

THE TOWN OF LUDLOW, MASSACHUSETTS



2016 HAZARD MITIGATION PLAN UPDATE

MISSION

**TO REDUCE OR ELIMINATE THE LOSS OF LIFE, PROPERTY AND
GOVERNMENT DISRUPTION TO ALL NATURAL HAZARDS.**

2016 Hazard Mitigation Plan Update

Prepared by:

Ludlow Hazard Mitigation Planning Committee



The Pioneer Valley Planning Commission

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ACKNOWLEDGEMENTS

LUDLOW HAZARD MITIGATION COMMITTEE

Chief Mark Babineau – Ludlow Fire Department

Ken Batista – Department of Public Works

Sergeant David Belanger – Ludlow Police Department

Lieutenant Joseph Metcalf – Ludlow Police Department

Lieutenant Michael Brennen – Ludlow Police Department

Justin Laravee – Building Commissioner

Deputy James Machado – Ludlow Fire Department

Captain Ryan Pease – Ludlow Fire Department

Doug Stefancik – Planning Department

Ellie Villano – Town Administrator

The Ludlow Selectboard offers thanks to the Massachusetts Emergency Management Agency (MEMA) for developing the Commonwealth of Massachusetts 2013 State Hazard Mitigation Plan which served as a model for this plan.



Town of Ludlow, Massachusetts
Office of the Board of Selectmen
Ellie Villano, Town Administrator

CERTIFICATE OF ADOPTION
TOWN OF LUDLOW, MASSACHUSETTS
BOARD OF SELECTMEN

A RESOLUTION ADOPTING THE

TOWN OF LUDLOW 2016 HAZARD MITIGATION PLAN UPDATE

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

WHEREAS, the Town of Ludlow participated in the development of the Town of Ludlow **2016 Hazard Mitigation Plan Update**;

and WHEREAS, the Town of Ludlow **2016 Hazard Mitigation Plan Update** contains several potential future projects to mitigate potential impacts from natural hazards in the Town of Ludlow, and

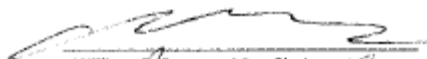

WHEREAS, a duly-noticed public meeting was held by the Board of Selectmen on 11/16 for the public and municipality to review prior to consideration of this resolution; and


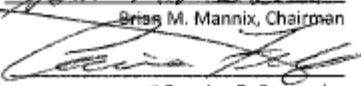

WHEREAS, the Town of Ludlow authorizes responsible departments and/or agencies to execute their responsibilities demonstrated in the plan, and

NOW, THEREFORE BE IT RESOLVED that the Town of Ludlow Board of Selectmen formally approves and adopts the Town of Ludlow **2016 Hazard Mitigation Plan Update**, in accordance with M.G.L. c. 40.

ADOPTED AND SIGNED this

ATTEST


William E. Rooney, Vice Chairman

Manuel D. Silva


Brian M. Mannix, Chairman

Carmina D. Fernandes

Derek DeBarge

LIST OF ACRONYMS

Ag Com	Agricultural Commission
BOS	Board of Selectmen
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
DPW	Department of Public Works
EMA	Emergency Management Agency
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
GIS	Geographic Information Systems
HAZMAT	Hazardous Material
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
RACES	Radio Amateur Civil Emergency Service
SFHA	Special Flood Hazard Area
TRI	Toxics Release Inventory
WMECO	Western Massachusetts Electric Company
WRHSAC	Western Regional Homeland Security Advisory Council

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CHAPTER 1. PLANNING PROCESS

The Federal Emergency Management Agency (FEMA) and the Massachusetts Emergency Management Agency (MEMA) define Hazards 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, and earthquakes. 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 this one undertaken by the Town of Ludlow with technical assistance provided by the Pioneer Valley Planning Commission (PVPC), 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, and updating every five years, a local natural hazards mitigation plan before a disaster happens can save the community money and will 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.

PLANNING PROCESS

In 2016, the Town of Ludlow completed an update of their 2007 Local Natural Hazards Mitigation Plan, in collaboration with the Pioneer Valley Planning Commission and Jamie Caplan Consulting. All portions of the plan were reviewed and updated as necessary. The planning area profile reflects changes in development to infrastructure as well as buildings, the risk assessment reflects a more current list of hazards, the critical facility list has been updated to reflect a current list of facilities and the mitigation action list was updated based on need and mitigation action implementation over the last five years. All aspects of this plan were reviewed and updated to reflect development in the town. Planning for hazard mitigation in Ludlow involved a Hazard Mitigation Committee comprised of the following Town representatives:

- Chief Mark Babineau – Ludlow Fire Department
- Ken Batista – Department of Public Works
- Sergeant David Belanger – Ludlow Police Department
- Lieutenant Joseph Metcalf – Ludlow Police Department
- Lieutenant Michael Brennen – Ludlow Police Department
- Justin Laravee – Building Commissioner
- Deputy James Machado – Ludlow Fire Department

- Captain Ryan Pease – Ludlow Fire Department
- Doug Stefancik – Planning Department
- Ellie Villano – Town Administrator

The hazard mitigation planning process for the Town 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 key product of this process is the development of an Action Plan with a Prioritized Implementation Schedule.

The planning process began with a meeting on January 13, 2016 between Ryan Pease, Ludlow Fire Department and Jamie Caplan, Jamie Caplan Consulting LLC. Ms. Caplan was hired by the Pioneer Valley Planning Commission to assist them and the Town of Ludlow with the planning process.

During this meeting, Ms. Caplan reviewed the mitigation planning process with Captain Pease. Together they brainstormed a list of potential Hazard Mitigation Committee members and outlined potential meeting dates for the Hazard Mitigation Committee. They also spoke about the need for two public meetings and identified potential dates for those as well.

HAZARD MITIGATION COMMITTEE MEETINGS

Meetings of the Hazard Mitigation Committee, most of which took place at the Fire Station at 574 Center Street, Ludlow were held on the dates listed below. Sign-in sheets for each meeting are included in Appendix B. While not all members of the Hazard Mitigation Committee 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.

JANUARY 22, 2016

The Hazard Mitigation Committee reviewed a PowerPoint presentation that emphasized the planning process, discussed the list of hazards to consider and reviewed the old list of critical facilities. They are interested in seeing hail storms added to the hazard list. They discussed the list of critical facilities primarily. They focused on the locations of generators as well as approved shelters. They also reviewed the mitigation goal statement and agreed

with the consultant's suggestion to remove the list of natural hazards and list natural hazards in general because that seems more inclusive.

