impacts are classified according to the following scale:

Impacts, Magnitude of Multiple Impacts of Given Natural Hazard	
Impacts	Magnitude of Multiple Impacts
Catastrophic	Multiple deaths and injuries possible. More than 50% of property in affected area damaged or destroyed. Complete shutdown of facilities for 30 days or more.
Critical	Multiple injuries possible. More than 25% of property in affected area damaged or destroyed. Complete shutdown of facilities for more than 1 week.
Limited	Minor injuries only. More than 10% of property in affected area damaged or destroyed. Complete shutdown of facilities for more than 1 day.
Minor	Very few injuries, if any. Only minor property damage and minimal disruption on quality of life. Temporary shutdown of facilities.

Vulnerability

Based on the above metrics, a hazard index rating was determined for each hazard. The hazard index ratings are based on a scale of 1 through 5 as follows:

- 1 – Highest risk
- 2 – High risk
- 3 – Medium risk
- 4 – Low risk
- 5 – Lowest risk

The ranking is qualitative and is based, in part, on local knowledge of past experiences with each type of hazard. The size and impacts of a natural hazard can be unpredictable. However, many of the mitigation strategies currently in place and many of those proposed for implementation can be applied to the expected natural hazards, regardless of their unpredictability.

Hazard Identification and Analysis Worksheet for Amherst

Type of Hazard	Location of Occurrence	Probability of Future Events	Impact	Vulnerability
Floods (100-year)	Large	Low	Limited	2 – High risk
Flooding (localized)	Medium	High	Minor	1 – Highest Risk
Severe snow/ Ice storms	Large	Very High	Limited	1 – Highest risk
Hurricanes	Large	Low	Critical	3 – Medium risk
Severe thunderstorms / wind	Small	Low	Limited	3 – Medium risk
Tornadoes	Small	Low	Catastrophic	4 – Low risk
Wildfires / brushfires	Small	Very High	Minor	3 – Medium risk
Earthquakes	Large	Low	Minor (town) Catastrophic (UMass)	4 – Low risk
Dam failures	Small	Very Low	Minor	5 – Lowest risk
Drought	Large	Very Low	Minor	5 - Lowest risk
Extreme Temperatures	Large	Very High	Critical	1 – Highest risk

Source: Adapted from FEMA Local Hazard Mitigation Planning Handbook (March 2013) Worksheet 5.1; Town of Holden Beach North Carolina Community-Based Hazard Mitigation Plan, July 15, 2003 and the Massachusetts Emergency Management Agency (MEMA).

Floods

Hazard Description

There are three major types of storms that can generate flooding in Amherst:

- Continental storms are typically low-pressure systems that can be either slow or fast moving. These storms originate from the west and occur throughout the year.
- Coastal storms, also known as nor'easters, usually occur in late summer or early fall and originate from the south. The most severe coastal storms, hurricanes, occasionally reach Massachusetts and generate very large amounts of rainfall.
- Thunderstorms form on warm, humid summer days and cause locally significant rainfall, usually over the course of several hours. These storms can form quickly and are more difficult to predict than continental and coastal storms.

A floodplain is the relatively flat, lowland area adjacent to a river, lake or stream. Floodplains serve an important function, acting like large “sponges” to absorb and slowly release floodwaters back to surface waters and groundwater. Over time, sediments that are deposited in floodplains develop into fertile, productive farmland like that found in the Connecticut River valley. In the past, floodplain areas were also often seen as prime locations for development. Industries were located on the banks of rivers for access to hydropower. Residential and commercial development occurred in floodplains because of their scenic qualities and proximity to the water. Although periodic flooding of a floodplain area is a natural occurrence, past and current development and alteration of these areas will result in flooding that is a costly and frequent hazard.

The Floodplain Map for the Town of Amherst shows the 100-year and 500-year flood zones identified by FEMA flood maps. The 100-year flood zone is the area that will be covered by water as a result of a flood that has a one percent chance of occurring in any given year. Likewise, the 500-year flood has a 0.2 percent chance of occurring in any given year. There are several floodplain areas: in North Amherst along Route 116 between Summer Street and State Street at Factory Hollow; along East Leverett Road; and along either side of Pelham Road after crossing Northeast Street. In South Amherst the floodplain area is along Fort River and Plum Brook, and at the Lawrence Swamp. There are some smaller 500-year floodplains mapped as well, in several low-lying areas throughout Amherst.

A Flood Prone Conservancy (FPC) district crosses Route 9 heading southeast towards Belchertown, while in the north a separate FPC district runs parallel to Route 116 before heading in an easterly direction across Route 63 and Leverett Road. Flooding of these and surrounding areas could result in difficulty moving populations out of harm's way.

The major floods recorded in Western Massachusetts during the 20th century have been the result of rainfall alone or rainfall combined with snowmelt. Amherst has experienced no major flooding events over the last decade, except for during Hurricane Floyd in 1999. Generally, any small floods have had minor impacts, temporarily impacting roads and residents' yards.

Location

The percentage of the Town impacted by flooding is estimated as “large,” or more than 50 percent. In addition to the floodplains mapped by FEMA for the 100-year and 500-year flood (noted above), Amherst often experiences minor flooding at isolated locations due to drainage problems and/or problem culverts.

Most of the flood hazard areas listed here were identified due to known past occurrence in the respective area. There are many areas with no record of previous flood incidents that could be affected in the future by heavy rain and runoff.

Specific vulnerability was estimated for sites which have been susceptible to localized flooding in the past, and are described below:

College Street and Route 9

This area consists predominantly of commercial and business occupancies with some residential units.

W. Pomeroy Lane and Pondview Drive and Markert’s Pond

This area is predominantly single family residential with a small amount of commercial property and open space.

Pomeroy Lane and Pomeroy Court

This area is predominantly single family residential with a small amount of commercial property and open space

Main Street at the Fort River

This area is predominantly residential and includes Fort River Elementary School and some commercial property.

North Pleasant Street, below Marks Meadow

This area north of the University includes residential property, Marks Meadow Elementary School, DMH Intermediate Care Facilities, and University buildings.

South East Street near the railroad bridge

This area is a mix of single family residential, farmland and open land. The land around the bridge floods.

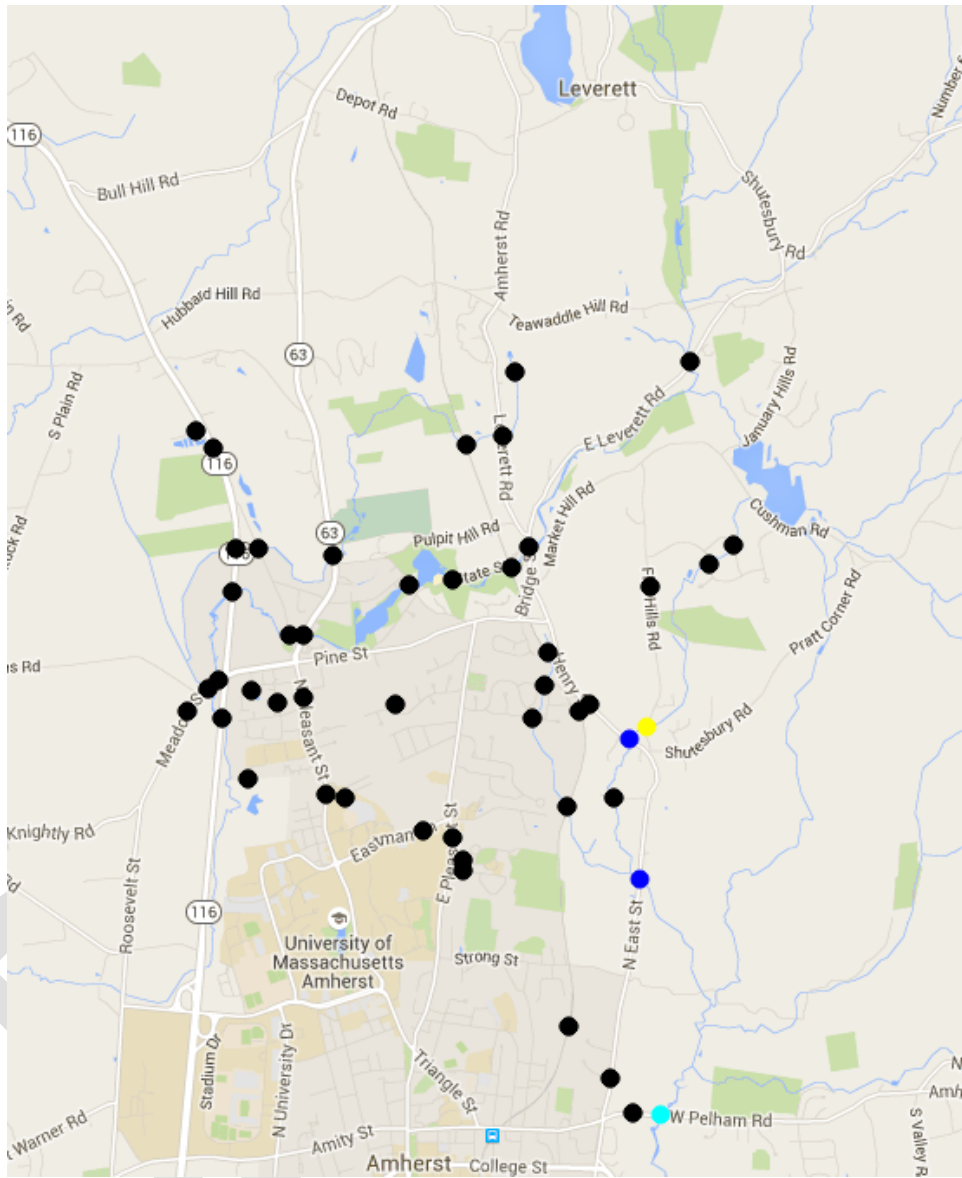
Station Road

This area is mainly open land and farm land. The road is a main travel route and is impacted by flooding caused by beavers.

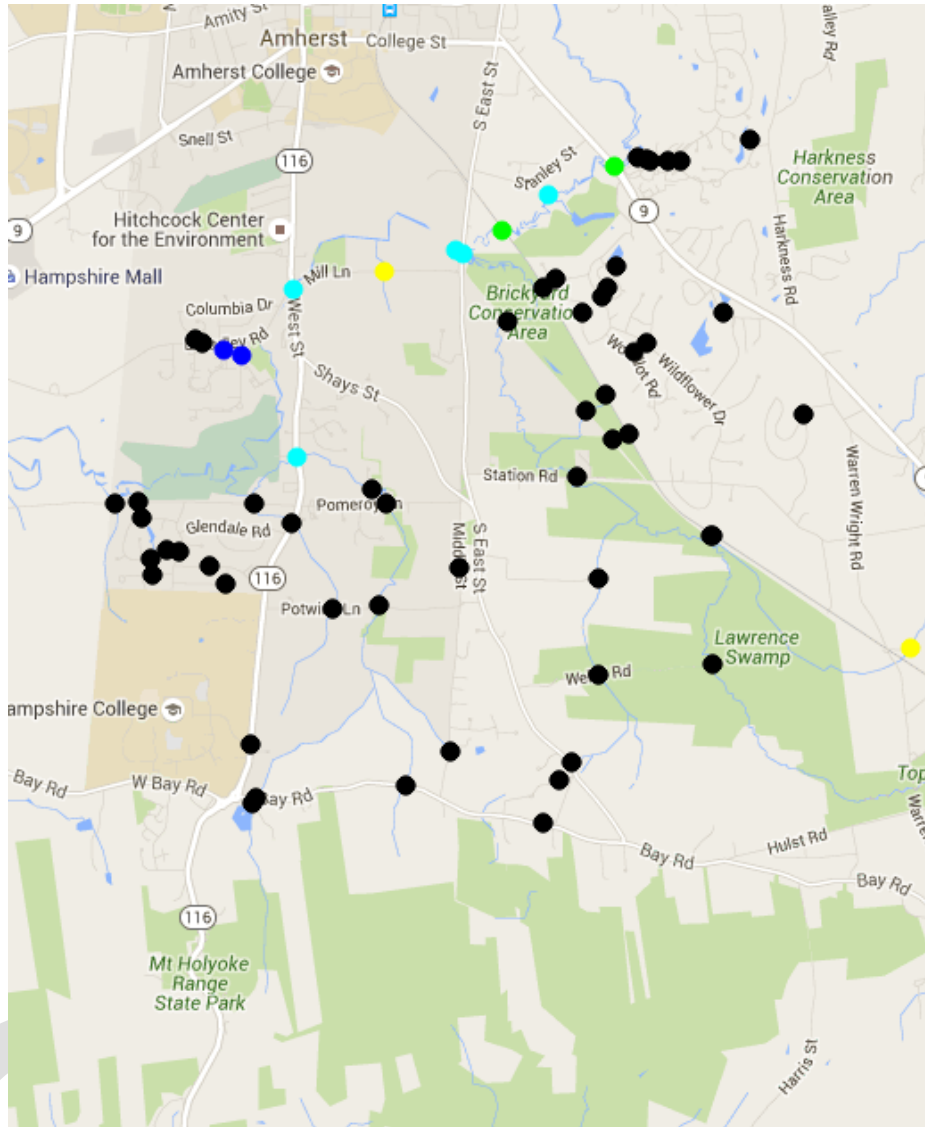
University Drive

This area includes commercial and business occupancies, an assisted living facility and extended care facility. It floods occasionally.

In addition to localized flooding, undersized culverts can also contribute to flooding in town. Below are maps of culvert locations in north and south Amherst:



North Amherst Culvert Locations



South Amherst Culvert Locations

Legend:

The colored circles on the map represent surveyed crossings color coded as follows:

- Full Passage: green ●
- Insignificant barrier: blue green ●
- Minor barrier: blue ●
- Moderate barrier: yellow ●
- Significant barrier: orange ●
- Severe barrier: red ●
- Missing data: magenta ●
- No crossing: black circle with bold red x ❌
- New crossing pending approval: black circle with red slash 🚧

(Source: University of Massachusetts Stream Continuity Project 2015
 <<https://streamcontinuity.org/index.htm>>)

Flooding due to undersized culverts has occurred in the following locations:

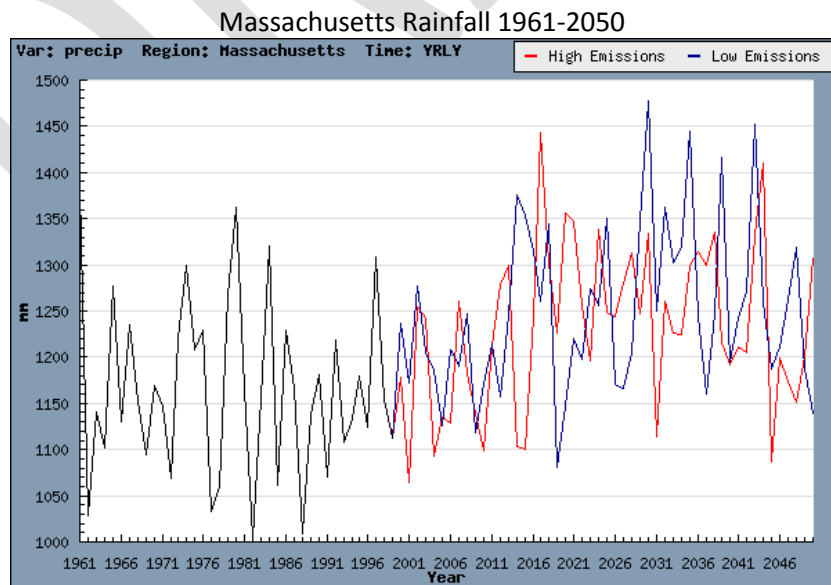
- W. Pomeroy and Pomeroy Roads
- Station Road (culvert/bridge)
- University Drive into Hadley (Route 116)
- North Pleasant Street (all culverts)
- Tan Brook (Fearing Street and East Pleasant Street)

Extent

Floods can be classified as one of two types: flash floods and general floods.