FEBRUARY 4, 2016

During this meeting, the Hazard Mitigation Committee reviewed the updated list of critical facilities. Additional changes were made including the removal of ethnic neighborhoods and apartment complexes. Ludlow is a culturally diverse community and specific ethnic neighborhoods cannot be identified and do not serve a purpose for the plan. The categories from the previous plan were amended. The meeting then turned to a review of the list of mitigation actions from the previous plan. The majority of those actions were implemented or no longer considered relevant. The committee then turned their attention to identifying new mitigation actions.

FEBRUARY 18, 2016

The Hazard Mitigation Committee reviewed an updated list of mitigation actions during this meeting and added potential funding sources and costs for each action. They also brainstormed some additional mitigation actions that can be added to the plan such as aquifer protection. In addition, outreach for the first public meeting was discussed as well as a presentation agenda for the public meeting. The meeting ended with a review of capabilities based on the Local Mitigation Planning Handbook worksheet.

MARCH 24, 2016

The Hazard Mitigation Committee began this meeting with an exercise to rank the level of risk for each identified hazard. They then focused on the list of mitigation actions. They identified the responsible department, cost and timeline for each mitigation action. Through discussion they added a number of mitigation actions including retrofit and replacement of several bridges and education and outreach to homeowners regarding disaster preparedness. During the Public Meeting on March 17, 2016 it was recommended that replacing the emergency communication system used by town officials and first responders be replaced. The Hazard Mitigation Committee agreed with this and, in fact, ranked this as the number one priority of all mitigation actions.

APRIL 21, 2016

The Hazard Mitigation Committee met in the Town Hall Building prior to the start of the second public meeting. The Committee had another opportunity to review the list of mitigation actions and they did not see a need for changes. They reviewed the process of implementing the Mitigation Plan Update and determined that the Director of Public Works should lead that effort. They discussed the process of reviewing the final plan and having it available for public review. It was decided that the Committee will review the final plan and then make it available to the public in hard copy at the Town Hall and in digital copy by way of the PVPC website and the Town website.

PARTICIPATION BY THE PUBLIC AND NEIGHBORING COMMUNITIES

Two public meetings were held as part of the mitigation planning process – on March 17, 2016 and April 21, 2016. Public meeting outreach materials and notices can be found in Appendix B. Both meetings occurred after the Hazard Mitigation Committee had provided input on hazards and mitigation strategies relevant to the community. A flyer and press release were developed prior to each meeting. Notice of both public meetings was posted in the Town Hall in compliance with the Commonwealth of Massachusetts' open meeting law.

The press releases were sent to several media outlets. The flyer was posted as well in the Town Hall, the Public Safety Building and distributed by each Committee member. The media outreach served to invite members of adjacent communities to participate in the Ludlow mitigation planning process. Citizens from adjacent municipalities were encouraged to comment on Ludlow's plan. The Pioneer Valley Planning Commission's regional scope ensured that residents and government officials throughout the Pioneer Valley saw the press release and request for comments.

Public participation will be a critical component of the Hazard Mitigation Plan maintenance process. The Hazard Mitigation Committee will hold all meetings in accordance with Massachusetts open meeting laws.

MARCH 17, 2016 PUBLIC MEETING

Fourteen people attended the first public meeting, held at the Town Hall in conjunction with a Local Emergency Planning Committee (LEPC) meeting. Participants included members of the Hazard Mitigation Committee as well as the LEPC. The meeting was videotaped for historical record. Ms. Caplan delivered a PowerPoint presentation that included basic information regarding hazard mitigation planning, a participatory exercise and an overview of the Ludlow 2016 Mitigation Plan Update. Participation was good and included the suggestion of two additional mitigation actions, improved radio communications for town employees and first responders and retrofit of the Green Town Bridge. Each of these will be considered by the Hazard Mitigation Committee.

APRIL 21, 2016 PUBLIC MEETING

Twelve people participated in the second public meeting, held at the Town Hall in conjunction with a Local Emergency Planning Committee (LEPC) meeting. Participants included members of the Hazard Mitigation Committee as well as the LEPC. This meeting was also videotaped for historical record. Ms. Caplan presented a review of the mitigation planning process and the identified hazards for the plan. She then emphasized the mitigation actions and their priority order as well as the implementation plan. She answered questions regarding funding availability and the approval process. The public was made aware that they will have the opportunity to review the draft plan in mid-May and then it will go for MEMA and FEMA review in June.

PARTICIPATION BY ADDITIONAL STAKEHOLDERS

A variety of stakeholders were provided with an opportunity to be involved in the development of the 2016 Hazard Mitigation Plan Update. The different categories of stakeholders that were involved, and the engagement activities that occurred, are described below.

LOCAL AND REGIONAL AGENCIES

The Pioneer Valley Planning Commission (PVPC) is a regional planning agency for forty-three towns and cities in Massachusetts' Hampden and Hampshire Counties. PVPC regularly engages with the Town of Ludlow 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 Ludlow 2016 Hazard Mitigation Plan Update by PVPC ensured that the information from these plans was incorporated into the Hazard Mitigation Planning process.

In addition, the PVPC 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 Ludlow 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 Ludlow. 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 Ludlow's 2016 Hazard Mitigation Plan Update process and encouraged to comment.

DRAFT PLAN REVIEW

Citizens from adjacent municipalities were encouraged to comment on Ludlow's plan. Public participation will be a critical component of the Hazard Mitigation Plan maintenance process. The Hazard Mitigation Committee held all meetings in accordance with Massachusetts open meeting laws.

PLAN ADOPTION

In 2015, the Select Board agreed to begin the process of developing a Hazard Mitigation Plan Update. Once the plan was provisionally approved by FEMA, the Select Board held a public hearing on the plan and adopted it.

AUTHORITY AND ASSURANCES

The Town of Ludlow will continue to comply with all applicable federal laws and regulations during the periods for which it receives grant funding in compliance with 44 CFR 201.6 and will amend its plan whenever necessary to reflect changes in Town, State or Federal laws and regulations as required in 44 CFR 201.6.

CHAPTER 2. LOCAL PROFILE

Ludlow is situated along the northeastern border of Springfield, in Hampden County, on the western edges of the uplands in central Massachusetts. The Towns of Palmer and Belchertown form the eastern border, the westerly flowing Chicopee River forms the southern border with the Town of Wilbraham, the Town of Granby forms the northern border, and the Town of Chicopee and City of Springfield both form the western border.

Settled in 1775, the Town developed around the Ludlow Manufacturing Company which produced jute for twine for the U.S. Postal Service. The former mill and manufacturing company, marked by a traditional old clock tower, is situated along the banks of the Chicopee River. The waves of immigrants that moved from Scotland, Ireland, Poland, and Portugal to work in the mills contribute to Ludlow's current ethnic flavor. The Our Lady of Famita Festival is one of the Pioneer Valley's largest ethnic celebrations. The historic town center of Ludlow, with its First Church, established in 1774, and First Meeting house, offers a glimpse into Ludlow's past.

Ludlow is proximate to the employment centers of Chicopee and Springfield, and provides easy access to the Massachusetts Turnpike (Interstate 90) and Interstate 291. Route 21 (Center Street) is the main artery through Town, running diagonally from the northeastern corner of Town to the southwestern corner, where it provides access to I-90. I-90 runs through the entire southern edge of Ludlow.

Ludlow is a part of the Chicopee River Watershed Basin. The Chicopee River, along the southern border of Town, and the Springfield Reservoir, located in the northeastern corner of Town, are the Town's two major bodies of water. The total land area of Ludlow is approximately 18,184 acres. The majority of its land is either undeveloped (56%) or residential (22%).

Located among pleasant rolling hills, Ludlow has changed from a mill town to a desirable residential community. The numbers of its residents has steadily climbed during recent decades. Since 1990, its population has increased by 13% to 21,209. Ludlow has a population density of 781 people per square mile and is one of the more densely settled communities in its sub-region of the Pioneer Valley. Its residential neighborhoods of single- and two-family homes are growing. Interestingly, almost one quarter of the housing units are rentals.

While it is a residential community, Ludlow is more than a bedroom community. It has an established factory district, an outlet mall, and along with neighboring Chicopee, it is home to the Westover Industrial Park. Ludlow is also the site of the new Hampden County Jail. Recreational opportunities are provided at Memorial Park, Memorial Field, and a state pool which was the first indoor swimming pool in Western Massachusetts. There is a Town beach at Haviland Pond.

SCHOOLS

Public schools serving Ludlow include Chapin Street Elementary, East Street Elementary, Veterans Park Elementary, Baird Middle School, Ludlow High School, as well as two pre-school programs - Early Childhood Partnership and the Integrated Preschool Program.

INFRASTRUCTURE

Ludlow's history and geography have been major factors in the development of the town's infrastructure. Key factors that have played a role in the development of town are the manufacturing industry along the Chicopee

River, and the construction of the Springfield Reservoir, I-90, and the Westover Air Force Base. With a growing residential population, Ludlow's infrastructure has more recently developed within these core areas.

ROADS AND HIGHWAYS

The major artery running through town is Route 21, or Central Street. It travels diagonally from the northwest corner of Ludlow to the southeast corner, where it provides access to I-90 at Interchange 7. The majority of Ludlow's road network is concentrated in the southwestern corner of town, allowing access to the interstate, Springfield, and Chicopee, as well as the industrial park on the Westover Air Force Base.

Other key thoroughfares include Fuller Street, West Street, Holyoke Street, Lyons Street, Cady Street, Chapin Street, East Street, and Miller Street.

RAIL LINES

There are no active rail lines running through Ludlow, although there is one federal line which is currently out of service. In addition, the CSX rail line runs just beyond the city limits. It is a well-used line, accommodating over thirty trains per day, both freight and passenger rail.

PUBLIC TRANSPORTATION

Ludlow is served by the Pioneer Valley Transit Authority (PVTA), both with regular bus service and paratransit service. Bus service is somewhat limited throughout Ludlow, but provides commuting options to larger employment centers from a park-and-ride lot at Interchange 7 off of I-90. Paratransit, a door-to-door demand responsive van service, is provided in Ludlow by PVTA, through MV Transportation.

PUBLIC DRINKING WATER SUPPLY

The Springfield Water and Sewer Commission provides water service to residents of Ludlow. The water originates at Borden Brook and Cobble Mountain Reservoirs in the towns of Blandford and Granville. It is filtered and disinfected at the West Parish Filters Treatment Plant in Westfield, and stored at a distribution reservoir on Provin Mountain, Agawam, which supplies Ludlow, as well as Springfield, Agawam, East Longmeadow, and Longmeadow. The Springfield Reservoir, located in the northeastern portion of Ludlow, is a reserve water supply.

Ludlow is also served by the Massachusetts Water Resources Authority (MWRA) through Wilbraham Water Department and South Hadley FD #1.

In addition, some residents in Ludlow rely on well water.

SEWER SERVICE

Ludlow is served by public sewer, with wastewater treatment provided by Springfield Water and Sewer Commission. In addition, some residents rely on septic for sewage disposal.

NATURAL RESOURCES

Ludlow is blessed with a wide variety of landscapes and natural resources, from steep slopes along the Holyoke Range to the low, flat lands along the Chicopee River. Development has followed topographical cues, with much of the density along the southern edge of town. But working farms and pastureland are scattered throughout the land and reflect Ludlow's history as an agricultural community.

TOPOGRAPHY

Ludlow's topography is characteristic of the valley region, transitioning from the gradually rolling meadows on the southern part of town to the steep slopes bordering the Holyoke Range. The western portion of the town consists of dry and marshy lowlands, while the eastern part of town has an average elevation of 400 – 650 feet.

There are two major area of extreme relief in Ludlow, Minnechaug Mountain, in the Ludlow State Park and Facing Rock, in Facing Rock Wildlife Management Area (WMA). Facing Rock WMA contains three hills over 450 feet in elevation; High Hill, Facing Rock, and Jefferson Peak. Small brooks and streams flow through these areas producing gentle stream valleys and occasional wetland areas.

Its lowest point lies in the central portion of Town, at an elevation of 230 feet. This is the location of the historic Ludlow Center. The Springfield Reservoir, the largest body of water in Ludlow, lies at an elevation of 373 feet. The highest point, in Ludlow State Park, is about 720 feet, located west of Tower Rd.

The areas of dense residential development have loose soil, are less rocky and gently sloping which is conducive to development. These soils are found in the southwestern quadrant of the Town, an area of residential and commercial uses. The areas north of the Chicopee River and towards the Massachusetts Turnpike are extremely flat and dry, but are broken up occasionally by wetlands and large ponds along Minechoag Brook. Little open space exists in the southern part of town, with the exception of the Ludlow Country Club, straddling the Minechoag Brook.

The remainder of the land in Ludlow is undeveloped, agricultural lands, located in the eastern half of town. This area is dominated by steep slopes, upland hills, dense forest, and large glacial rocks. The eastern part of town is primarily open spaces, like woodlands, open meadow, and farmland, but is slowly being developed.