- Flash floods are the product of heavy, localized precipitation in a short time period over a given location. Flash flooding events typically occur within minutes or hours after a period of heavy precipitation, after a dam or levee failure, or from a sudden release of water from an ice jam. Most often, flash flooding is the result of a slow-moving thunderstorm or the heavy rains from a hurricane. In rural areas, flash flooding often occurs when small streams spill over their banks. However, in urbanized areas, flash flooding is often the result of clogged storm drains (leaves and other debris) and the higher amount of impervious surface area (roadways, parking lots, roof tops).
- General floods may last for several days or weeks and are caused by precipitation over a longer time period in a particular river basin. Excessive precipitation within a watershed of a stream or river can result in flooding particularly when development in the floodplain has obstructed the natural flow of the water and/or decreased the natural ability of the groundcover to absorb and retain surface water runoff (e.g., the loss of wetlands and the higher amounts of impervious surface area in urban areas).

The average annual precipitation for Amherst and surrounding areas in western Massachusetts is 46 inches. This is likely to increase. Rainfall has increased approximately 10% during the past 50 years, and is expected to continue increasing (see figure below).



Source: NECIA 2006

Previous Occurrences

According to the National Climactic Data Center, there were 34 flood events reported in Hampshire County between 01/01/1950 and 12/31/2009. None of these were reported in Amherst, but one, on 7/7/94 was classified as “urban flooding,” which might have included Amherst. Hurricane Floyd resulted in 100-year flood levels in 1999.

Probability of Future Events

Based upon previous data, it is likely that there is a “low” chance of flooding in the 100-year floodplain, with a 1 to 10 percent probability in the next year. For localized flood events, there is a “high” chance of flooding, with a 40 to 70 percent probability in the next year.

Climate scientists predict that in the next few decades, climate change will increase the frequency and intensity of all storms that can cause flooding. Currently, floods are the most costly natural hazard in the United States, and climate change will only increase this damage. More information about the effect of Climate Change can be found in the Pioneer Valley Planning Commission’s Climate Action Plan, available at www.sustainableknowledgecorridor.org.

The Massachusetts State Climate Change Adaptation Report has additional information about the impact of climate change and can be accessed at www.mass.gov/eea/air-water-climate-change/climate-change/climate-change-adaptation-report.html.

Impact

The impact of 100-year floods to the Town is estimated to be “limited,” with less than 10 percent of property in affected areas damaged or destroyed, and “minor” impact for localized flooding. There are approximately 1,968 acres of land within the FEMA mapped 100-year floodplain and 254 acres of land within the 500-year floodplain within the Town of Amherst. According to the Community Information System (CIS) of FEMA, there were 9 structures located within the Special Flood Hazard Area (SFHA) (A zone) and 31 policies in Zones B, C, or X in Amherst as of January 2016, the most current records in the CIS for the Town of Amherst. Therefore, a vulnerability assessment for a 100-year flood equals at least approximately \$3,087,000 (according to the American Community Survey 2014 estimate of \$343,000 medium home value) of damage (at 100% loss).

Vulnerability

Based on the above analysis, Amherst faces a vulnerability of “2 - High risk” (100-year flood) or “1 – Highest risk” (localized flood).

Due to the presence of streams and rivers and a number of undersized culverts, many sections of Amherst are prone to localized flooding as described in the location section above. The majority of the town’s critical facilities are located in areas that are not prone to flooding and are therefore unlikely to be impacted. Both evacuation routes in town (Route 9 and Route 116) could be impacted by the flooding of the Fort River and the Eastman River.

Severe Snowstorms/Ice Storms

Hazard Description

Snow is characterized as frozen precipitation in the form of six-sided ice crystal. In order for snow to occur, temperatures in the atmosphere (from ground level to cloud level) must be at or below freezing. The strongest form of a severe snow storm is a blizzard. Blizzards are characterized by frequent wind gusts above 35 miles per hour, limited to no visibility due to falling snow and extreme cold that lasts longer than three hours.

Ice storms are liquid rain that falls and freezes upon contact with cold objects. There must be an ice build-up of greater than $\frac{1}{4}$ inch for it to be considered an ice storm. When more than a $\frac{1}{2}$ inch of ice build-up is forecasted a winter storm warning can be triggered.

Severe winter storms can pose a significant risk to property and human life. The rain, freezing rain, ice, snow, cold temperatures and wind associated with these storms can cause the following hazards:

- Disrupted power and phone service
- Unsafe roadways and increased traffic accidents
- Infrastructure and other property are also at risk from severe winter storms and the associated flooding that can occur following heavy snow melt.
- Tree damage and fallen branches that cause utility line damage and roadway blockages
- Damage to telecommunications structures
- Reduced ability of emergency officials to respond promptly to medical emergencies or fires

Location

The entire town of Amherst is susceptible to severe snowstorms, making the location of occurrence for this hazard "large." Areas of higher elevation are at most risk for impact from ice accumulation. Areas in the northeastern part of town including Flat Hills Road, High Point Drive, Shutesbury Road and the area south of Bay Road are at higher elevations and thus at the most risk.

All areas of town are susceptible to damage from snow accumulation, particularly wet snow. The low elevation of most areas of town is likely to receive wet snow while areas of higher elevation receive drier snow.

Severe winter weather occurs regionally and therefore would impact the entire town.

Extent

The Northeast Snowfall Impact Scale (NESIS) developed by Paul Kocin of The Weather Channel and Louis Uccellini of the National Weather Service (Kocin and Uccellini, 2004) characterizes and ranks high-impact Northeast snowstorms. These storms have large areas of 10-inch snowfall accumulations and greater. NESIS has five categories: Extreme, Crippling, Major, Significant, and Notable. The index differs from other meteorological indices in that it uses population information in addition to meteorological measurements. Thus NESIS gives an indication of a storm's societal impacts.

NESIS scores are a function of the area affected by the snowstorm, the amount of snow, and the number of people living in the path of the storm. The aerial distribution of snowfall and population

information are combined in an equation that calculates a NESIS score which varies from around one for smaller storms to over ten for extreme storms. The raw score is then converted into one of the five NESIS categories. The largest NESIS values result from storms producing heavy snowfall over large areas that include major metropolitan centers.

Northeast Snowfall Impact Scale Categories		
Category	NESIS Value	Description
1	1—2.499	Notable
2	2.5—3.99	Significant
3	4—5.99	Major
4	6—9.99	Crippling
5	10.0+	Extreme

Source: [NESIS Snowfall Categories](#)

Previous Occurrences

New England generally experiences at least one or two severe winter storms each year with varying degrees of severity. Severe winter storms typically occur during January and February; however, they can occur from late September through late April.

Based on data available from the National Oceanic and Atmospheric Administration, there are 47 winter storms since 1958 that have registered on the NESIS scale. Of these, approximately 26 storms resulted in snow falls in the Pioneer Valley of at least 10 inches. These storms are listed in the table on the next page and represent the best available data for Amherst.

**Winter Storms Producing Over 10 inches of Snow
in the Pioneer Valley, 1958-2015**

Date	NESIS Value	NASIS Category	NESIS Classification
1958-02-14	6.25	4	Crippling
1958-03-18	3.51	2	Significant
1960-03-02	8.77	4	Crippling
1960-12-11	4.53	3	Major
1961-01-18	4.04	3	Major
1961-02-02	7.06	4	Crippling
1964-01-11	6.91	4	Crippling
1966-01-29	5.93	3	Major
1966-12-23	3.81	2	Significant
1967-02-05	3.50	2	Significant
1969-02-08	3.51	2	Significant
1969-02-22	4.29	3	Major
1969-12-25	6.29	4	Crippling
1972-02-18	4.77	3	Major
1978-01-19	6.53	4	Crippling
1978-02-05	5.78	3	Major
1982-04-06	3.35	2	Significant
1983-02-10	6.25	4	Crippling
1987-01-21	5.40	3	Major
1993-03-12	13.20	5	Extreme
1994-02-08	5.39	3	Major
1995-02-02	1.43	1	Notable
1996-01-06	11.78	5	Extreme
1997-03-31	2.29	1	Notable
2000-01-24	2.52	2	Significant
2000-12-30	2.37	1	Notable
2003-02-15	7.50	4	Crippling
2005-01-21	6.80	4	Crippling
2006-02-12	4.10	3	Major
2007-02-12	5.63	3	Major
2007-03-15	2.54	2	Significant
2009-03-01	1.59	1	Notable
2010-02-23	5.46	3	Major
2010-12-24	4.92	3	Major
2011-01-09	5.31	3	Major
2011-01-26	2.17	1	Notable
2011-02-01	5.30	3	Major
2011-10-29	1.75	1	Notable
2013-02-07	4.35	3	Major
2013-03-04	3.05	2	Significant
2013-12-13	2.95	2	Significant
2013-12-30	3.31	2	Significant
2014-02-11	5.28	3	Major
2014-11-26	1.56	1	Notable
2014-12-09	1.49	1	Notable
2015-01-25	2.62	2	Significant
2015-01-29	5.42	3	Major
2015-02-08	1.32	1	Notable

Source: <http://www.ncdc.noaa.gov/snow-and-ice/rsi/nesis>

Probability of Future Events

Based upon the availability of records for Hampshire County, the likelihood that a severe snow storm will hit Amherst is “Very High,” or more than 70 percent.

Research on climate change indicates that there is great potential for stronger, more frequent storms as the global temperature increases. More information about the effect of Climate Change can be found in the Pioneer Valley Planning Commission’s Climate Action Plan, available at www.sustainableknowledgecorridor.org.

The Massachusetts State Climate Change Adaptation Report has additional information about the impact of climate change and can be accessed at www.mass.gov/eea/air-water-climate-change/climate-change/climate-change-adaptation-report.html.

Impact

The impact to the Town is estimated to be “limited,” with more than 10 percent but less than 25 percent of property in affected areas damaged or destroyed.

To approximate the potential impact to property and people that could be affected by this hazard, the total value of all property in town, \$3,233,118,000, is used (this figure represents the median home value of \$343,000 x 8,884 housing units, per American Community Survey 2014 estimates). An estimated 20 percent of damage would occur to 10 percent of structures, resulting in a total of \$60,944,240 worth of damage. The cost of repairing or replacing the roads, bridges, utilities, and contents of structures is not included in this estimate.

Vulnerability

Based on the above assessment, Amherst’s vulnerability from snowstorms and ice storms is “1 – Highest risk.”

The entire town is vulnerable to the impacts of severe snow and ice. Most of the town’s critical facilities are likely to endure this hazard without any damage. The town’s communication and energy infrastructure could be vulnerable to heavy snow and ice, which has been known to cause power outages across the region. Parts of Amherst located at a higher elevation are more likely to have to contend with ice build, while areas at a lower elevation are prone to heavy wet snow.

Hurricanes

Hazard Description

Hurricanes are classified as cyclones and defined as any closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise in the Northern Hemisphere (or clockwise in the Southern Hemisphere) and whose diameter averages 10 to 30 miles across. The primary damaging forces associated with these storms are high-level sustained winds and heavy precipitation. Hurricanes are violent rainstorms with strong winds that can reach speeds of up to 200 miles per hour and generate large amounts of precipitation. Hurricanes generally occur between June and November and can result in flooding and wind damage to structures and above-ground utilities.

Location

Because of the hazard’s regional nature, all of Amherst is at risk from hurricanes. Ridge tops are more susceptible to wind damage. The location of occurrence is “large,” at over 50 percent of the Town affected.

Extent

As an incipient hurricane develops, barometric pressure (measured in millibars or inches) at its center falls while wind speeds increase. If the atmospheric and oceanic conditions are favorable, it can intensify into a tropical depression. When maximum sustained winds reach or exceed 39 miles per hour, the system is designated a tropical storm, given a name, and is closely monitored by the National Hurricane Center in Miami, Florida. When sustained winds reach or exceed 74 miles per hour the storm is deemed a hurricane. Hurricane intensity is further classified by the Saffir-Simpson Hurricane Wind Scale, which rates hurricane wind intensity on a scale of 1 to 5, with 5 being the most intense.

Saffir-Simpson Scale	
Category	Maximum Sustained Wind Speed (MPH)
1	74–95
2	96–110
3	111–129
4	130–156
5	157 +

Source: National Hurricane Center, 2012

Previous Occurrences

Hurricanes that have affected the Pioneer Valley are show in the following table. None of the storms are known to have tracked directly over Amherst. (“Super Storm Sandy” in 2012 was not considered a hurricane or tropical storm, as it did not meet the meteorological criteria for having a warmer temperature at its core; nonetheless, the storm was significant in Amherst.)

Major Hurricanes in the Pioneer Valley		
Hurricane/Storm Name	Year	Saffir/Simpson Category (when reached MA)
Great Hurricane of 1938	1938	3
Great Atlantic Hurricane	1944	1
Carol	1954	3
Edna	1954	1
Diane	1955	Tropical Storm
Donna	1960	Unclear, 1 or 2
Groundhog Day Gale	1976	Not Applicable
Gloria	1985	1
Bob	1991	2
Floyd	1999	Tropical Storm
Irene	2011	Tropical Storm
Sandy	2012	Super Storm

Probability of Future Events

Amherst’s location in western Massachusetts reduces the risk of extremely high winds that are associated with hurricanes, although it can experience some high wind events. The probability of future events is estimated to be “low,” or between 1 and 10 percent in any given year.

Impact

A description of the damages that could occur due to a hurricane is described by the Saffir-Simpson scale, as shown below.

Hurricane Damage Classifications			
Storm Category	Damage Level	Description of Damages	Wind Speed (MPH)
1	MINIMAL	No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Also, some coastal flooding and minor pier damage. An example of a Category 1 hurricane is Hurricane Dolly (2008).	74-95
	Very dangerous winds will produce some damage		
2	MODERATE	Some roofing material, door, and window damage. Considerable damage to vegetation, mobile homes, etc. Flooding damages piers and small craft in unprotected moorings may break their moorings. An example of a Category 2 hurricane is Hurricane Francis in 2004.	96-110
	Extremely dangerous winds will cause extensive damage		
3	EXTENSIVE	Some structural damage to small residences and utility buildings, with a minor amount of curtain wall failures. Mobile homes are destroyed. Flooding near the coast destroys smaller structures, with larger structures damaged by floating debris. Terrain may be flooded well inland. An example of a Category 3 hurricane is Hurricane Ivan (2004).	111-129
	Devastating damage will occur		
4	EXTREME	More extensive curtain wall failures with some complete roof structure failure on small residences. Major erosion of beach areas. Terrain may be flooded well inland. An example of a Category 4 hurricane is Hurricane Charley (2004).	130-156
	Catastrophic damage will occur		
5	CATASTROPHIC	Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. Flooding causes major damage to lower floors of all structures near the shoreline. Massive evacuation of residential areas may be required. An example of a Category 5 hurricane is Hurricane Andrew (1992).	157+
	Catastrophic damage will occur		

In the event of a tropical storm or hurricane, the greatest risk to Amherst will be flooding of the Mill River in the northern section of the Town and Fort River in the south and eastern portions. Wind damage will be limited, but widely spread, perhaps including downed power and communications lines, but flooding damage will be more severe and focused on residential properties; the town's transportation infrastructure and evacuation routes could also be impacted.

The impact of hurricanes to the Town is estimated to be "critical," with more than 25 percent of property in the affected area damaged or destroyed.

For most hurricanes or severe wind events, the Town has experienced small blocks of downed timber and uprooting of trees onto structures. Using a total a value of all structures in town of \$3,233,118,000, and an estimated wind damage of 25 percent to all structures with 10 percent damage to each

structure, an estimated \$80,827,950 damage would occur. Estimated flood damage to 10 percent of the structures with 20 percent damage to each structure would result in \$64,662,360 of damage. The cost of repairing or replacing the roads, bridges, utilities, and contents of structures is not included in this estimate.

Vulnerability

Based on the above analysis, Amherst faces a vulnerability of “3 – Medium Risk” from hurricanes.

The entire town would be vulnerable to the impact of a hurricane. Areas prone to flooding are particularly vulnerable. Additionally, high winds could impact the town’s communication and energy infrastructure. The location and severity of flooding could impact evacuation routes throughout Amherst.

DRAFT

Severe Thunderstorms/Wind/Tornadoes

Hazard Description

A thunderstorm is a storm with lightning and thunder produced by a cumulonimbus cloud, usually producing gusty winds, heavy rain, and sometimes hail. Effective January 5, 2010, the National Weather Service (NWS) modified the hail size criterion to classify a thunderstorm as 'severe' when it produces damaging wind gusts in excess of 58 mph (50 knots), hail that is 1 inch in diameter or larger (quarter size), or a tornado (NWS, 2013).

Wind is air in motion relative to surface of the earth. For non-tropical events over land, the NWS issues a Wind Advisory (sustained winds of 31 to 39 mph for at least 1 hour or any gusts 46 to 57 mph) or a High Wind Warning (sustained winds 40+ mph or any gusts 58+ mph). For non-tropical events over water, the NWS issues a small craft advisory (sustained winds 25-33 knots), a gale warning (sustained winds 34-47 knots), a storm warning (sustained winds 48 to 63 knots), or a hurricane force wind warning (sustained winds 64+ knots). For tropical systems, the NWS issues a tropical storm warning for any areas (inland or coastal) that are expecting sustained winds from 39 to 73 mph. A hurricane warning is issued for any areas (inland or coastal) that are expecting sustained winds of 74 mph. 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. High winds are also a hazard for the boating, shipping, and aviation industry sectors.

According to the National Weather Service, microbursts are downdrafts in thunderstorms (<http://www.srh.noaa.gov/ama/?n=microbursts>, accessed Feb. 18, 2016). Wind speeds up to 150 miles per hour are possible in microbursts, though their impact area may be less than 2.5 miles in diameter.

Tornadoes are swirling columns of air that typically form in the spring and summer during severe thunderstorm events. In a relatively short period of time and with little or no advance warning, a tornado can attain rotational wind speeds in excess of 250 miles per hour and can cause severe devastation along a path that ranges from a few dozen yards to over a mile in width. The path of a tornado may be hard to predict because they can stall or change direction abruptly. Within Massachusetts, tornadoes have occurred most frequently in Worcester County and in communities west of Worcester, including towns in eastern Hampshire and Hampden Counties. High wind speeds, hail, and debris generated by tornadoes can result in loss of life, downed trees and power lines, and damage to structures and other personal property (cars, etc.).

Location

As per the Massachusetts Hazard Mitigation Plan, the entire Town is at risk of high winds, severe thunderstorms, and tornadoes. The location of occurrence for severe thunderstorms/wind hazards is "small," or less than 10 percent of the Town affected. The location of occurrence for tornadoes is also small.

Extent

An average thunderstorm is 15 miles across and lasts 30 minutes; severe thunderstorms can be much larger and longer. Southern New England typically experiences 10 to 15 days per year with severe thunderstorms. Thunderstorms can cause hail, wind, and flooding. Hail damage often correlates with hail size.

Hail Extent

Hail Size	Object Analog
.50	Marble, moth ball
.75	Penny
.88	Nickel
1.00	Quarter
1.25	Half dollar
1.50	Walnut, ping pong
1.75	Golf ball
2.00	Hen egg
2.50	Tennis ball
2.75	Baseball
3.00	Tea cup
4.00	Grapefruit
4.50	Softball

Source: <http://www.spc.noaa.gov/misc/tables/hailsiz.htm>

Tornadoes are measured using the enhanced F-Scale, shown with the following categories and corresponding descriptions of damage:

Enhanced Fujita Scale Levels and Descriptions of Damage			
EF-Scale Number	Intensity Phrase	3-Second Gust (MPH)	Type of Damage Done
EF0	Gale	65–85	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
EF1	Moderate	86–110	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
EF2	Significant	111–135	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
EF3	Severe	136–165	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
EF4	Devastating	166–200	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.

Previous Occurrences

Thunderstorms and high winds affect Amherst regularly. While municipal records of storms are not kept, the National Weather Service compiles such data on a statewide basis which is included in the Massachusetts Hazard Mitigation Plan. According to the most recent update of this plan, there are approximately 10 to 30 days of thunderstorm activity in the state each year.

There are typically 1 to 3 tornadoes somewhere in southern New England per year. Most occur in the late afternoon and evening hours, when the heating is the greatest. The most common months are June, July, and August, but the Great Barrington, MA tornado (1995) occurred in May and the Windsor Locks, CT tornado (1979) occurred in October.

Within Massachusetts, tornadoes have occurred most frequently in Worcester County and in communities west of Worcester. In 2011, a tornado ranked F3 (Severe Damage) on the Fujita Scale of Tornado Intensity, blew through West Springfield, Westfield, Springfield, Monson, Wilbraham, Brimfield, Sturbridge, and Southbridge. The tornado and related storm killed 3 people and resulted in hundreds of injuries across the state.

No known tornadoes have ever touched down in Amherst, though there have been several high-wind storms and hail events. Tornadoes have touched down in the neighboring towns of Pelham and Leverett. Thirteen incidents of tornado activity (all F2¹ or less) occurred in Hampshire County between 1959 and 2005.

Probability of Future Events

One measure of tornado activity is the tornado index value. It is calculated based on historical tornado events data using USA.com algorithms. It is an indicator of the tornado level in a region. A higher tornado index value means a higher chance of tornado events. Data was used for Hampshire County to determine the Tornado Index Value as shown in the table below.

Tornado Index for Hampshire County	
Hampshire County	125.73
Massachusetts	87.60
United States	136.45

Source: USA.com - <http://www.usa.com/hampshire-county-ma.htm>

Based upon the available historical records, it is reasonable to estimate that there is a “low” probability of severe thunderstorms, wind, and tornadoes affecting Amherst in any given year.

Impact

The potential for locally catastrophic damage is a factor in any tornado, severe thunderstorm, or wind event. In Amherst, a tornado that may hit the residential areas along major roadways would leave much more damage than a tornado with a travel path that ran along the town’s eastern sections, where less

¹ F2 refers to the commonly used Fujita Tornado Damage Scale which ranks tornados F0-F5 depending on estimated wind speeds and damages, with F5 the most severe.

settlement has occurred. Most buildings in the Town of Amherst have not been built to Zone 1, Design Wind Speed Codes. The first edition of the Massachusetts State Building Code went into effect on January 1, 1975, with a sizeable portion of the Town's building stock built before this date.

The estimated impact from a severe thunderstorm, wind, or tornado is "catastrophic," with over 50 percent of property in the affected area damaged or destroyed.

Using a total value of \$3,233,118,000 of all structures in Amherst, and an estimated 10 percent of structures damaged each by 20 percent for both severe thunderstorms/wind and tornadoes, yields a total damage of \$64,662,360. This estimate does not include building contents, land values or damages to utilities.

Vulnerability

Based on the above assessment, Amherst's vulnerability from severe thunderstorms, wind, and tornadoes is "3 - Medium Risk."

The entire town would be vulnerable to the destruction caused by severe thunderstorms, wind and tornadoes. The vulnerabilities associated with flooding could be present if substantial rain accompanies severe thunderstorms. High winds could impact the town's power lines and older buildings. The exact location of a tornado touchdown and tract would dictate which critical facilities would be most vulnerable.

Wildfire/Brushfire

Hazard Description

Wildland fires are typically larger fires, involving full-sized trees as well as meadows and scrublands. Brushfires are uncontrolled fires that occur in meadows and scrublands, but do not involve full-sized trees. Both wildland fires and brushfires can consume homes, other buildings and/or agricultural resources. Typical causes of brushfires and wildfires are lightning strikes, human carelessness, and arson.

FEMA has classifications for three different types of wildland fires:

- Surface fires – the most common type of wildland fire, surface fires burn slowly along the floor of a forest, killing or damaging trees.
- Ground fires burn on or below the forest floor and are usually started by lightning
- Crown fires move quickly by jumping along the tops of trees. A crown fire may spread rapidly, especially under windy conditions.

Location

Hampshire County has approximately 252,000 acres of forested land, which accounts for 72% of total land area. Forest fires are therefore a potentially significant issue. In Amherst, approximately 43% of the town's total land area is in forest, or about 7,951 acres, and is therefore at risk of fire.

Amherst has experienced fires in all sections of town. The largest and most difficult fires have occurred in the following areas: North East Street and the open land to the east; Lawrence Swamp; the Flat Hills Road area; the Mount Holyoke Range; and in woodlands in the northern part of town. There is open land throughout the Town in which a large wildland fire could develop. Most brushfires occur in spring due to both permitted and unpermitted burns.

South Hadley and Hadley had a large (approximately 500 acres) wildfire in the Mount Holyoke Range in approximately 2004. If the fire had crossed Route 116 it would have threatened Amherst and Granby.

The location of occurrence for this hazard is "small," or less than 10 percent of the Town affected.

Extent

Wildfires can cause widespread damage to the areas they impact. They can spread very rapidly, depending on local wind speeds and be very difficult to get under control. Fires can last for several hours up to several days.

Significant risk exists for potential wildfire incidents, especially near some of the town's forested, agricultural, and recreational lands. Forested and agricultural areas with high fuel content have more potential to burn. In addition, it is often very difficult to access some of the locations to extinguish the brushfire. However, Massachusetts receives more than 40 inches of rain per year and much of the landscape is fragmented, and together these two traits make wildfires uncommon in Massachusetts.

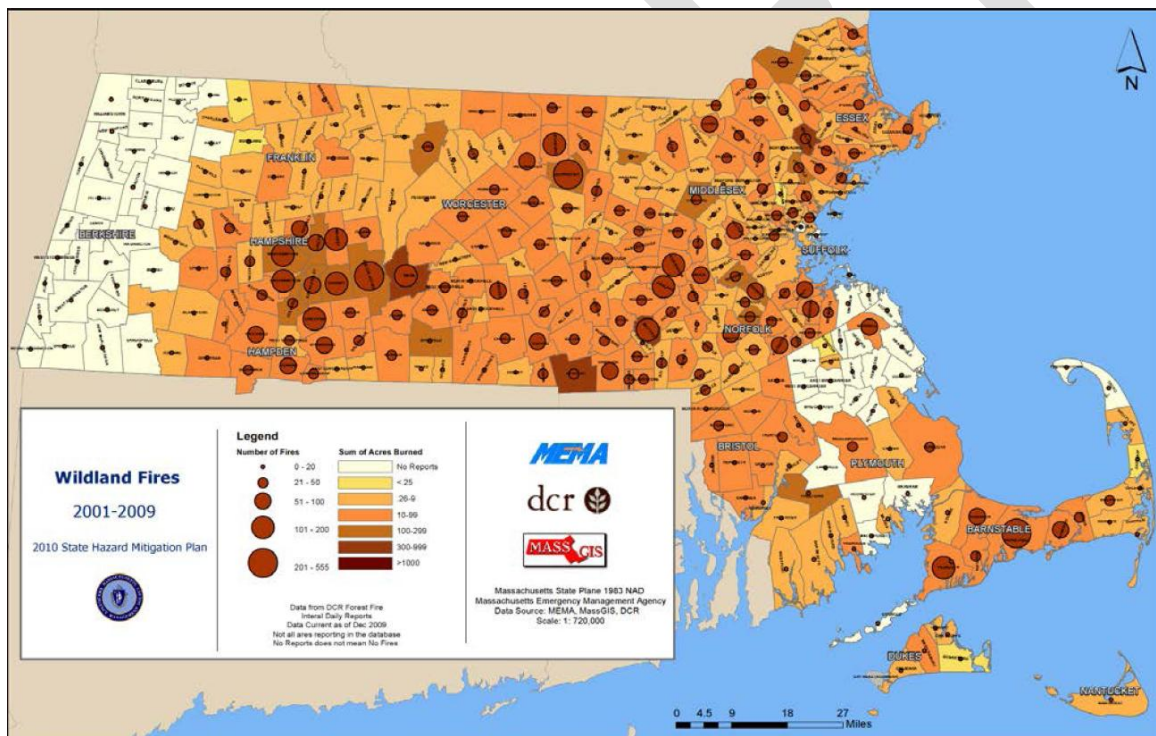
Previous Occurrences

Fires originating from illegal and unattended open burning are somewhat common in Amherst. The majority are small and quickly contained. According to the Amherst Fire Department, there are approximately 15 unauthorized burns (or brushfires) per year, on average. As a point of comparison, approximately 500 burn permits are issued annually.

During the past 100 years, there have not been many wildfires occurring in the Pioneer Valley. However, several have occurred during the past 20 years, as shown in the list below:

- 1995 – Russell, 500 acres burned on Mt. Tekoa
- 2000 – South Hadley, 310 acres burned over 14 days in the Lithia Springs Watershed
- 2001 – Ware, 400 acres burned
- 2010 – Russell, 320 acres burned on Mt. Tekoa
- 2012 – Eastern Hampden County, dry conditions and wind gusts created a brush fire in Brimfield, and burned 50 acres

Wildland Fires in Massachusetts, 2001-2009



Source: Massachusetts Hazard Mitigation Plan

Probability of Future Events

In accordance with the Massachusetts Hazard Mitigation Plan, the Town Hazard Mitigation Workgroup found it difficult to predict the likelihood of wildfires because of the number of variables involved. However, given the proximity of previous wildfires, and their proximity to the Town, the Hazard Mitigation Workgroup identified the likelihood of a future wildfire to be “very high,” or between 70 and 100 percent in any given year.

Climate scenarios project summer temperature increases between 2°C and 5°C and precipitation decreases of up to 15 percent. Such conditions would exacerbate summer drought and further promote high-elevation wildfires, releasing stores of carbon and further contributing to the buildup of greenhouse gases. Forest response to increased atmospheric carbon dioxide—the so-called “fertilization effect”—could also contribute to more tree growth and thus more fuel for fires, but the effects of carbon dioxide on mature forests are still largely unknown.

Climate change is also predicted to bring increased wind damage from major storms, as well as new types of pests to the region. Both increased wind and the introduction of new pests could potentially create more debris in wooded areas and result in a larger risk of fires.

Impact

The estimated impact from wildfire was determined to be “minor,” with minor property damage and minimal disruption to quality of life for Town residents. Using a total value of \$3,233,118,000 of all structures in Amherst, and an estimated 1 percent of structures damaged each by 50 percent, an estimated damage due to wildfire is \$16,165,590. This estimate does not include building contents, land values or damages to utilities.

Vulnerability

Based on the above assessment, Amherst faces a vulnerability of “3 – Medium Risk” from wildfires.

With just over 43% of the town forest, most of Amherst is vulnerable to wildfires. Depending on where burns were to happen, different critical facilities, evacuation routes and populations could be impacted. These areas of town are likely to be the most vulnerable, based on past occurrences: North East Street and the open land to the east, Lawrence Swamp, the Flat Hills Road area, and the Mount Holyoke Range.

Earthquakes

Hazard Description

An earthquake is a sudden, rapid shaking of the ground that is caused by the breaking and shifting of rock beneath Earth's surface. Earthquakes can occur suddenly, without warning, at any time of the year. New England experiences an average of 30 to 40 earthquakes each year although most are not noticed by people.² Ground shaking from earthquakes can rupture gas mains and disrupt other utility service, damage buildings, bridges and roads, and trigger other hazardous events such as avalanches, flash floods (dam failure) and fires. Un-reinforced masonry buildings, buildings with foundations that rest on filled land or unconsolidated, unstable soil, and mobile homes not tied to their foundations are at risk during an earthquake.³

Location

Because of the regional nature of the hazard, the entire town is susceptible to earthquakes. This means that the location of occurrence of this hazard is "large," with more than 50 percent of the Town affected.