WATER RESOURCES

Wetlands and bodies of water comprise approximately 8,817 acres of Ludlow's 18,000 acres of total landmass. Water resources are essential to residents. Waterways in Ludlow have had a large influence on development and recreation. The first settlers in Ludlow harnessed the power of water to run the mill industry for almost 100 years. The Town of Ludlow owns a beach along the shore of Haviland Pond. This beach hosts many sports and activities throughout the year. There are several protected water supply areas in town, however only one is open for public passive recreation. The Town has a Pond Management Committee comprised of fifteen (15) volunteers who are all trained in water testing procedures and equipped with test kits.

WATERSHED

The Chicopee River carves the southern border of Ludlow from Palmer through the southeastern corner of Town and continues west to Springfield and Wilbraham. The Chicopee River is 17 miles long and has numerous small tributaries which travel south through the town. Among these are Broad Brook, Higher Brook, Minechoag Brook, Harris Brook and St Brook. The Chicopee River Basin, with an area of 721 square miles, is the second largest in Massachusetts and makes up the largest tributary area to the Connecticut River. The average flow of the Chicopee River is 900 cubic feet per second, or about 581,644,800 gallons per day.

WATER BODIES

The Springfield Reservoir is the largest body of water in Ludlow. This water resource is not currently being utilized for public drinking water, but as a reserve water supply. Ludlow residents are presently being serviced with water from Cobble Mountain in Westfield. A series of aqueducts connect the Reservoir to other sections of Town. Springfield Reservoir has several areas in which passive recreation is encouraged.

Nash Hill Reservoir located south of Nash Hill Road is connected by an aqueduct to Ludlow Center. This parcel, owned by the Massachusetts Departments of Conservation and Recreation is approximately 40 acres. Recreation is not encouraged on this land due to the level of resource protection.

Numerous small ponds are scattered throughout the Town of Ludlow. Alden Pond, Lyon Pond, and Second Pond are located in the central and northern areas of Town. Harris Pond, Murphy Pond, Gamache Pond, Pickerell Pond, Wood Pond, Haviland Pond, and Minnechoag Pond are located in the southern half of Town. Haviland Pond, Lyon Pond, and Minnechoag Pond, are the three largest ponds in town. They all have depths in excess of 200 feet, while the other ponds in Ludlow are shallower.

MAJOR RIVERS AND STREAMS

The Chicopee River, forming the southern boundary of Ludlow, is a key water resource and component of the topography. In addition, several smaller tributary streams and brooks traverse the town, including Higher Brook, Harris Brook, Minnechoag Brook, Broad Brook, and Stony Brook.

WETLANDS

Fairly extensive wetlands are located throughout the town. Two of the largest areas are located in Westover Wildlife Area and along Second Pond and Minnechoag Brook. These wetland areas are important ecological areas, particularly for species of special concern. Many of these wetland areas are marked as potential vernal pools sites.

FLOOD HAZARD AREAS

The Town of Ludlow has several FEMA Q3 Flood Hazard areas identified. The Chicopee River, which creates the entire southern border of Town, sees a year swell every spring. Another flood prone area is the Westover Wildlife Management Area, which consists of several large wetlands and ponds. FEMA data indicates that Ludlow is a member community of the National Flood Insurance Program and has FIRM date of 5/19/1981.

FORESTS

Portions of Ludlow are heavily forested with a mixture of hemlock, pine, oak, maple, and birch trees. There are significant climax forests consisting of generally even aged stands, which are punctuated by streams and ponds. The diversity of forests, wetlands and plant communities provide many excellent wildlife habitats.

An increase in subdivision development has altered the vegetation in many newly developed areas in Ludlow. Many of these developments are almost completely clear cut, in attempts to keep construction costs down. Because of this loss of the Town's urban trees, the Town worked to adopt a shade tree bylaw.

DEVELOPMENT

DEVELOPMENT PATTERNS

Several factors have played, and will continue to play, an important role in the development of Ludlow. These include: the existing development pattern and availability of land for future development; the present road network; physical factors such as steep slopes, poor soil conditions, land set aside for conservation, the Chicopee River, its tributaries and floodplains; and the availability of utilities such as public water and sanitary sewers. These factors have an impact, both individually and cumulatively, on where and how development occurs.

Zoning and other land use regulations constitute a town'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 may use to manage development and direct growth to suitable and desired areas while also protecting critical resources and ensuring that development is in keeping with the town's character.

Ludlow has nine base zoning districts and three 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. These districts are described below.

Residential Districts - RA-1, RA, and RB: Areas of town which are best suited for low-density residential development; land uses and activities in keeping with the Town's rural character, primarily but not limited to farm and forest uses.

Business Districts - BA and BB: These district permits many types of offices, commercial, and retail businesses by special permit or site plan approval. BA is considered light commercial use, and BB is considered heavy commercial use.

Agricultural District – A: This district is spread throughout the majority of the town, especially north of Route 21, and permits land uses and activities in keeping with the Town's rural character, primarily but not limited to farm and forest uses and single family homes.

Industrial Districts - IA, IB, and IC: Areas of town which are best suited for manufacturing and industrial uses, as well as any use permitted in the Business District.

Ludlow's Overlay Districts further regulate land use within the community. These include:

Agriculture Moderate Density District - AMD: This overlay district establishes the locations where some business uses are allowed by special permit within the Agricultural District.

Aircraft Flight District – AF: This overlay district establishes the locations affected by the Westover Air Force Base and establishes additional prohibited uses.

Water Supply Protection District - WSP: This overlay district sets forth standards, rules and permitting procedure for uses that are located within the town's drinking water source recharge areas.

The Zoning Bylaw establishes a Site Plan Approval procedure for most business, industrial, and commercial buildings within the Town. Site Plan Review allows the Planning Board the ability to review the development proposal to ensure that the basic safety and welfare of the people of Ludlow are protected.

CURRENT DEVELOPMENT TRENDS

Today, this small community is home to approximately 21,209 residents. The majority of Ludlow's 18,184 acres is undeveloped forest and water, totaling nearly 12,000 acres. Agricultural land totaling 925 acres and residential land totaling 3,878 acres account for the majority of the remaining Town area. Commercial and industrially used land consists of approximately 500 acres, with public/urban open land contributing an additional 640 acres.

Since the creation of the previous Hazard Mitigation Plan, Ludlow has seen both residential and commercial development. Residential development has included two apartment complexes aimed at housing senior citizens—Keystone development and Stevens Memorial—some single family home dispersed throughout town, and a few subdivisions. The subdivision developments in Ludlow occurred on land that was previously used primarily for agricultural uses. The town has also seen new commercial development, which has occurred primarily on land zoned for business uses and has not been concentrated in one general area. The mill district in Ludlow has also seen redevelopment in recent years with the creation of a large health complex and the redevelopment of some of the mill spaces. While the town has seen a substantial amount of development, it is not likely to impact the town's vulnerabilities to natural hazards.