Extent

The magnitude of an earthquake is measured using the Richter magnitude scale, which measures the energy of an earthquake by determining the size of the greatest vibrations recorded on the seismogram. On this scale, one step up in magnitude (from 5.0 to 6.0, for example) increases the energy more than 30 times. The intensity of an earthquake is measured using the Modified Mercalli Scale. This scale quantifies the effects of an earthquake on the Earth's surface, humans, objects of nature, and man-made structures on a scale of I through XII, with I denoting a weak earthquake and XII denoting an earthquake that causes almost complete destruction. Both scales are represented below.

² Northeast States Emergency Consortium Web site: www.nesec.org/hazards/earthquakes.cfm.

³ Federal Emergency Management Agency Web site: www.fema.gov/hazards/earthquakes/quake.shtm.

Richter Scale Magnitudes and Effects	
Magnitude	Effects
< 3.5	Generally not felt, but recorded.
3.5 - 5.4	Often felt, but rarely causes damage.
5.4 - 6.0	At most slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.
6.1 - 6.9	Can be destructive in areas up to about 100 kilometers across where people live.
7.0 - 7.9	Major earthquake. Can cause serious damage over larger areas.
8 or >	Great earthquake. Can cause serious damage in areas several hundred kilometers across.

Modified Mercalli Intensity Scale and Effects			
Scale	Intensity	Description Of Effects	Corresponding Richter Scale Magnitude
I	Instrumental	Detected only on seismographs.	
II	Feeble	Some people feel it.	< 4.2
III	Slight	Felt by people resting; like a truck rumbling by.	
IV	Moderate	Felt by people walking.	
V	Slightly Strong	Sleepers awake; church bells ring.	< 4.8
VI	Strong	Trees sway; suspended objects swing, objects fall off shelves.	< 5.4
VII	Very Strong	Mild alarm; walls crack; plaster falls.	< 6.1
VIII	Destructive	Moving cars uncontrollable; masonry fractures, poorly constructed buildings damaged.	
IX	Ruinous	Some houses collapse; ground cracks; pipes break open.	< 6.9
X	Disastrous	Ground cracks profusely; many buildings destroyed; liquefaction and landslides widespread.	< 7.3
XI	Very Disastrous	Most buildings and bridges collapse; roads, railways, pipes and cables destroyed; general triggering of other hazards.	< 8.1
XII	Catastrophic	Total destruction; trees fall; ground rises and falls in waves.	> 8.1

Previous Occurrences

Earthquakes have been felt in the Town in the past, with the most recent occurrences noted in the table below. In addition, there is a historic record of earthquakes to occur in the New England states. Both charts have been compiled by the Northeast States Emergency Consortium.

Largest Earthquakes to Be Felt in Amherst Since 1924		
Location	Date	Magnitude
Ossipee, NH	December 20, 1940	5.5
Ossipee, NH	December 24, 1940	5.5
Dover-Foxcroft, ME	December 28, 1947	4.5
Kingston, RI	June 10, 1951	4.6
Portland, ME	April 26, 1957	4.7
Middlebury, VT	April 10, 1962	4.2
Near NH/Quebec Border	June 15, 1973	4.8
West of Laconia, NH	Jan. 19, 1982	4.5
Plattsburg, NY	April 20, 2002	5.1
Bar Harbor, NH	October 3, 2006	4.2
Hollis Center, ME	October 16, 2012	4.6

Source: Northeast States Emergency Consortium <www.nesec.org/hazards/earthquakes.cfm>

New England States Record of Historic Earthquakes		
State	Years of Record	Number Of Earthquakes
Connecticut	1668 - 2007	137
Maine	1766 - 2007	544
Massachusetts	1668 - 2007	355
New Hampshire	1638 - 2007	360
Rhode Island	1776 - 2007	38
Vermont	1843 - 2007	73
New York	1840 - 2007	755
<i>Total Number of Earthquakes within the New England states between 1638 and 1989 is 2,262.</i>		

Source: Northeast States Emergency Consortium <www.nesec.org/hazards/earthquakes.cfm>

Probability of Future Events

One measure of earthquake activity is the Earthquake Index Value. It is calculated based on historical earthquake events data using USA.com algorithms. It is an indicator of the earthquake activity level in a region. A higher earthquake index value means a higher chance of earthquake events. Data was used for Hampshire County to determine the Earthquake Index Value for Amherst, as shown in the table below.

Earthquake Index for Hampshire County	
Hampshire County	0.17
Massachusetts	0.70
United States	1.81

Based upon existing records, the probability of future earthquakes is “low,” or between 1 and 10 percent probability in any given year.

Impact

Massachusetts introduced earthquake design requirements into their building code in 1975. However, these specifications apply only to new buildings or to extensively-modified existing buildings. Buildings, bridges, water supply lines, electrical power lines and facilities built before 1975 may not have been designed to withstand the forces of an earthquake. The seismic standards have also been upgraded with the 1997 revision of the State Building Code.

Due to the infrequency and relatively low intensity of earthquakes in the New England region, the impact to the Town from an earthquake is considered “minor” with only minor property damage, including UMass.

Structures are mostly of wood frame construction in Amherst. Assuming a total value of all structures in town of \$3,233,118,000, an estimated loss of 1 percent of structures in Town, and a 20 percent loss of those structures, an earthquake would result in \$6,466,236 worth of damage. The costs of repairing or replacing roads, bridges, power lines, telephone lines, or the contents of structures are not included in this estimate.

Vulnerability

Based on the above analysis, Amherst’s vulnerability from an earthquake is “4 – Low Risk.”

The whole town is vulnerable to the impacts of an earthquake. Older buildings are particularly vulnerable to earthquakes because their construction pre-dates buildings codes that included strong seismic considerations. The hazard mitigation committee lacks the information needed to determine how critical facilities might fare in an earthquake. There are multiple bridges on the town’s identified evacuation routes. If the bridges were to fall, these routes may not be able to be used for evacuations and could lead to isolated populations.

Dam Failure

Hazard Description

Dams and their associated impoundments provide many benefits to a community such as water supply, recreation, hydroelectric power generation, and flood control. However, they also pose a potential risk to lives and property. Dam failure is not a common occurrence, but dams do represent a potentially disastrous hazard. When a dam fails, the potential energy of the stored water behind the dam is released rapidly. Most failures occur when waters above the dam go over the top and erode the material components of the dam. Dam breaches often lead to catastrophic consequences as the water rushes in a torrent downstream, flooding lands that engineers refer to as an “inundation area.” The number of casualties and the amount of property damage will depend upon the timing of the warning provided to downstream residents, the number of people living or working in the inundation area, and the number of structures in the inundation area.

Many dams in Massachusetts were built during the 19th century without the benefit of modern engineering design and construction oversight. Dams of this age can fail because of structural problems due to age and/or lack of proper maintenance, as well as from structural damage caused by an earthquake or flooding.

The Massachusetts Department of Conservation and Recreation Office of Dam Safety is the agency responsible for regulating dams in the state (M.G.L. Chapter 253, Section 44 and the implementing regulations 302 CMR 10.00). To be regulated, these dams are in excess of 6 feet in height (regardless of storage capacity) and have more than 15 acre feet of storage capacity (regardless of height). Dam safety regulations enacted in 2005 transferred significant responsibilities for dams from the State of Massachusetts to dam owners, including the responsibility to conduct dam inspections.

The inspection schedule for dams is as follows:

- Low Hazard dams – 10 years
- Significant Hazard dams – 5 years
- High Hazard dams – 2 years

The time intervals represent the maximum time between inspections. More frequent inspections may be performed at the discretion of the state. Dams and reservoirs licensed and subject to inspection by the Federal Energy Regulatory Commission (FERC) are excluded from the provisions of the state regulations provided that all FERC-approved periodic inspection reports are provided to the DCR. All other dams are subject to the regulations unless exempted in writing by DCR.

Location

According to DCR and MEMA sources, as well as local knowledge, there are currently eight (8) dams⁴ in Amherst. The follow table identifies the dams within the town as well as whether they are classified as low, significant, non-jurisdictional or high hazard.

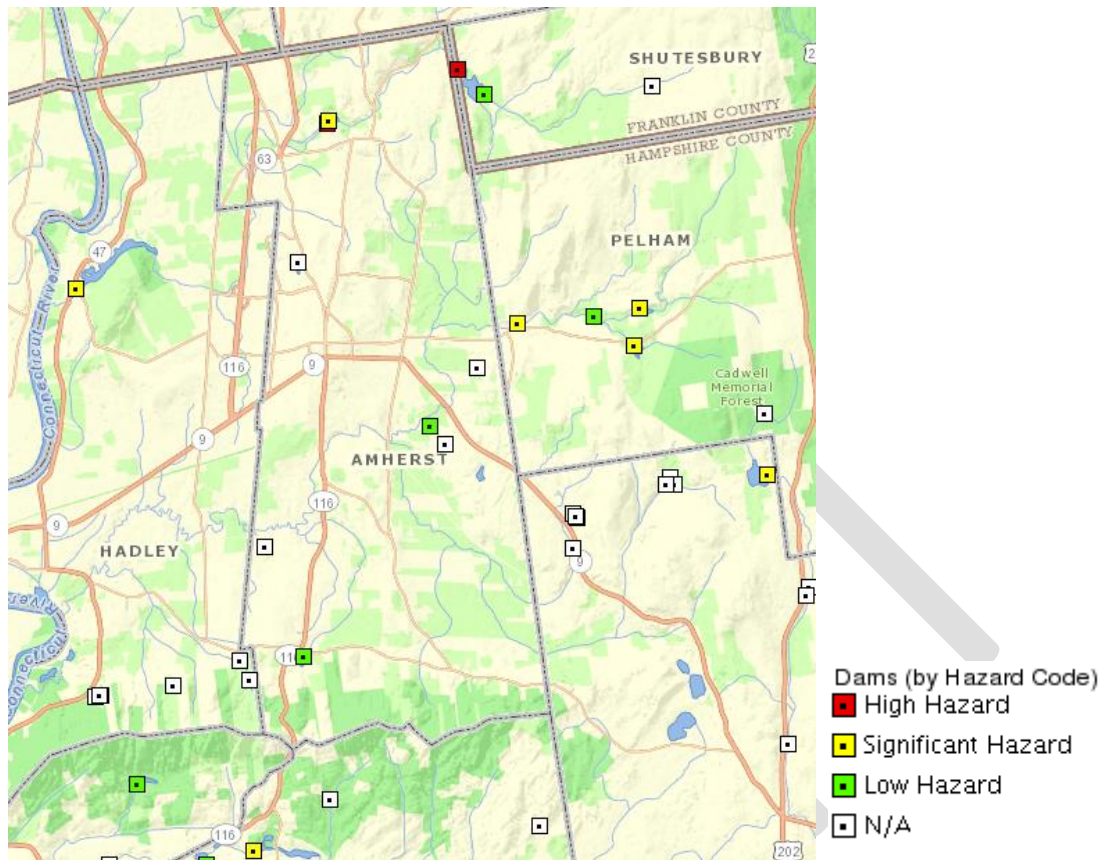
Several dams in surrounding communities are listed in this table, as a failure in those locations will have a significant impact on Amherst.

Dams in Amherst (Updated 12/2015)					
Dam name/ date built	ID	Owner	Purpose	Condition/last inspected	Hazard Risk
Factory Hollow Dam	MA00063	Town of Amherst DPW	Recreation	Fair / 7-7-15	High
Factory Hollow Dike	MA00597	Town of Amherst Cons. Comm.	Recreation	Poor / 10-28-11	Significant
Ice Pond Dam	MA01665	Amherst Field Association	drainage	Non-jurisdictional	--
Epstein Pond Dam	MA00483	Balderwood Realty Trust	Recreation	Fair / 6-29-09	--
Owens Farm Pond Dam	MA01667	Town of Amherst Cons. Comm.	drainage	Unknown / Unknown	Low
Echo Hill Association Pond Dam	MA01666	Echo Hill Association	Drainage	Non-Jurisdictional	--
University Pond Dam	MA01668	Commonwealth of MA- Dept. of Higher Education	drainage	Non-Jurisdictional	--
Markert Pond Dam	MA02303	Town of Amherst-DPW	Drainage	Non-Jurisdictional	--
Atkins Reservoir (Shutesbury)		Town of Amherst - DPW	Water Supply	Unknown	
Hills Reservoir (Pelham)	MA00064	Town of Amherst DPW	Water Supply	Fair / 10-28-11	Significant
Hawley Reservoir (Pelham)	MA00065	Town of Amherst DPW	Water Supply	Satisfactory / 10-28-11	Significant
Bartlett (Pelham)	MA01761	No record / non-jurisdictional		Non-Jurisdictional	--

The location of occurrence of this hazard is “small,” with less than 10 percent of the Town affected.

⁴ It is difficult to track down accurate records of dams, as ownership and exact location is not clear. Furthermore, many very old dams listed in DCR records are not in existence anymore, according to local knowledge. This list is compiled from a combination of sources, and then verified by the Committee.

Dam Locations and Hazard Ratings in Amherst (2015)



Source: MassGIS Oliver

Extent

Dams in Massachusetts are assessed according to their risk to life and property. The state has three hazard classifications for dams:

- **High Hazard:** Dams located where failure or improper operation will likely cause loss of life and serious damage to homes, industrial or commercial facilities, important public utilities, main highways, or railroads.
- **Significant Hazard:** Dams located where failure or improper operation may cause loss of life and damage to homes, industrial or commercial facilities, secondary highways or railroads or cause interruption of use or service of relatively important facilities.
- **Low Hazard:** Dams located where failure or improper operation may cause minimal property damage to others. Loss of life is not expected.

Previous Occurrences

To date there have been no dam failures in Amherst.

Probability of Future Events

Based upon the past events, it is reasonable to say that there is a “very low” frequency of dam failure in Amherst, with a less than 1 percent chance of a dam failing in any given year.

As described in the Massachusetts Hazard Mitigation Plan, 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 the hydrograph 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. Such early releases of increased volumes can increase flood potential downstream. Throughout the west, communities downstream of dams are already increases in stream flows from earlier releases from dams. Dams are constructed with safety features known as “spillways.” Spillways are put in place on dams as a safety measure in the event of the reservoir filling too quickly. Spillway overflow events, often referred to as “design failures,” result in increased discharges downstream and increased flooding potential. Although climate change will not increase the probability of catastrophic dam failure, it may increase the probability of design failures.

Impact

The impact from a dam failure is estimated to be “minor,” with only minor property damage and minimal disruption on the quality of life.

A failure of the Factory Hollow Dam would create an inundation area that would include:

- Mill Hollow apartments (estimated 40 apartments valued at \$150,000 each)
- 11 single family homes
- Three commercial structures (including a towing company and an auto body shop) on Sunderland Road
- Two Town park buildings in the Mill River recreation area.

Economic cost of total destruction of all properties: \$9,725,500.

Given the current use of the Ice Pond dam and development around it, its failure would cause minor property damage to an estimated 15 condominiums and one private residence.

Vulnerability

Based on this analysis, Amherst faces a vulnerability of “5 – Lowest Risk” from dam failure.

The areas of Amherst vulnerable to a dam failure are quite minimal. The local hazard mitigation committee did not feel that any of the town’s critical facilities or evacuation routes were particularly vulnerable to a dam failure.

In addition to dams in Amherst, the Town is also vulnerable to dam failure in the neighboring community of Shutesbury. On East Leverett Road approximately 45 private residences are located in the inundation zone of Atkins Reservoir Dam, as is the whole area previously identified in the Factory Hollow

dam vulnerability assessment. In addition, three homes on Summer Street are located in the inundation zone. Fifteen additional residences located on Meadow Street are also in the inundation zone as are portions of Russellville Road including Kieras Oil, home to a 100,000 gallon oil tank. The economic cost would include the previous figures for Factory Hollow plus \$17,041,500 (not including cost of damage to commercial properties) for properties noted here.

DRAFT

Drought

Drought is a normal, recurrent feature of climate. It occurs almost everywhere, although its features vary from region to region. In the most general sense, drought originates from a deficiency of precipitation over an extended period of time, resulting in a water shortage for some activity, group, or environmental sector. Reduced crop, rangeland, and forest productivity; increased fire hazard; reduced water levels; increased livestock and wildlife mortality rates; and damage to wildlife and fish habitat are a few examples of the direct impacts of drought. Of course, these impacts can have far-reaching effects throughout the region and even the country.

Location

Because of this hazard's regional nature, a drought would impact the entire Town. This means that the location of occurrence is "large," with more than 50 percent of the Town affected.

Extent

The severity of a drought would determine the scale of the event and would vary among town residents depending on whether the residents' water supply is derived from a private well or the public water system.

The U.S. Drought Monitor records information on historical drought occurrence. Unfortunately, data could only be found at the state level. The U.S. Drought Monitor categorizes drought on a D0-D4 scale as shown below.

U.S. Drought Monitor		
Classification	Category	Description
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered
D1	Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested
D2	Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed
D3	Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies

Source: US Drought Monitor, <http://droughtmonitor.unl.edu/classify.htm>

Previous Occurrences

In Massachusetts, six major droughts have occurred statewide since 1930.⁵ They range in severity and length, from three to eight years. In many of these droughts, water-supply systems were found to be inadequate. Water was piped in to urban areas, and water-supply systems were modified to permit withdrawals at lower water levels. The following table indicates previous occurrences of drought in Massachusetts since 2000, based on the US Drought Monitor:

Annual Drought Status	
Year	Maximum Severity
2000	No drought
2001	D2 conditions in 21% of the state
2002	D2 conditions in 99% of the state
2003	No drought
2004	D0 conditions in 44% of the state
2005	D1 conditions in 7% of the state
2006	D0 conditions in 98% of the state
2007	D1 conditions in 71% of the state
2008	D0 conditions in 57% of the state
2009	D0 conditions in 44% of the state
2010	D1 conditions in 27% of the state
2011	D0 conditions in 0.01% of the state
2012	D2 conditions in 51% of the state
2013	D1 conditions in 60% of the state
2014	D1 conditions in 54% of the state
2015	D1 conditions in 100% of the state

Source: US Drought Monitor

Amherst has had limited experience with severe drought conditions. Droughts tend to be localized, such as at wells on Leverett Road and E. Harkness Road.

Probability of Future Occurrences

The probability of a future event in Amherst is “very low,” with less than 1 percent chance of occurring in any given year.

Based on past events and current criteria outlined in the Massachusetts Drought Management Plan, it appears that Western Massachusetts may be more vulnerable than Eastern Massachusetts to severe drought conditions. However, many factors, such as water supply sources, population, economic factors (i.e., agriculture based economy), and infrastructure, may affect the severity and length of a drought event.

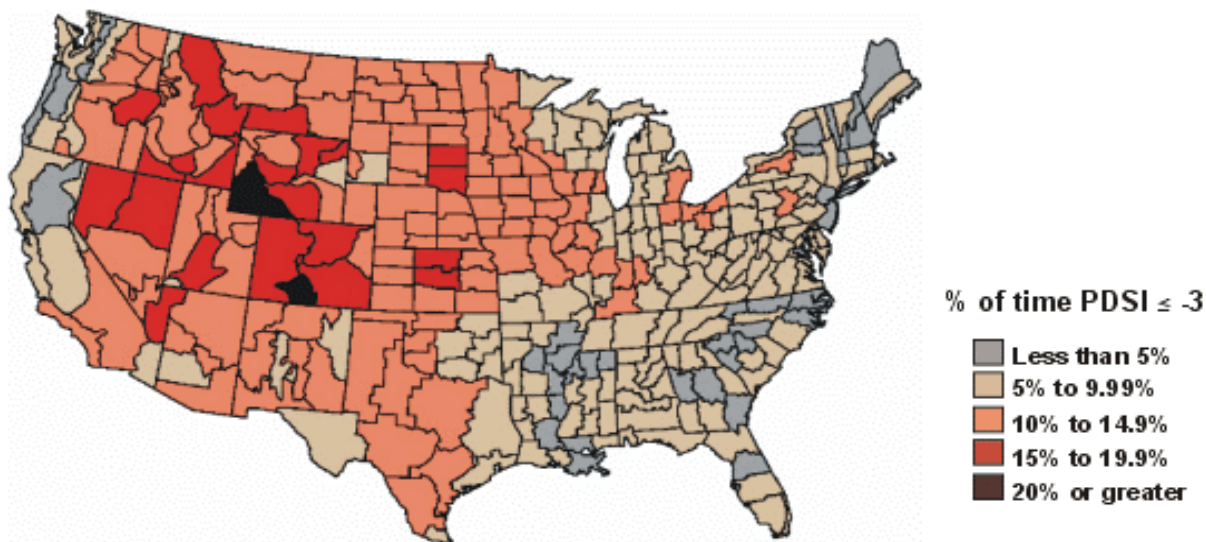
⁵ US Geological Survey Water-Supply Paper 2375. “National Water Summary 1989 – Floods and Droughts: Massachusetts.” Prepared by S. William Wandle, Jr., US Geological Survey.

When evaluating the region's risk for drought on a national level, utilizing a measure called the Palmer Drought Severity Index, Massachusetts is historically in the lowest percentile for severity and risk of drought.⁶ However, global warming and climate change may have an effect on drought risk in the region. With the projected temperature increases, some scientists think that the global hydrological cycle will also intensify. This would cause, among other effects, the potential for more severe, longer-lasting droughts.

Palmer Drought Severity Index

1895–1995

Percent of time in severe and extreme drought



Impact

Due to the water richness of western Massachusetts, Amherst is unlikely to be adversely affected by anything other than a major, extended drought. The impacts of a drought are categorized by the U.S. Drought Monitor to include:

- Slowing or loss of crops and pastures
- Water shortages or restrictions
- Low water levels in streams, reservoirs, and wells

As a result, the impact of a drought would be “minor” with only minimal property damage or disruption on quality of life.

Vulnerability

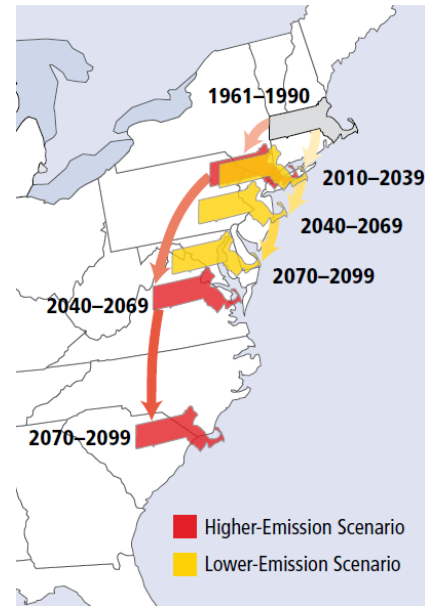
Based on the above assessment, Amherst's vulnerability from drought is “5 – Lowest Risk.” While a severe drought would require water saving measures to be implemented, there would be no foreseeable damage to structures or loss of life resulting from the hazard.

⁶ National Drought Mitigation Center – <http://drought.unl.edu>

Extreme Temperatures

Hazard Description

Greater variation and extremes in local atmospheric temperatures due to global changes in climate are now among the natural hazards that this plan anticipates. Amherst is likely to experience more instances of extreme and sustained heat and cold. And, because warmer air holds more moisture, higher temperatures will also bring wetter winters, more severe storms, and more frequent flooding. Locally, there will also be more single-day records highs, and more total days with highs above 90 degrees, and more heat waves with 3 or more days above 90 degrees. More extreme temperatures throughout Western Massachusetts and New England mean that there will be more floods, droughts, and tornados. There will also be more Atlantic hurricanes and nor'easters. Anticipated increases in extreme local temperatures is directly related to many of the previously described vulnerabilities, as well as increasing the risk of heat-related disease and injury, especially among senior citizens and residents unable to afford air conditioning.



At current rates of greenhouse gas accumulation and temperature increases, the climate of Massachusetts will become similar to those of present-day New Jersey or Virginia by 2040-2069, depending on future GHG emissions. *Source: NECIA 2006*

Anticipated Climatic Variation / Location

In Western Massachusetts, annual precipitation is expected to increase by 14% by the end of the 21st century. However, most of this precipitation increase will come during the winter months – as much as 30% more than today – while summertime precipitation will actually decrease slightly. Also, most of the added winter precipitation is expected to be in the form of rain, rather than snow. This will mean a continuation of the current regional trend of a decreasing snowfall totals, as well as the number of days with snow cover on the ground, but more precipitation overall. The increased amount of strong precipitation events and overall increase in rainfall, combined with the aging stormwater infrastructure in the region, will likely result in more flooding.

Anticipated Climatic Variations for Massachusetts Due to Climate Change

Category	Current (1961-1990 avg.)	Predicted Change 2040-2069	Predicted Change 2070-2099
Average Annual Temperature (°F)	46°	50° to 51°	51° to 56°
Average Winter Temperature (°F)	23°	25.5° to 27°	31° to 35°
Average Summer Temperature (°F)	68°	69.5° to 71.5°	74° to 82°
Days over 90 °F	5 to 20 days	-	30 to 60 days
Days over 100 °F	0 to 2 days	-	3 to 28 days
Annual Precipitation	41 inches	43 to 44 inches	44 to 47 inches
Winter Precipitation	8 inches	8.5 to 9 inches	9 to 10.4 inches
Summer Precipitation	11 inches	10.9 to 10.7 inches	10.9 to 11 inches

Extent

Extreme temperatures would affect Amherst town-wide. In August, the dormitories at UMass and other colleges are re-populated with students, but many dormitories lack air conditioning, putting the student population at risk during particularly intense heat events. Other susceptible areas during heat waves include the Amherst Housing Authority units and Wayland Apartments, where there are vulnerable populations. The Town utilizes a regional shelter during extreme temperature events. Otherwise, the largest risk in Amherst is damage to property due to pipes freezing during cold weather. This is because of Amherst's large renter population.

Previous Occurrences

The most frequent impact of extreme temperatures in Amherst is the freezing of pipes and water service. Water services have frozen at the Wayland Apartments (Amherst Housing Authority) in the past. During an extreme but brief cold snap in February 2016, pipes at several buildings on the University of Massachusetts campus froze, but no significant damage occurred.

Probability of Future Events

Based on past events, it is reasonable to anticipate a very high frequency of extreme temperatures in Amherst.

Impact

Increased temperatures will likely have the following projected impacts to people, property, and the local economy:

- There will be greater stress on special populations, such as senior citizens and economically disadvantaged people, without access to air conditioning during heat waves.
- Increased temperatures and changes in growing seasons for various crops will put stress on current food production and require farming operations to adjust by planting new varieties of crops.
- Livestock will be at greater risk from extreme and extended heat.
- Increased energy usage in order to cool buildings in the summer and long-term electrical needs will increase.
- Rental properties are at greater risk for property damage due to frozen pipes.
- Municipal and housing authority properties are at greater risk for frozen pipes.
- Student occupants of dorms without air conditioning are at risk of exposure to extreme heat during the late summer months.

Vulnerability

Based on this analysis, Amherst faces a vulnerability of "1 – Highest Risk" to extreme temperatures.

Structures, critical facilities and evacuation route are unlikely to be impacted by extreme temperatures. Populations that are not prepared to deal with temperature extremes will be most vulnerable.

Other Hazards

In addition to the hazards identified above, the Hazard Mitigation Team reviewed the full list of hazards listed in the Massachusetts Hazard Mitigation Plan. Due to the location and context of the Town, landslides, coastal erosion, hail, lightning, sea level rise, storm surge, subsidence, and tsunamis were determined to not be a threat.

DRAFT

4: CRITICAL FACILITIES

Facility Classification

A critical facility is defined as a building, structure, or location that:

- Is vital to the hazard response effort
- Maintains an existing level of protection from hazards for community residents and property
- Would create a secondary disaster if a hazard were to impact it

The Critical Facilities List for the Town of Amherst has been identified utilizing a Critical Facilities List provided by the State Hazard Mitigation Officer. Amherst's Hazard Mitigation Workgroup has divided this list of facilities into four categories:

- Facilities needed for Emergency Response in the event of a disaster.
- Non-Emergency Response Facilities that have been identified by the Committee as non-essential. These are not required in an emergency response event, but are considered essential for the everyday operation of Amherst.
- Facilities/Populations that the Committee wishes to protect in the event of a disaster.
- Potential Resources, which can provide services or supplies in the event of a disaster.

The critical facilities and evacuation routes potentially affected by hazard areas are identified in Table 4-1, following this list. The Past and Potential Hazards/Critical Facilities Map (Appendix C) identifies these facilities.

Category 1 – Emergency Response Services

The Town has identified the Emergency Response Facilities and Services as the highest priority in regards to protection from natural and man-made hazards.

1) Emergency Operations Center

Primary: Amherst Public Safety Communications Center - 111 Main Street
Secondary: Amherst Fire Department - 603 East Pleasant Street

2) Fire Station

Amherst Fire Department
Central Station - 68 North Pleasant Street
North Station - 603 East Pleasant Street

3) Police Station

Amherst Police Department – 111 Main Street

4) Highway Department

Highway Department – 586 South Pleasant Street

5) Water Department

4 wells - Belchertown, South Amherst
Water Department – 586 South Pleasant Street
Water Treatment Plants – 33 Market Hill Road, Amherst Road, Southeast Street
Wastewater Treatment Plant - 1 Mullins Way

6) Emergency Fuel Stations

Fire Department - 603 East Pleasant Street
5,000 gallons diesel; 10,000 gallons gasoline
Highway Department – 586 South Pleasant Street
4,000 gallons diesel; 4,000 gallons gas

7) Emergency Electrical Power Facility

Police Department and Emergency Operations Center – 111 Main Street
Fire Department, Central Station - 68 North Pleasant Street
Fire Department, North Station - 603 East Pleasant Street
Town Hall - 4 Bolton Avenue

8) Emergency Shelters

Primary*: Smith Vocational School 80 Locust Street
Amherst Regional High School - 21 Mattoon Street (short term “comfort station”,
agreement in place)
Amherst Regional Middle School - 170 Chestnut Street (agreement in place)
Crocker Farm Elementary School - 280 West Street
Fort River Elementary School - 70 Southeast Street
Wildwood Elementary School - 71 Strong Street

*Shelters also have generators.

9) Water Sources

Numerous locations in Amherst – primary reservoir varies based on season. #5 well is backup supply.

10) Transfer Station

On Past and Potential Hazards/Critical Facilities Map – 740 Belchertown Road

11) Helicopter Landing Sites

Hampshire College – College Drive and North/South Campus Drive
Groff Park, Baseball Field – Off Mill Lane
Amherst Regional High School – Parking Lot or Field
UMass (Lorden) Playing Field – 150 Mullins Way
Amherst Fire Department, Lot Behind North Station – 603 E. Pleasant Street
Route 116 Bypass and Meadow Street – Intersection at Lights or Auction Barn

12) Communications

FCC Registered Cell Phone Towers:

- 151 College Street
- 100 Observatory Road
- Rifle Club (Notch) – West Street
- St. Bridges Church
- Old Landfill
- Amherst College
- Pulpit Hill Road
- E. Pleasant Street
- Some towers on Umass campus

FCC Registered Antenna Towers

- 740 Belchertown Road – 4 antennas on site

[Below from the original plan:]

- Cell and radio towers throughout town Pulpit Hill Road
- Police tower – Umass library
- Fire tower – Mt. Lincoln
- Highway Dept. – 586 S. Pleasant Street
- Regional Middle School
- Fearing Street – Verizon switching facility
- South Prospect Street – Verizon switching facility

13) Primary Evacuation Routes

- Route 9 (east/west)
- Route 116 (north/south)

14) Bridges/Culverts Located on Evacuation Routes

Bridges

<u>Evacuation Route</u>	<u>Crosses</u>
Route 116, West Street	Fort River

Route 9, Belchertown Road	Fort River
Route 116	Mill River
Route 116	Mill River
Route 116	Eastman Brook

Category 2 – Non Emergency Response Facilities

The town has identified these facilities as non-emergency facilities; however, they are considered essential for the everyday operation of Amherst.