DEVELOPMENT IN HAZARD AREAS

Most of the hazards identified in this plan are regional risks and, as such, all new development falls into the hazard area. The exceptions to this are flooding and inundation in the event of a dam failure.

- According to current aerial photography, overlaid with FEMA Q3 Flood Insurance Rate Maps (FIRMs), there are approximately 167 structures within or near the flood plain in Ludlow. According to the Community Information System (CIS) of FEMA, there were 30 structures located within the Special Flood Hazard Area (SFHA) in Ludlow as of November 20, 2003, the most current records in the CIS for the Town of Ludlow.

- For the high hazard dams, inundation zones are mapped as part of the Emergency Action Plans required of dam owners by the Commonwealth of Massachusetts. To date, an analysis of development trends in these inundation zones has not been conducted.

There are no restrictions on development that are articulated in terms of mitigating the other hazards. However, provisions within the Subdivision Rules and Regulations do in effect set limits that serve to mitigate the impacts of severe winter storms, hurricanes, wildfire and brushfires, earthquakes, drought, and man-made hazards:

- Grade limits on streets serve to minimize accident potential and power loss from severe winter storms.
- There are “height” limits in the dimensional requirements and in the subsection pertaining to wireless communications that reduce the incidence of problems during hurricanes and other high wind events. Requirements to place electrical transmission lines underground also reduce hazards during high winds/
- Provisions within the subdivision and site plan review process, which involve a fire control plan, including a supplemental water supply, and review of the plan by the Ludlow Fire Department, serve to mitigate wildfire and brushfire hazards.
- Requirements in the Subdivision Standards to place electrical transmission lines and gas transmission lines underground provide some mitigation of impacts from earthquakes.
- Impacts from drought are mitigated through a zoning overlay district that protects the town’s water supply, including surface and groundwater resources.
- Impacts from man-made hazards are mitigated to some extent through the Water Supply Protection District, which contains strong restrictions on uses, as well as regulations for the use and storage of hazardous materials.

CHAPTER 3. HAZARD IDENTIFICATION AND ANALYSIS

The Hazard Identification and Analysis chapter provides details regarding all of the natural hazards that may impact the Town of Ludlow. Gathering this information included historical research, conversations with local officials and emergency management personnel, available hazard mapping and other weather-related databases.

The Hazard Mitigation Committee referred to the 2013 Massachusetts Hazard Mitigation list of hazards and to the 2007 list of hazards included in the previous Ludlow Mitigation Plan. **Table 1** below illustrates a comparison between the relevant hazards in the state plan and in Ludlow’s plan. **Table 2** indicates the two additional hazards added to the 2016 Hazard Mitigation Plan Update compared to those included in the 2007 plan.

Table 1 MA State Plan Hazards and Hazards Relevant to Ludlow

2013 Massachusetts Hazard Mitigation Plan	Town of Ludlow Relevance
Coastal Hazards	The Town of Ludlow is not located on the coast.
Dam Failure	Dam Failure is a risk to Ludlow.
Drought (Severe Weather)	Drought is a risk to Ludlow.
Earthquake	Earthquake is a risk to Ludlow.
Extreme Temperature (Severe Weather)	Extreme Temperature is a risk to Ludlow.
Flood (including Ice Jam)	Flooding is a risk to Ludlow.
High Wind (Severe Weather)	High Wind is a risk to Ludlow and is included in the Severe Thunderstorm/Wind/Tornado category.
Hurricane/Tropical Storm	Hurricane is a risk to Ludlow.
Ice Storm (Severe Winter Weather)	Ice Storm is a risk to Ludlow and included in the category Severe Snowstorms/Ice Storms.
Landslide	Landslide is not a risk to Ludlow.
Major Urban Fires	Major Urban Fires are not considered a risk to Ludlow. However, wildfires and brush fires are considered a risk.
Nor’easter	Nor’easter is a risk to Ludlow and included in the category Severe Snowstorms/Ice Storms.
Snow & Blizzard (Severe Winter Weather)	Snow & Blizzard is a risk to Ludlow and included in the category Severe Snowstorms/Ice Storms.
Thunderstorm (Severe Weather)	Thunderstorm is a risk to Ludlow and included in the category Severe Thunderstorms/Wind/Tornadoes.
Tornado (Severe Weather)	Tornado is a risk to Ludlow and included in the category Severe Thunderstorms/Wind/Tornadoes.
Tsunami	The Town of Ludlow is not located on the coast or near the coast for tsunami to be a risk.
Wildland Fire	Wildland Fire is considered a risk to the Town of Ludlow.

Table 2 Comparison between 2007 and 2016 natural hazards.

2007 Natural Hazard List	2016 Natural Hazard List
Dam Failure	Dam Failure
Drought	Drought
Earthquakes	Earthquakes
	Extreme Temperatures
Floods	Floods
Hurricanes	Hurricanes
Severe Snowstorms/Ice Storms	Severe Snowstorms/Ice Storms
Tornadoes	Severe Thunderstorms/Wind/Tornadoes
Wildfire/Brush Fire	Wildfire/Brush Fire
Man-made Hazards/Hazardous Materials	
	Impact of Climate Change

Two hazard categories were added to the 2016 Hazard Mitigation Plan Update, extreme temperatures and climate change. Extreme temperatures are included in the Massachusetts Hazard Mitigation Plan and are considered a risk to the Town of Ludlow. For this reason the category was added. Climate Change was added not as a hazard category but as a factor that may impact natural hazards.

NATURAL HAZARD ANALYSIS METHODOLOGY

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 Ludlow are: dam failure, drought, earthquakes, extreme temperatures, floods, hurricanes, landslides, severe snowstorms/ice storms, severe thunderstorms/wind/tornadoes, wildfire/brush fire and climate change. Many of these hazards result in similar impacts to the 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 wildfires. Classifications are based on the area that would potentially be affected by the hazard, as shown in Table 3 below.

Table 3 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 scale shown in Table 4.

Table 4 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 scale shown in Table 5.

Table 5 Extent of 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 (highest risk) through 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. Table 6 below shows the worksheet used for Ludlow and Table 7 shows the final hazard risk ranking.