1) Water Supply

- Town reservoir
- 4 water tanks
- 1 water pump station
- 21 sewer pump stations

Category 3 – Facilities/Institutions with Special Populations

The third category contains people and facilities that need to be protected in event of a disaster.

1) Special Needs Population

- Nursing Home – numerous, updated regularly and available upon request

2) Elderly Housing/Assisted Living

- Senior Housing – numerous

3) Public Buildings/Areas

- | | |
|---|-----------------------------|
| Jones Library - | 43 Amity Street |
| Munson Memorial Library - | 1046 S East Street |
| Web Du Bois Library – | University of Massachusetts |
| North Amherst Library - | 8 Montague Road |
| Amherst History Museum (Strong) - | 67 Amity Street |
| Eric Carle Museum of Picture Book Art - | 125 West Bay Road |
| Leisure Services & Supplemental Education - | 170 Chestnut Street |
| Boys & Girls Club - | 39 N. Pleasant Street |

4) Schools

- | | |
|---|---------------------------|
| Amherst Regional Middle School - | 170 Chestnut Street |
| Amherst Regional Senior High School - | 21 Mattoon Street |
| Ft River Elementary School - | 70 South East Street |
| Wildwood Elementary School & Head Start - | 71 Strong Street |
| North Amherst Head Start | UMass Campus |
| Common School - | 521 South Pleasant Street |
| Crocker Farm Elementary School - | 280 West Street |
| Amherst Montessori - | 27 Pomeroy Lane |

Spring Street Preschool -
Cushman Scott Children's Center -

64 Spring Street
71 Henry Street

5) Churches

Amherst Chinese Christian Church -
Church Of Jesus Christ of LDS -
First Baptist Church-Amherst -
First Congregational Church -
Goodwin AME Zion Church -
Grace Episcopal Church -
Immanuel Lutheran Church -
Kingdom Hall-Jehovah's Witness -
Mercy House -
New Life Baptist Church -
Newman Center -
Korean Baptist Church -
South Congregational Church -
St Brigid's Catholic Church -
Unitarian Universalist Society -

611 Belchertown Road
104 Sunset Avenue
434 North Pleasant Street
165 Main Street
41 Woodside Avenue
14 Boltwood Avenue
867 N Pleasant Street
17 Pomeroy Lane
365 North Pleasant Street
51 Pondview Drive
472 North Pleasant Street
1199 North Pleasant Street
1066 South East Street
122 North Pleasant Street
121 North Pleasant Street

Synagogues
Hillel House -
Jewish Community of Amherst -

388 North Pleasant Street
742 Main Street

Mosques
Hampshire Mosque -

1 E Pleasant Street

6) Historic Buildings/Sites

Amherst History Museum (Strong) -
Eric Carle Museum of Picture Book Art -
Emily Dickinson House -
The Evergreens -
Hills Mansion -
Wildwood Cemetery -
North, West, and East Cemeteries -
Town Hall -

67 Amity Street
125 West Bay Road
280 Main Street
232 Main Street
38 Gray Street
70 Strong Street
N. Pleasant St., Triangle St., Middle St.
4 Boltwood Avenue

7) Apartment Complexes

Boulders
South Point
Hollister
Town House
Puffton Village
Colonial Village (history of flooding)
Green Leaves
Olympia Oaks
Village Park
River Glade
Vince O'Connors

The Hollow
Riverside (in floodplain)

8) Employment Centers

University of Massachusetts -
Amherst College –
Hampshire College –
Downtown Village
South Amherst Center
North Amherst Village Center
Pomeroy Village

300 Massachusetts Avenue
100 Boltwood Avenue
893 West Street

Category 4 – Potential Resources

This section contains facilities that provide potential resources for services or supplies. As the resources are numerous, please see Comprehensive Emergency Management Plan, CEMP, updated annually and available through the Town EMD.

The Town of Amherst has been pro-active in establishing cooperative agreements with local businesses to assure cooperation and collaboration in the event of an emergency.

1) Food/Water

Numerous grocery stores—EMD has working relationship with many, including Big Y

2) Hospitals/Medical Supplies

Cooley Dickinson Hospital in Northampton, 8 miles away
Many local pharmacies and drug stores

3) Gas/Heating Oil/Propane

Surner Oil – Formal Agreement
Kaiers Oil – Informal Agreement

4) Building Materials Suppliers

Obtained as needed

5) Heavy & Small Equipment Suppliers

Obtained as needed

Table 4.1: Critical Facilities and Evacuation Routes Potentially Affected by Hazard Areas

Hazard Type	Hazard Area	Critical Facilities Affected	Evacuation Routes Affected
Flooding (100-year)	Meadow ST., W. Pomeroy Lane	none	Routes 9 and 116
Flooding (localized)	W. Pomeroy, E. Hadley , State, Main, Summers, Meadow	none	Probably not
Severe Snow/Ice Storm	Varies—all over Town	Possibly, but not at all likely	possibly
Hurricane/Severe Wind	Varies—all over Town	Possibly, but not at all likely	possibly
Wildfire/Brushfire	Agriculture land	none	no
Earthquake	All over	Possibly, but not at all likely	yes
Dam Failure	Sunderland RD, E. Leverett RD, Russellville RD, Summer ST, Meadow ST	none	no
Drought	Town-wide	none	no
Extreme Temperatures	Town-wide	None	none

(Past & Potential Hazards/Critical Facilities Map Located In Appendix C)

5: MITIGATION STRATEGIES

One of the steps of this Hazard Mitigation Plan is to evaluate all of the Town's existing policies and practices related to natural hazards and identify potential gaps in protection. After reviewing these policies and the hazard identification and assessment, the Town Hazard Mitigation Workgroup developed a set of hazard mitigation strategies it would like to implement.

The Town of Amherst has developed the following goal to serve as a framework for mitigation of the hazards identified in this plan.

Goal Statement

To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to natural disasters. To provide adequate shelter, water, food and basic first aid to residents displaced in the event of a natural disaster, and to provide adequate notification and information regarding evacuation procedures, etc., to residents in the event of a natural disaster.

For the extent of this analysis, the Committee reviewed the following Town documents:

- Zoning Bylaws
- Subdivision Rules and Regulations
- Open Space and Recreation Plan - [approved 2009 plan](#)
- Comprehensive Planning Study: Defining Village Boundaries & Open Space Preservation Strategies
- Comprehensive Emergency Management Plan
- Master Plan 2010
- Transportation Plan 2015

Overview of Mitigation Capabilities by Hazard

An overview of the capabilities of the Town of Amherst for each of the hazards identified in this plan is as follows:

Flooding

The key factors in flooding are the water capacity of water bodies and waterways, the regulation of waterways by flood control structures, and the preservation of flood storage areas and wetlands. As more land is developed, more flood storage is demanded of the town's water bodies and waterways. The Town currently addresses this problem with a variety of mitigation tools and strategies. Flood-related regulations and strategies are included in the Town's general bylaws, zoning by-law, and subdivision regulations. This includes a floodplain ordinance, as well as a stormwater ordinance that follows state standards. Each large development requires a stormwater management plan to keep stormwater on-site. In 2016 the Town was engaged with a consultant to re-evaluate the boundaries of the flood zone to eliminate any discrepancies with FEMA; the effort is funded through the Capital Improvements Plan. The floodplain is administered by the Conservation Commission and the Planning Board.

Amherst also has a successful track record in preserving open space, particularly along flood zones in South Amherst. Land conservation is an ongoing pursuit in Amherst by the Conservation Commission, and also by the Kestrel Land Trust, a non-profit organization.

Infrastructure like dams and culverts are also in place to manage the flow of water in Amherst.

Severe Snowstorms / Ice Storms

Winter storms can be especially challenging for emergency management personnel. The Massachusetts Emergency Management Agency (MEMA) serves as the primary coordinating entity in the statewide management of all types of winter storms and monitors the National Weather Service (NWS) alerting systems during periods when winter storms are expected. Even though the storm has usually been forecast, there is no certain way for predicting its length, size or severity. Therefore, mitigation strategies must focus on preparedness prior to a severe snow/ice storm.

The Town's current mitigation tools and strategies focus on preparedness, with many regulations and standards established based on safety during storm events. The Town has a Local Emergency Operations Plan and a Continuity of Operations Plan is underway with MEMA.

To the extent that some of the damages from a winter storm can be caused by flooding, flood protection mitigation measures also assist with severe snowstorms and ice storms.

Hurricanes

Hurricanes provide the most lead warning time of all identified hazards, because of the relative ease in predicting the storm's track and potential landfall. MEMA assumes "standby status" when a hurricane's location is 35 degrees North Latitude (Cape Hatteras) and "alert status" when the storm reaches 40 degrees North Latitude (Long Island). Even with significant warning, hurricanes can do significant damage – both due to flooding and severe wind.

The flooding associated with hurricanes can be a major source of damage to buildings, infrastructure and a potential threat to human lives. Flood protection measures can thus also be considered hurricane mitigation measures. The high winds that often accompany hurricanes can also damage buildings and infrastructure, similar to tornadoes and other strong wind events.

In Amherst the building code is stringently enforced, including areas that protect against high winds. The Town also has a tree warden that attends to preventative tree trimming as needed.

Severe Thunderstorms / Winds / Tornadoes

Most damage from tornadoes and severe thunderstorms come from high winds that can fell trees and electrical wires, generate hurtling debris and, possibly, hail. According to the Institute for Business and Home Safety, the wind speeds in most tornadoes are at or below design speeds that are used in current building codes, making strict adherence to building codes a primary mitigation strategy, which is the case in Amherst. In addition, current land development regulations, such as restrictions on the height of telecommunications towers, can also help prevent wind damages.

Wildfires / Brushfires

Wildfire and brushfire mitigation strategies involve educating people about how to prevent fires from starting, as well as controlling burns within the town. The Town conducts Senior Safe and Safe fire prevention programs for the elderly and school-aged populations. In addition, the Town imposes stricter standards on allowing burns during windy days than the state to ensure planned fires remain under control.

Earthquakes

Although there are five mapped seismological faults in Massachusetts, there is no discernible pattern of previous earthquakes along these faults nor is there a reliable way to predict future earthquakes along these faults or in any other areas of the state. Consequently, earthquakes are arguably the most difficult natural hazard for which to plan.

Most buildings and structures in the state were constructed without specific earthquake resistant design features. The Town enforces current building codes for new development. In addition, earthquakes precipitate several potential devastating secondary effects such as building collapse, utility pipeline rupture, water contamination, and extended power outages. Therefore, many of the mitigation efforts for other natural hazards identified in this plan may be applicable during the Town's recovery from an earthquake.

Dam Failure

Dam failure is a highly infrequent occurrence, but a severe incident could prove catastrophic. In addition, dam failure most often coincides with flooding, so its impacts can be multiplied, as the additional water has nowhere to flow. The only mitigation measures currently in place are the state regulations governing the construction, inspection, and maintenance of dams. This is managed through the Office of Dam Safety at the Department of Conservation and Recreation.

Drought

Although Massachusetts does not face extreme droughts like many other places in the country, it is susceptible to dry spells and drought. Drought can most likely be effectively mitigated in regions like the Pioneer Valley if measures are put into place, such as ensuring that groundwater is recharged. In support of this, the Town of Amherst's master plan encourages the siting of development in existing town centers, rather than on the undeveloped outskirts of town. In addition, the Town of Amherst has a Water Supply Protection Committee that works with town staff to ensure the protection of the town's aquifer as well as other water supply issues.

Extreme Temperatures

The Town of Amherst has a large amount of rental properties, which are more subject to damage due to extreme temperatures. Education about proper maintenance of pipes in winter weather and other related issues to the appropriate audience may be possible through the new (2013) rental registration bylaw. Challenges to reaching renter populations directly may be language barriers, as well as the transient nature of students that often occupy rental properties.

General Capabilities

The Town of Amherst maintains a Capital Improvement Plan to avoid overrides. It collects fees for water and sewer, but not stormwater. However, the Town has developed good relationships with the development community, and in the past has entered into agreements for upgrades to infrastructure (such as culverts) with the private sector in conjunction with development projects. The Town is able to incur debt through general obligation bonds, and receives Community Development Block Grants. These sources could potentially, but not likely, be utilized for hazard mitigation activities. State land conservation grants are also used for land protection, which can assist in hazard mitigation, particularly for flooding.

There are no development impact fees, and there is no centralized grant writer.

The Town's police, fire, and highway departments are signatories to a statewide mutual aid compact (signed 2014). The Town also employs a Reverse 911 system and utilizes social media and its website for notices about severe weather or other emergency events. A challenge in communicating with residents is the large amount of languages spoken in Amherst, and sometimes an unfamiliarity with natural hazards common to New England due to the large amount of foreign immigrants and students and residents from other areas of the country.

Existing Mitigation Strategies and Capabilities

The Town of Amherst has a list of existing mitigation strategies that were in place prior to the development of the first Hazard Mitigation Plan in 2010, as well as a set of prioritized mitigation strategies to be pursued in the future. Strategies that were previously completed prior to 2010, or completed between 2010 and 2015, are listed below and noted under the “effectiveness” column.

As part of the development of this plan update in 2015, the Hazard Mitigation Workgroup evaluated each mitigation strategy to determine its effectiveness and whether any improvements could be made.

Action Item Description	Hazards Mitigated	Area Covered	Effectiveness	Potential Changes
Replace top priorities on culvert replacement list.	Floods	Town wide	Not effective.	None. Delete.
Ensure dam owners realize their responsibility to inspect the dams regularly.	Dam Failure	Areas with dams.	Effective. Conversations are informal but ongoing.	None.
Implement the goals and strategies of the Amherst Open Space and Recreation Plan dealing with protection of floodplain, forests, and farmland.	Floods	Town wide, especially in flood prone areas (Lawrence Swamp) and forests	Effective. Strategy is now an ongoing capability. Land protection continues to be pursued, and land management plans are being written for existing protected properties.	None.
Evaluate whether to become a part of FEMA’s Community Rating System.	Floods	Flood zones	Effective. Evaluation is still underway.	None.

Educate citizens living in the floodplain about the NFIP.	Floods	Flood zones	Not effective. Most homeowners already educated by their banks.	None. Additional awareness of the NFIP will come through the flood district re-mapping process currently underway (2016). Delete strategy.
Work with Western Mass Electric Company to facilitate the underground placement of new utility lines in general and existing utility lines in locations where repetitive outages occur (as applicable).	Thunderstorms / Severe Wind	Triangle & East Pleasant Streets Spring Street Areas of new development	Effective. Some burial of lines completed with MassWorks grant (Triangle & E. Pleasant Streets). New developments are required to place utility lines underground.	Determine areas of repetitive outages to prioritize underground placement.
Include maximum street grade standards in subdivision regulations.	Floods Snowstorms	Town wide	Somewhat effective. Street grade regulations exist but need to be updated.	Update street grade standards in subdivision regulations.
Determine if existing generators at shelters are effective, replace if not effective.	All hazards	Town wide	Effective. Police station (EOC) generator is due to be replaced. But all other shelters are regional.	None.
Participate in the creation of a Regional Debris Management Plan.	Floods Thunderstorms / Severe Wind	Town wide	Not effective. No regional debris management plan was developed. FEMA has developed agreements.	Delete
Evaluate critical facilities to determine if they are earthquake resistant.	Earthquakes	Town wide	Not effective. No action taken. Retrofitting critical facilities to current seismic code is not cost effective.	Delete.
Increase enforcement of restrictions prohibiting residents from plowing snow into the road.	Snowstorms Floods	Town wide	Not effective. Complaint-driven strategy. Difficult to enforce, and not a big problem.	Delete.

Identify sources of funding for dam safety inspections.	Dam Failure	Town wide	Effective. Funding was identified for the water enterprise dams.	Complete. Delete.
In regards to the Amherst Open Space and Recreation Plan, implement the goals and strategies dealing with protection of waterbodies and forestland.	Flooding	Town wide	Effective.	Delete. Duplicative with similar strategy above.
Create Water Conservation Guidelines to use as an educational tool for Town residents.	Drought	Town wide	Somewhat effective. Information sent every summer with compliance mailings.	Provide more explicit water conservation information on town website.
Revise Watershed Protection District definitions for clarification – utilize DEP model.	Drought	Watershed Protection Zones	Effective. A new zone complete. Effective. Implemented near Atkins Reservoir.	Complete. Delete.

Deleted Mitigation Strategies

Several mitigation strategies listed in the 2010 version of the Amherst Hazard Mitigation Plan have been removed in this 5-year update. Strategies were deleted for one of two reasons:

- 1) They have been determined as no longer useful for mitigating a hazard.
- 2) They have been determined to be over-generalized and in need of being replaced by a more specific mitigation strategy.

Description	Hazards Mitigated	Responsible Agency	Reason for Deletion
Replace top priorities on culvert replacement list.	Floods	DPW	No major flooding issues.
Determine if existing generators at shelters are effective, replace if not effective.	All hazards	Police/EMD	Completed.
Evaluate critical facilities to determine if they are earthquake resistant.	Earthquakes	Building Dept.	Not cost effective to retrofit facilities to current seismic code.
Increase enforcement of restrictions prohibiting residents from plowing snow into the road.	Police Dept.	Police Dept.	Not a large problem, and difficult to enforce.
Educate citizens living in the floodplain about the NFIP.	Conservation Commission Floodplain Administrator	Conservation Commission Floodplain Administrator	Citizens learn through their banks, and awareness will be increased through 2016 re-mapping of Flood Conservation District by the Town.

Description	Hazards Mitigated	Responsible Agency	Reason for Deletion
In regards to the Amherst Open Space and Recreation Plan, implement the goals and strategies dealing with protection of waterbodies and forestland.	Flooding	Conservation Commission	Duplicative with another capability
Implement the goals and strategies of the Amherst Open Space and Recreation Plan dealing with protection of floodplain, forests, and farmland.	Flooding	Conservation Commission	Too general; to be revised.

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Previously Identified and New Strategies

Several of the action items previously identified in the 2008 Hazard Mitigation Plan are currently continuing, either because they require more time to secure funding or their construction process is ongoing. In addition, the Hazard Mitigation Workgroup identified several new strategies that are also being pursued. These new strategies are based on experience with currently implemented strategies, as well as the hazard identification and risk assessment in this plan.

Prioritization Methodology

The Amherst Hazard Mitigation Planning Workgroup reviewed and prioritized a list of previously identified and new mitigation strategies using the following criteria:

Application to multiple hazards – Strategies are given a higher priority if they assist in the mitigation of several natural hazards.

Time required for completion – Projects that are faster to implement, either due to the nature of the permitting process or other regulatory procedures, or because of the time it takes to secure funding, are given higher priority.

Estimated benefit – Strategies which would provide the highest degree of reduction in loss of property and life are given a higher priority. This estimate is based on the Hazard Identification and Analysis Chapter, particularly with regard to how much of each hazard's impact would be mitigated.

Cost effectiveness – in order to maximize the effect of mitigation efforts using limited funds, priority is given to low-cost strategies. For example, regular tree maintenance is a relatively low-cost operational strategy that can significantly reduce the length of time of power outages during a winter storm. Strategies that have identified potential funding streams, such as the Hazard Mitigation Grant Program, are also given higher priority.

Eligibility Under Hazard Mitigation Grant Program – The Hazard Mitigation Grant Program (HMGP) provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster. Funding is made available through FEMA by the Massachusetts Emergency Management Agency. Municipalities apply for grants to fund specific mitigation projects under MEMA requirements

The following categories are used to define the priority of each mitigation strategy:

Low – Strategies that would not have a significant benefit to property or people, address only one or two hazards, or would require funding and time resources that are impractical

Medium – Strategies that would have some benefit to people and property and are somewhat cost effective at reducing damage to property and people

High – Strategies that provide mitigation of several hazards and have a large benefit that warrants their cost and time to complete

Very High – extremely beneficial projects that will greatly contribute to mitigation of multiple hazards and the protection of people and property. These projects are also given a numeric ranking within the category.

Cost Estimates

Each of the following implementation strategies is provided with a cost estimate. Projects that already have secured funding are noted as such. Where precise financial estimates are not currently available, categories were used with the following assigned dollar ranges:

- **Low** – cost less than \$50,000
- **Medium** – cost between \$50,000 – \$100,000
- **High** – cost over \$100,000

Cost estimates take into account the following resources:

- Town staff time for grant application and administration (at a rate of \$25 per hour)
- Consultant design and construction cost (based on estimates for projects obtained from town and general knowledge of previous work in town)
- Town staff time for construction, maintenance, and operation activities (at a rate of \$25 per hour)

Project Timeframe

Each strategy is provided with an estimated length of time it will take for implementation. Where funding has been secured for the project, a specific future date is provided for when completion will occur. However, some projects do not currently have funding and thus it is difficult to know exactly when they will be completed. For these projects, an estimate is provided for the amount of time it will take to complete the project once funding becomes available.

New Mitigation Strategies for 2016

Mitigation Type	Description	Status	Hazards Mitigated	Responsible Agency	Priority	Cost	Funding Source	Timeframe
New	Identify potential land acquisition possibilities in areas subject to natural hazard impacts such as floods, or that provide natural mitigation services (such as wetlands), with the potential added benefit of creating wildlife corridors and restoring habitat.	Land acquisition is ongoing as opportunities and funding arise.	Floods Hurricanes Severe Thunderstorms / Wind	Conservation Commission Planning Dept.	High	Medium	State grants (LAND, PARC, etc.) CPA HMPG	5 years
New	Revise site plan review criteria to incorporate green infrastructure, LID, and other best management stormwater practices.	Occurring informally already, but practices are not codified. Goal is to require that stormwater be addressed on-site for all new development.	Floods Hurricanes Drought Extreme Temperatures	Planning Dept. Highway Dept.	Medium	Low	Town funds	3-5 years
New	Link flood hazard mitigation with new EPA MS4 stormwater permit, such as identifying beneficial areas for green infrastructure.	Not started.	Floods	DPW	Low	Low-Medium	Town funds Private development	5 years

New Mitigation Strategies for 2016

Mitigation Type	Description	Status	Hazards Mitigated	Responsible Agency	Priority	Cost	Funding Source	Timeframe
New	Conduct outreach to populations that may be unfamiliar with winter weather hazards (frozen pipes, ventilation issues), potentially by partnering with schools. Identify interpreters in the community that can help translate information in the event of a severe winter event.	Some winter weather safety and preparation information is available on the town website, but not in the variety of languages spoken in Amherst.	Snowstorms / ice storms	Fire/Police/EMD	Medium	Low	Town funds	1-2 years
New	Identify vulnerability to cellular infrastructure in town to natural hazards, and identify alternative methods of mass communication in the event of natural hazard emergencies.	Not yet started.	Snowstorms / ice storms Hurricanes Thunderstorms / severe wind	Fire/Police/EMD	Low	Low	Staff time EMPG	1-2 years
New	Review existing town evacuation plans to identify vulnerabilities to various natural hazards and develop alternative plans as needed for different natural hazard scenarios.	Evacuation plans are already in place, but have not been evaluated for vulnerabilities to different types of natural hazards.	All hazards	Fire/Police/EMD	Low	Low	Staff time	1 year

6: PLAN REVIEW, EVALUATION, IMPLEMENTATION, AND ADOPTION

Plan Adoption

Upon completion, copies of the updated Hazard Mitigation Plan for the Town of Amherst were distributed to the various Town boards for their review and comment. A public meeting was held on March 29, 2016, in order to solicit comments. The Hazard Mitigation Plan was formally approved by the Select Board and forwarded to the Massachusetts Emergency Management Agency (MEMA) and the Federal Emergency Management Agency (FEMA) for their review. Upon receiving conditional approval of the plan by FEMA, the plan was presented to the Town's Select Board and adopted.

Plan Implementation

The implementation of this plan began upon its formal adoption by the Amherst Select Board and approval by MEMA and FEMA. Those town departments and boards responsible for ensuring the development of policies, bylaw revisions, and programs as described in Sections 5 and 6 of this plan will be notified of their responsibilities immediately following approval. The Town's Hazard Mitigation Workgroup will oversee the implementation of the plan.

Incorporation with Other Planning Documents

Existing plans, studies, reports and technical information were incorporated throughout the planning process. This included a review and incorporation of significant information from the following key documents:

- *Comprehensive Planning Study: Defining Village Boundaries and Open Space Preservation Strategies*
- *Comprehensive Emergency Management Plan*
- *Amherst Open Space and Recreation Plan* – this Plan was used to identify the natural context within which the Amherst mitigation planning would take place. This proved useful insofar as it identified water bodies, rivers, streams, infrastructure components (i.e. water and sewer, or the lack thereof), as well as population trends. This was incorporated to ensure that the Town's mitigation efforts would be sensitive to the surrounding environment. During the OSRP 2009 update, the Town used the work of the Hazard Mitigation Plan to incorporate identified hazard areas into open space and recreation planning.
- The proposed *2015 Community Development Strategy*—this Plan was used to identify any action items that might prove successful, based on previous planning efforts.
- *Amherst Zoning Bylaws* - The Town's Zoning Bylaws were used to identify those actions that the Town is already taking that are reducing the potential impacts of a natural hazard (i.e. floodplain regulations) to avoid duplicating existing successful efforts.
- *Subdivision Rules and Regulations*
- *Commonwealth of Massachusetts Hazard Mitigation Plan* - This plan was used to insure that the Town's Pre-Disaster Mitigation Plan was consistent with the State's Plan.

As the Town of Amherst creates new and updates existing planning documents, this plan and its implementation strategies will be incorporated as applicable. This process will be ongoing and part of the standard practice of reviewing other plans to ensure consistency between plans.

While it is the understanding of the Hazard Mitigation Committee that the previous Hazard Mitigation plan has been integrated into other planning mechanisms in the Town, the committee did not track this work. The committee is committed to doing so going forward.

Plan Monitoring and Evaluation

The measure of success of the Amherst Hazard Mitigation Plan will be the number of identified mitigation strategies implemented. In order for the town to become more disaster resilient and better equipped to respond to natural disasters, there must be a coordinated effort between elected officials, appointed bodies, town employees, regional and state agencies involved in disaster mitigation, and the general public.

The Town's Emergency Management Director or his designee will call meetings of all responsible parties to review plan progress on an annual basis (in coordination with the Police Department's Emergency Plan each March) in each of the following years: 2017, 2018, 2019, 2020, 2021 and as needed (*i.e.*, following a natural disaster). The public will be notified of these meetings in advance through a posting of the agenda at Town Hall. Responsible parties identified for specific mitigation actions will be asked to submit their reports in advance of the meeting. Meetings will entail the following actions:

- Review events of the year to discuss and evaluate major issues, effectiveness of current mitigation, and possible mitigation for future events.
- Assess how the mitigation strategies of the plan can be integrated with other Town plans and operational procedures, including the Zoning Bylaw and Emergency Management Plan.
- Review and evaluate progress toward implementation of the current mitigation plan based on reports from responsible parties.
- Amend current plan to improve mitigation practices.

Following these discussions, it is anticipated that the Workgroup may decide to reassign the roles and responsibilities for implementing mitigation strategies to different town departments and/or revise the goals and objectives contained in the plan. The Workgroup will review and update the Hazard Mitigation Plan every five years. The next updated plan will be submitted to MEMA and FEMA in the spring of 2021.

CERTIFICATE OF ADOPTION
TOWN OF AMHERST, MASSACHUSETTS
SELECTBOARD
A RESOLUTION ADOPTING THE
AMHERST HAZARD MITIGATION PLAN Update 2016

WHEREAS, the Town of Amherst established a Committee to prepare the Amherst Hazard Mitigation Plan Update 2016; and

WHEREAS, public planning meetings were held on January 26, 2016 and March 29, 2016 regarding the review of the Amherst Hazard Mitigation Plan Update 2016; and

WHEREAS, the Amherst Hazard Mitigation Plan Update 2016 contains several potential future projects to mitigate hazard damage in the Town of Amherst; and

WHEREAS, the Federal Emergency Management Agency has conditionally approved the Town's updated Hazard Mitigation Plan.

NOW, THEREFORE BE IT RESOLVED that the Selectboard of Amherst adopts the Amherst Hazard Mitigation Plan Update 2016.

ADOPTED AND SIGNED this _____, _____

Selectboard
Town of Amherst

ATTEST

7: APPENDICES

Appendix A – Technical Resources

1) Agencies

Massachusetts Emergency Management Agency (MEMA).....	508/820-2000
Hazard Mitigation Section	617/626-1356
Federal Emergency Management Agency (FEMA).....	617/223-4175
MA Regional Planning Commissions:	
Berkshire Regional Planning Commission (BRPC).....	413/442-1521
Cape Cod Commission (CCC).....	508/362-3828
Central Massachusetts Regional Planning Commission (CMRPC).....	508/693-3453
Franklin Regional Council of Governments (FRCOG).....	413/774-3167
Martha’s Vineyard Commission (MVC).....	508/693-3453
Merrimack Valley Planning Commission (MVPC).....	978/374-0519
Metropolitan Area Planning Council (MAPC).....	617/451-2770
Montachusett Regional Planning Commission (MRPC).....	978/345-7376
Nantucket Planning and Economic Development Commission (NP&EDC).....	508/228-7236
Northern Middlesex Council of Governments (NMCOG).....	978/454-8021
Old Colony Planning Council (OCPC).....	508/583-1833
Pioneer Valley Planning Commission (PVPC).....	413/781-6045
Southeastern Regional Planning and Economic Development District (SRPEDD).....	508/823-1803
MA Board of Building Regulations & Standards (BBRS).....	617/227-1754
MA Coastal Zone Management (CZM).....	617/626-1200
DCR Water Supply Protection.....	617/626-1379
DCR Waterways.....	617/626-1371
DCR Office of Dam Safety.....	508/792-7716
DFW Riverways.....	617/626-1540
MA Dept. of Housing & Community Development.....	617/573-1100
Woods Hole Oceanographic Institute.....	508/457-2180
UMass-Amherst Cooperative Extension.....	413/545-4800
National Fire Protection Association (NFPA).....	617/770-3000
New England Disaster Recovery Information X-Change (NEDRIX – an association of private companies & industries involved in disaster recovery planning).....	781/485-0279
MA Board of Library Commissioners.....	617/725-1860
MA Highway Dept., District 2.....	413/582-0599
MA Division of Marine Fisheries.....	617/626-1520
MA Division of Capital & Asset Management (DCAM).....	617/727-4050
University of Massachusetts/Amherst.....	413/545-0111
Natural Resources Conservation Services (NRCS).....	413/253-4350
MA Historical Commission.....	617/727-8470
U.S. Army Corps of Engineers.....	978/318-8502
Northeast States Emergency Consortium, Inc. (NSEC).....	781/224-9876

National Oceanic and Atmospheric Administration: National Weather Service;
 Taunton, MA.....508/824-5116
 US Department of the Interior: US Fish and Wildlife Service.....413/253-8200
 US Geological Survey.....508/490-5000

2) Mitigation Funding Resources

404 Hazard Mitigation Grant Program (HMGP)Massachusetts Emergency Management Agency
 406 Public Assistance and Hazard MitigationMassachusetts Emergency Management Agency
 Community Development Block Grant (CDBG).....DHCD, also refer to RPC
 Dam Safety Program.....MA Division of Conservation and Recreation
 Disaster Preparedness Improvement Grant (DPIG)Massachusetts Emergency Management Agency
 Emergency Generators Program by NESEC‡Massachusetts Emergency Management Agency
 Emergency Watershed Protection (EWP) Program.....USDA, Natural Resources Conservation
 Service Flood Mitigation Assistance Program (FMAP).....Massachusetts Emergency Management Agency
 Flood Plain Management Services (FPMS).....US Army Corps of Engineers
 Mitigation Assistance Planning (MAP).....Massachusetts Emergency Management Agency
 Mutual Aid for Public Works.....Western Massachusetts Regional Homeland Security Advisory Council
 National Flood Insurance Program (NFIP) †Massachusetts Emergency Management Agency
 Power of Prevention Grant by NESEC‡Massachusetts Emergency Management Agency
 Roadway Repair & Maintenance Program(s).....Massachusetts Highway Department
 Section 14 Emergency Stream Bank Erosion & Shoreline ProtectionUS Army Corps of Engineers
 Section 103 Beach Erosion.....US Army Corps of Engineers
 Section 205 Flood Damage Reduction.....US Army Corps of Engineers
 Section 208 Snagging and ClearingUS Army Corps of Engineers
 Shoreline Protection Program.....MA Department of Conservation and Recreation
 Various Forest and Lands Program(s).....MA Department of Environmental Protection
 Wetlands ProgramsMA Department of Environmental Protection

‡NESEC – Northeast States Emergency Consortium, Inc. is a 501(c) (3), not-for-profit natural disaster, multi-hazard mitigation and emergency management organization located in Wakefield, Massachusetts. Please, contact NESEC for more information.