Table 6 Identification and Analysis Worksheet for Ludlow

Type of Hazard	Location of Occurrence	Probability of Future Events	Impact	Vulnerability
Dam Failure	Medium	Very Low	Limited	4
Drought	Large	Moderate	Limited	3
Earthquake	Large	Low	Critical	5
Extreme Temperatures	Large	Very High	Limited	3
Flood	Medium	Low	Limited	2
High Winds	Large	High	Limited	2
Hurricane/Tropical Storm	Large	High	Critical	1
Ice Storm	Large	Very High	Critical	1
Wildfires/Brushfires/Urban Fires	Medium	Low	Limited	2
Nor'easter	Large	Very High	Critical	1
Snow & Blizzard	Large	Very High	Critical	1
Thunderstorms	Large	Very High	Limited	4
Tornado	Large	Low	Catastrophic	1

Table 7 Hazard Risk Ranking

Risk Index	2007 Hazard Mitigation Plan	2016 Hazard Mitigation Plan Update
Very High Risk		Hurricane/Tropical Storm Ice Storm Nor'easter Snow & Blizzard Tornado
High Risk	Floods	Floods High Winds Wildfires/Brushfires/Urban Fires
Moderate Risk	Hurricanes Severe Snowstorms/Ice Storms Severe Thunderstorms Wildfire/Brushfire Winds	Drought Extreme Temperatures
Low Risk	Drought Earthquakes Tornadoes	Dam Failure Thunderstorms
Very Low Risk	Dam Failures	Earthquake

DAM FAILURE

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 structure is released rapidly. Most dam failures occur when floodwaters above overtop and erode the material components of the dam. Often dam breaches lead to catastrophic consequences as the water rushes in a torrent downstream flooding an area 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.

LOCATION

The Massachusetts Emergency Management Agency (MEMA) identifies 11 dams in Ludlow. The location of occurrence, therefore, is considered “medium.”

Dams in Ludlow or Affecting Ludlow	
Dam	Hazard Level
Ludlow Reservoir Dam	High
Cherry Valley Dam	High
Indian Orchard Dam	High
Red Bridge Dam	High
Putts Bridge	High
Harris Pond Dam	Significant
Collins Pond Dam	Significant
Alden Pond Dam	Low
Gauthier Pond Dam	Low
Ackerman Upper Pond Dam	Non Jurisdictional
Nash Hill Reservoir Dam	Non Jurisdictional

EXTENT

Often dam breaches lead to catastrophic consequences as the water ultimately rushes in a torrent downstream flooding an area 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.

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 operations 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

According to committee members, there has been only one dam that has failed in Ludlow, the Collin’s Pond Dam on the Swift River. This dam breached during the huge floods of 1938 and 1955, washing out several warehouses along the riverfront. Assuming 100% damage to 100% of structures within the inundation zone of the dam, the estimated cost in today’s dollars would be \$6,825,000.

It is important to note:

- No critical facilities are located in this area.
- Area is within the 100-year floodplain.
- Dam has been re-built, in good condition.

PROBABILITY OF FUTURE EVENTS

As Ludlow’s high hazard dams age, and if maintenance is deferred, the likelihood of a dam failure will increase, but, currently the frequency of dam failures is “very low” with a less than one 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 its entire 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 Town faces a “limited” impact in the event of a dam failure with less than twenty-five percent of Ludlow affected.

A failure of the Ludlow Reservoir Dam, with a high hazard level, could result in an estimated 100 percent of damage to 20 percent of structures, resulting in a total of \$644,415,060 worth of damage and 8,715 people affected. The cost of repairing or replacing the roads, bridges, utilities, and contents of structures is not included in this estimate.

VULNERABILITY

Ludlow faces a hazard index rating of “4 – low risk” from dam failure due to the number of dams in the Town, the location and conditions of those structures, and the downstream resources that are vulnerable.

There are four high hazard dams in the town that could be most vulnerable to failure. Depending on which dam were to fail would determine who and what would be vulnerable to damage. The failure of the Ludlow Reservoir Dam is likely to impact many of the town’s residents and critical facilities due to its location and size. The Putts Bridge Dam, which is much smaller, would leave fewer people and structures vulnerable.

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, thus creating a location of occurrence that is “large.” The Hazard Mitigation Committee did not identify any areas of Ludlow that they felt were especially vulnerable to drought.

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

Table 8 U.S. Drought Monitor Table

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 1930.¹ 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 since 2000, based on the US Drought Monitor:

¹ US Geological Survey Water-Supply Paper 2375. "National Water Summary 1989 – Floods and Droughts: Massachusetts." Prepared by S. William Wandle, Jr., US Geological Survey.

Table 9 Annual Drought Status

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

PROBABILITY OF FUTURE EVENTS

In Ludlow, as in the rest of the state, the probability of a drought is “moderate,” between 10 percent and 40 percent in a single 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.

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.² 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.

² National Drought Mitigation Center – <http://drought.unl.edu>

Palmer Drought Severity Index

1895–1995

Percent of time in severe and extreme drought

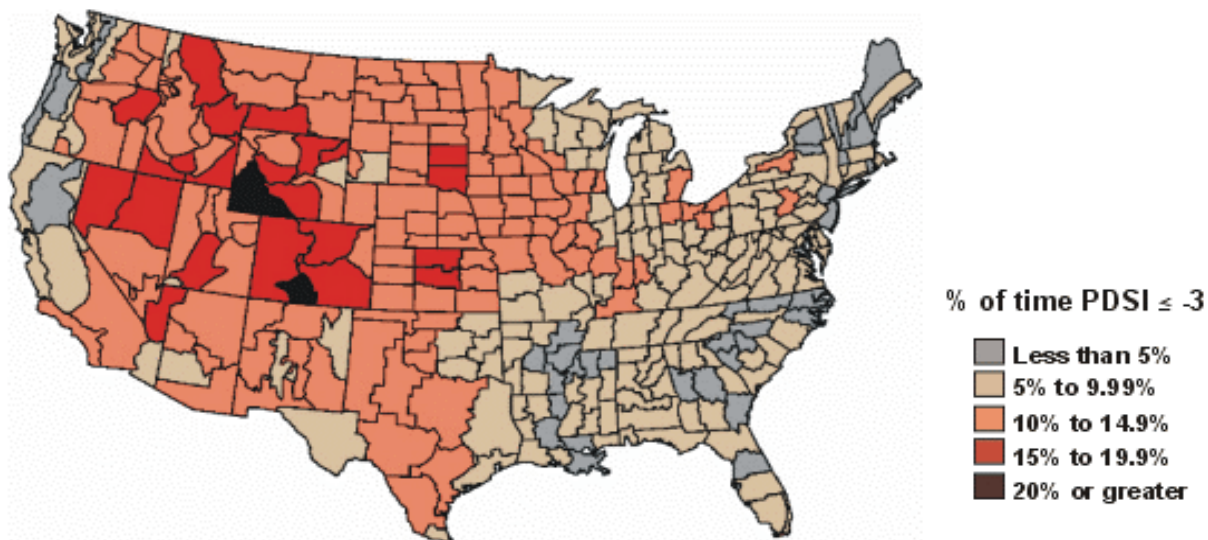


Figure 1 Palmer Drought Severity Index

IMPACT

Due to the water richness of Western Massachusetts, Ludlow is unlikely to be adversely affected by anything other than a major, extended drought. The impacts of a drought are characterized 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, Ludlow faces a hazard index rating of “3 - low risk” of drought. While such a 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.