† Note regarding National Flood Insurance Program (NFIP) and Community Rating System (CRS): The National Flood Insurance Program has developed suggested floodplain management activities for those communities who wish to more thoroughly manage or reduce the impact of flooding in their jurisdiction. Through use of a rating system (CRS rating), a community’s floodplain management efforts can be evaluated for effectiveness. The rating, which indicates an above average floodplain management effort, is then factored into the premium cost for flood insurance policies sold in the community. The higher the rating achieved in that community, the greater the reduction in flood insurance premium costs for local property owners. MEMA can provide additional information regarding participation in the NFIP-CRS Program.

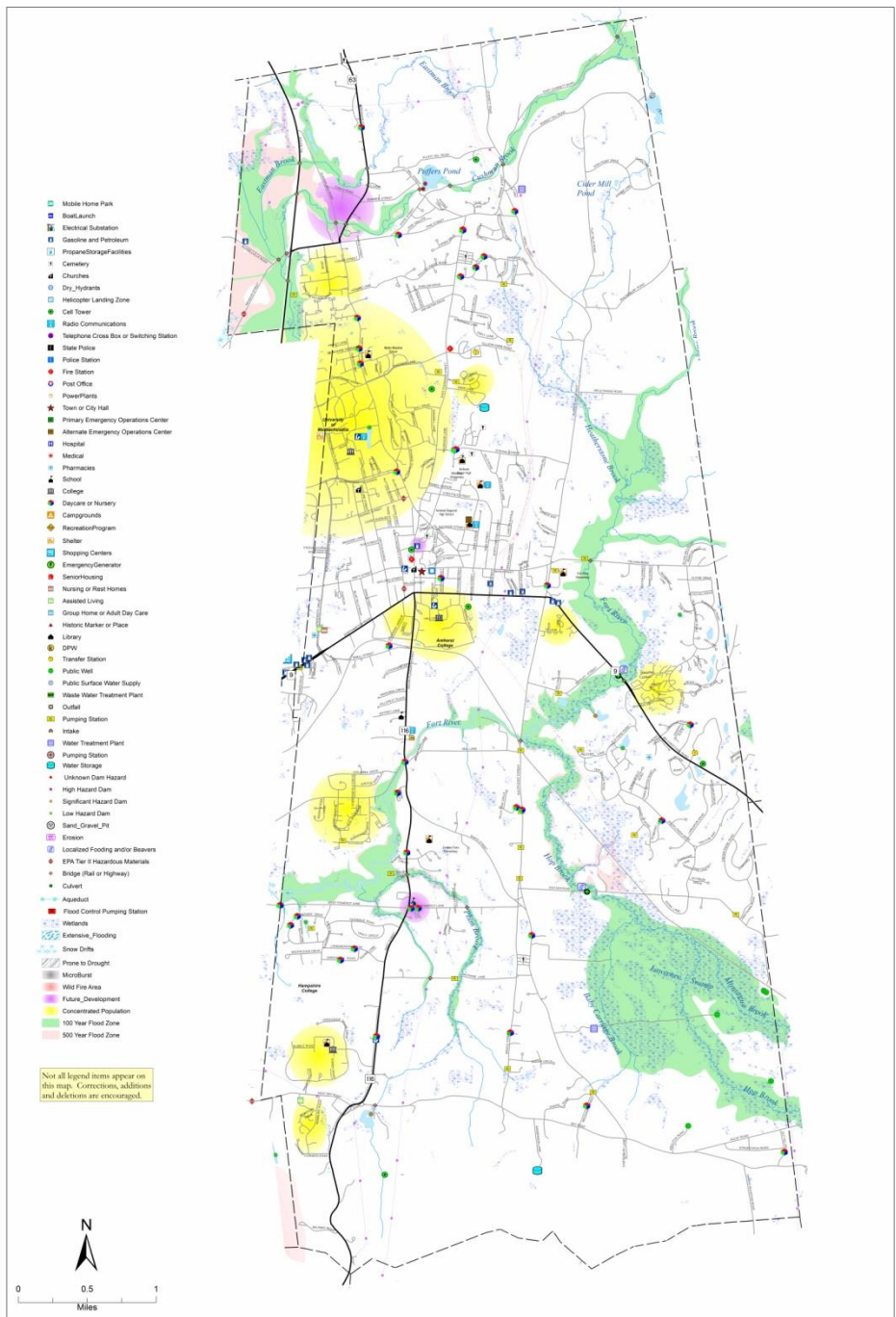
3) Internet Resources

Sponsor	Internet Address	Summary of Contents
Natural Hazards Research Center, U. of Colorado	http://www.colorado.edu/litbase/hazards/	Searchable database of references and links to many disaster-related websites.
Atlantic Hurricane Tracking Data by Year	http://wxc.eas.purdue.edu/hurricane	Hurricane track maps for each year, 1886 – 1996
National Emergency Management Association	http://nemaweb.org	Association of state emergency management directors; list of mitigation projects.
NASA – Goddard Space Flight Center “Disaster Finder:	http://www.gsfc.nasa.gov/ndrd/disaster/	Searchable database of sites that encompass a wide range of natural disasters.
NASA Natural Disaster Reference Database	http://ltpwww.gsfc.nasa.gov/ndrd/main/html	Searchable database of worldwide natural disasters.
U.S. State & Local Gateway	http://www.statelocal.gov/	General information through the federal-state partnership.
National Weather Service	http://nws.noaa.gov/	Central page for National Weather Warnings, updated every 60 seconds.
USGS Real Time Hydrologic Data	http://h20.usgs.gov/public/realtime.html	Provisional hydrological data
Dartmouth Flood Observatory	http://www.dartmouth.edu/artsci/geog/floods/	Observations of flooding situations.
FEMA, National Flood Insurance Program, Community Status Book	http://www.fema.gov/fema/csb.html	Searchable site for access of Community Status Books
Florida State University Atlantic Hurricane Site	http://www.met.fsu.edu/explores/tropical.html	Tracking and NWS warnings for Atlantic Hurricanes and other links
The Tornado Project Online	http://www.tornadoobject.com/	Information on tornadoes, including details of recent impacts.
National Severe Storms Laboratory	http://www.nssl.uoknor.edu/	Information about and tracking of severe storms.
Independent Insurance Agents of America IIAA Natural Disaster Risk Map	http://www.iaa.iix.com/ndcmap.html	A multi-disaster risk map.
Earth Satellite Corporation	http://www.earthsat.com/	Flood risk maps searchable by state.
USDA Forest Service Web	http://www.fs.fed.us/land	Information on forest fires and land management.

Appendix B – List of Acronyms

BOH	Board of Health
BOS	Select Board
CDBG	Community Development Block Grant
CEM Plan	Comprehensive Emergency Management Plan
CIS	Community Information System
Con Com	Conservation Commission
CRS	Community Rating System
DCR	Massachusetts Department of Conservation and Recreation
DEP	Massachusetts' Department of Environmental Protection
EMD	Emergency Management Director
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FIRM	Flood Insurance Rate Map
FMA	Flood Mitigation Assistance Program
HAZMAT	Hazardous Materials
HMGP	Hazard Mitigation Grant Program
LEPC	Local Emergency Planning Committee
MEMA	Massachusetts Emergency Management Agency
NFIP	National Flood Insurance Program
NWS	National Weather Service
PVPC	Pioneer Valley Planning Commission
SFHA	Special Flood Hazard Area
TRI	Toxics Release Inventory
WMECO	Western Massachusetts Electric Company

Appendix C – Past & Potential Hazards/Critical Facilities Map



Amherst, Massachusetts
Predisaster Mitigation Plan
Past & Present Hazards with Critical Facilities
 March, 2016



Appendix D – Documentation of the Planning Process

Amherst Hazard Mitigation Committee Meeting #1 Agenda

**Amherst Town Hall
December 21, 2015, 3 p.m. – 5 p.m.**

1. Introductions/Administrative
 - a. Affirm local Hazard Committee membership
 - b. Review in-kind match and reporting procedure
2. Overview of Hazard Mitigation Planning Process
 - a. Background on Hazard Mitigation Planning
 - b. Planning process and requirements
 - i. 3-5 committee meetings
 - ii. 2 public outreach meetings
 - iii. MEMA / FEMA review and conditional approval
 - iv. Select Board adoption
 - v. FEMA final approval
 - c. Schedule for committee and public outreach meetings
3. Review of Chapter 1: Planning Process
4. Review of Chapter 2: Local Profile
5. Review of Chapter 3: Hazard Identification and Risk Assessment

**Amherst Hazard Mitigation Committee
Meeting #2 Agenda**

**Amherst Town Hall
January 26, 2016 3 p.m. – 5 p.m.**

6. Highlights of changes made since first meeting (chapters 1-3)
7. Review of Chapter 4: Critical Facilities and Critical Facilities/Hazards Map
8. Review of Chapter 5: Hazard Identification and Risk Assessment

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**Amherst Hazard Mitigation Plan Update
Committee Meeting #3**

Thursday, February 18, 2016

**3-5 PM, First Floor Conference Room
Amherst Town Hall**

1. Review of updates made to plan since last meeting (Sections 3-4)
2. Review and update of Section 5 – Hazard Mitigation Capabilities and Strategies
3. Review and update of Section 6 – Plan Review, Implementation, Evaluation, and Adoption
4. Set date for public engagement meeting #2

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Catalyst for Regional Progress

PVPC

Timothy W. Brennan, Executive Director

MEDIA RELEASE

CONTACT: Jaimye Bartak, PVPC Senior Planner, (413) 781-6045 or jbartak@pvpc.org
Chief Tim Nelson, Amherst Fire Chief, (413) 259-3082 or nelson@amherstma.gov

FOR IMMEDIATE RELEASE
January 12, 2016

Town of Amherst to Hold Public Engagement Event for Hazard Mitigation Plan Update

Amherst residents, businesses, and surrounding community representatives are invited to provide comments on the update of the Town of Amherst Hazard Mitigation Plan on January 26, 2016, at 5 pm at the Town Meeting Room, 4 Boltwood Avenue. The plan is being updated by the Town with assistance from the Pioneer Valley Planning Commission and is funded by the Federal Emergency Management Agency (FEMA) and the Massachusetts Emergency Management Agency (MEMA). All members of the public, representatives from surrounding communities and other interested parties are welcome to attend the event.

The meeting will include an overview of the hazard mitigation planning process and a discussion of existing mitigation initiatives addressing natural hazards in Amherst. Municipal officials and PVPC staff will be available to answer questions and listen to comments on the draft plan.

This planning effort is being undertaken to help the Town of Amherst assess the risks faced from natural hazards, identify action steps that can be taken to prevent damage to property and loss of life, and prioritize funding for mitigation efforts. A mitigation action is any action taken to reduce or eliminate the long-term risk to human life and property from hazards.

For more information, please contact PVPC's Jaimye Bartak at jbartak@pvpc.org or (413) 781-6045.

**Amherst Hazard Mitigation Plan Update
Public Engagement Event #1**

**Amherst Town Hall – Town Room
January 26, 2016, 5 p.m.**

1. Overview and benefits of hazard mitigation
2. Plan development process
3. Identified hazards and vulnerability assessment
4. Next steps, questions, and discussion

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Catalyst for Regional Progress

PVPC

Timothy W. Brennan, Executive Director

MEDIA RELEASE

CONTACT: Jaimye Bartak, PVPC Senior Planner, (413) 781-6045 or jbartak@pvpc.org
Chief Tim Nelson, Amherst Fire Chief, (413) 259-3082 or
nelson@amherstma.gov

FOR IMMEDIATE RELEASE
March 16, 2016

Town of Amherst to Hold Rescheduled Second Public Engagement Event for Hazard Mitigation Plan Update

Amherst residents, businesses, and surrounding community residents and representatives are invited to provide comments on the update of the Town of Amherst Hazard Mitigation Plan on Tuesday, March 29, 2016, at 5 pm in the Town Room, 4 Boltwood Avenue. This is a rescheduling of the March 15 event, which was postponed.

The purpose of the 2016 Hazard Mitigation Plan Update is to identify and assess Amherst's natural hazard risks and determine how to best minimize and manage them. A mitigation action is any action taken to reduce or eliminate the long-term risk to human life and property from hazards. Public participation and input is essential!

The meeting will include a discussion of existing mitigation initiatives addressing natural hazards in Amherst, and the strategies as currently proposed by the committee. Municipal staff and PVPC staff will be available to answer questions and listen to comments on the draft plan. The meeting provides an opportunity for you to share your opinions and participate in the mitigation planning process. A draft of the plan is available for review on the PVPC website.

The plan is being updated by the Town with assistance from the Pioneer Valley Planning Commission and is funded by the Federal Emergency Management Agency (FEMA) and the Massachusetts Emergency Management Agency (MEMA).

Upon completion, the plan will be presented to the Town of Amherst for adoption and submitted to Massachusetts Emergency Management Agency (MEMA) and Federal Emergency Management Agency (FEMA) for review and approval. A FEMA approved plan makes the community eligible for federal and state mitigation grant funding.

For more information, please contact PVPC's Jaimye Bartak at jbartak@pvpc.org or (413) 781-6045.

**Amherst Hazard Mitigation Plan Update
Public Engagement Event #2**

**Amherst Town Hall – Town Room
March 29, 2016, 5 p.m.**

1. Overview of hazard mitigation
2. Content of Amherst Hazard Mitigation Plan
 - a. Hazard identification and risk assessment
 - b. Critical infrastructure
 - c. Existing strategies for mitigating hazards
 - d. Proposed strategies for mitigating hazards
3. Question and comment period

DRAFT