EARTHQUAKE

An earthquake is a sudden, rapid shaking of the ground that is caused by the breaking and shifting of rock beneath the 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.³ 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.⁴

LOCATION

Because of the regional nature of the hazard, the entire town is susceptible to earthquakes. This makes the location of occurrence "large," or over 50 percent of the total area.

EXTENT

The magnitude of an earthquake is measured using the Richter 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.

Table 10 Richter Scale Magnitudes and Effects

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.

³ Northeast States Emergency Consortium Web site: www.nesec.org/hazards/earthquakes.cfm.

⁴ Federal Emergency Management Agency Web site: www.fema.gov/hazards/earthquakes/quake.shtm.

Table 11 Modified Mercalli Intensity Scale

Modified Mercalli Intensity Scale for 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

Source: US Federal Emergency Management Agency

PREVIOUS OCCURRENCES

The most recent earthquakes to affect New England and the largest earthquakes in New England are shown in the tables below. Ludlow has not been impacted by these recorded earthquakes.

Table 12 Largest Earthquakes Affecting Ludlow

Largest Earthquakes Affecting Ludlow, MA, 1924 – 2012		
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, NH	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 website, www.nesec.org/hazards/earthquakes.cfm

Table 13 New England States Recorded Earthquakes

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
Total Number of Earthquakes within the New England states between 1638 and 1989 is 2262.		

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 Hampden County to determine the Earthquake Index Value as shown in the table below. Based upon existing records, there is a “low”

frequency of earthquakes in Ludlow with between a 1 percent and 2 percent chance of an earthquake occurring in any given year.

Table 14 Earthquake Index for Hampden County

Earthquake Index for Hampden County	
Hampden County	0.24
Massachusetts	0.70
United States	1.81

IMPACT

Massachusetts introduced earthquake design requirements into their building code in 1975 and improved building code for seismic reasons in the 1980s. 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 the 1980s 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.

The impact incurred by an earthquake would be between “limited” and “critical.” To approximate the potential impact to property and people that could be affected by this hazard, the total value of all residential property in town, \$3,222,075,300 is used.

An estimated 100 percent of damage would occur to 20 percent of structures, resulting in a total of \$644,415,060 worth of damage and 8,715 people affected. 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, Ludlow faces a hazard index rating of “5 - very low risk” from earthquakes.

Older building are particularly vulnerable to earthquakes because their construction pre-dates building codes that included strong seismic considerations. The Hazard Mitigation Committee did not have the information necessary to determine which critical facilities would be most impacted by earthquakes. Eight of the town’s evacuations routes contain bridges. If these bridges were compromised in an earthquake event, evacuation efforts could be compromised. The failure of bridges on the 1-90 (MassPike) could have regional impacts on evacuation efforts.

EXTREME TEMPERATURES

As per the Massachusetts Hazard Mitigation Plan, extreme cold is a dangerous situation that can result in health emergencies for susceptible people, such as those without shelter or who are stranded or who live in homes that are poorly insulated or without heat. There is no universal definition for extreme temperatures, with the term relative to local weather conditions. For Massachusetts, extreme temperatures can be defined as those that are far outside the normal ranges. The average temperatures for Massachusetts are:

- Winter (Dec-Feb) Average = 27.51°F
- Summer (Jun-Aug) Average = 68.15°F

Criteria for issuing alerts for Massachusetts are provided on National Weather Service web pages: <http://www.erh.noaa.gov/box/warningcriteria.shtml>.

EXTENT

As per the Massachusetts Hazard Mitigation Plan, the extent (severity or magnitude) of extreme cold temperatures are generally measured through the Wind Chill Temperature Index (shown in Figure 2). Wind Chill Temperature is the temperature that people and animals feel when outside and it is based on the rate of heat loss from exposed skin by the effects of wind and cold. The chart shows three shaded areas of frostbite danger. Each shaded area shows how long a person can be exposed before frostbite develops. In Massachusetts, a wind chill warning is issued by the NWS Taunton Forecast Office when the Wind Chill Temperature Index, based on sustained wind, is – 25°F or lower for at least three hours. Extreme temperatures would affect the whole community.

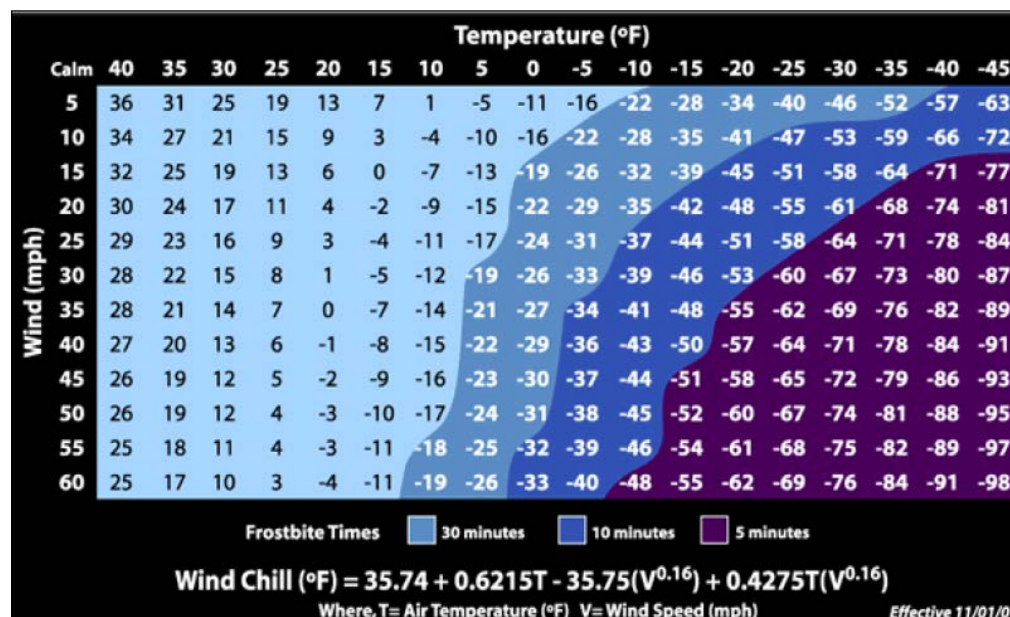


Figure 2 Wind Chills

For extremely hot temperatures, the heat index scale is used (shown in Figure 3), which combines relative humidity with actual air temperature to determine the risk to humans. The NWS issues a Heat Advisory when the Heat Index is forecast to reach 100-104 degrees F for 2 or more hours. The NWS issues an Excessive Heat Warning if the Heat Index is forecast to reach 105+ degrees F for 2 or more hours. The following chart indicates the relationship between heat index and relative humidity:

Relative Humidity (%)		80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
	40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
	45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
	50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
	55	81	84	86	89	93	97	101	106	112	117	124	130	137			
	60	82	84	88	91	95	100	105	110	116	123	129	137				
	65	82	85	89	93	98	103	108	114	121	128	136					
	70	83	86	90	95	100	105	112	119	126	134						
	75	84	88	92	97	103	109	116	124	132							
	80	84	89	94	100	106	113	121	129								
	85	85	90	96	102	110	117	126	135								
	90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127											
100	87	95	103	112	121	132											
Category		Heat Index					Health Hazards										
Extreme Danger		130 °F – Higher					Heat Stroke or Sunstroke is likely with continued exposure.										
Danger		105 °F – 129 °F					Sunstroke, muscle cramps, and/or heat exhaustion possible with prolonged exposure and/or physical activity.										
Extreme Caution		90 °F – 105 °F					Sunstroke, muscle cramps, and/or heat exhaustions possible with prolonged exposure and/or physical activity.										
Caution		80 °F – 90 °F					Fatigue possible with prolonged exposure and/or physical activity.										

Figure 3 Heat Index

PREVIOUS OCCURRENCES

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

- Blue Hills, MA- -21°F
- Boston, MA- -12°F
- Worcester, MA- -19°F

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

- Blue Hills, MA - 101°F
- Boston, MA - 102°F
- Worcester, MA - 96°F

PROBABILITY OF FUTURE EVENTS

The probability of future extreme heat and extreme cold is considered to be "very high," or between 70 and 100 percent in any given year.

IMPACT

The impact of extreme heat or cold in Ludlow is considered to be "limited," with no property damage and very limited effect on humans.

VULNERABILITY

Ludlow's vulnerability from extreme heat and cold is considered to be, "3 - Medium Risk."

Structures and infrastructure in town are not at risk for damage due to extreme temperatures, but populations that are not prepared to contend with these extreme temperatures could be highly vulnerable.

FLOODING

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

- 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.

LOCATION

According to the FEMA FIRM Maps some areas of Ludlow are located within the 100 year floodplain and thus susceptible to general flooding. The 100-year floodplain covers approximately 1,167 acres of the Town and the 500-year floodplain covers 278 acres of land in the town. According to the Community Information System (CIS) of FEMA, there were 20 1-4 family structures and 14 "other" structures located within the Special Flood Hazard Area (SFHA) in Ludlow.

Those locations susceptible to general flooding include:

- Land along the Chicopee River, which creates the Southern border of the town.
- Land within the Westover Wildlife Management Area, which has a number of wetlands and ponds.

As revealed by this information, there is a “medium” location of occurrence (10 to 50 percent of the Town) that is susceptible to and could be affected by flooding in any given year.

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 Ludlow and surrounding areas in western Massachusetts is 46 inches.

PREVIOUS OCCURRENCES

The Hazard Mitigation Workgroup identified the locations listed under the “location” section as where previous occurrences of localized flash flooding have occurred.

PROBABILITY OF FUTURE EVENTS

Based upon previous data, there is a “low” probability (between 1 percent and 10 percent in the next year) of flash flooding or general flooding occurring in Ludlow. Newly developed areas of the Town are less vulnerable to the effects of flash flooding because of the presence of modern storm water management systems.

IMPACT

There are approximately 14 structures within the Special Flood Hazard Area, designated as the 100-year floodplain, in Ludlow. Utilizing the Town’s median home value of \$189,300, and an average household size of 2.56 people, an estimated 20 percent of damage to each structure in the 100-year flood plain would result in a total of \$530,040 worth of damage and 36 people affected. 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, Ludlow faces a hazard index rating of “2 –high risk” from flooding.

Most of Ludlow’s critical facilities are not located in the 100-year flood plain and therefore are not vulnerable to flooding. Chapin Elementary School, Veteran’s Park Elementary School, Baird Middle School, Ludlow Senior High School and the Town Hall are located just outside of the flood zone along the Higher Brooke. If extreme flooding were to happen, these facilities could be vulnerable to damage.

HURRICANES

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 which 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 Ludlow is at risk from hurricanes. Ridgetops are more susceptible to wind damage. Due to this, the location of occurrence is “large,” meaning over 50 percent of the Town could be affected in the event of a hurricane.

EXTENT

As an incipient hurricane develops, barometric pressure (measured in millibars or inches) at its center falls and winds 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.

Table 15 Saffir-Simpson Scale

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

In 1960, Hurricane Brenda tracked through the NW corner on Ludlow. According to the National Oceanic and Atmospheric Administration's historical data this is the only hurricane to track through Ludlow. Hurricane Belle (1976) and Hurricane Gloria (1985) tracked through the nearby towns of Chicopee and Holyoke.

Hurricanes that have affected the Pioneer Valley are show in the following table.

Table 16 Major Hurricanes in the Pioneer Valley

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

Ludlow'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. Based upon past occurrences, it is reasonable to say that there is a "high" probability (40 percent to 70 percent in any given year) of hurricanes in Ludlow.

IMPACT

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

Table 17 Hurricane Damage Classification

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		

The Town faces a “critical” impact from hurricanes, with 25 percent or more of Ludlow affected.

In the event of a tropical storm or hurricane, the greatest risk to Ludlow will be flooding of the Chicopee River. 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. Flooding of this and surrounding areas could result in difficulty moving populations out of harm’s way.

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 \$3,222,075,300, wind damage of 5 percent with 10 percent of structures damaged would result in an estimated \$16,110,377 of damage. Estimated flood damage to 10 percent of the structures with 20 percent damage to each structure would result in \$64,441,506 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, Ludlow faces a hazard index rating of “1 – highest risk” from hurricanes.

The entire town would be vulnerable to the impact of a hurricane. Areas prone to flooding are particularly vulnerable. Additionally, high could impact the town’s communication and energy infrastructure. The Hazard Mitigation Committee was uncertain about how individual critical facility structures would fair in high wind scenarios.

SEVERE SNOWSTORMS/ICE STORMS

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 ¼ inch for it to be considered an ice storm. When more than a ½ 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 Ludlow is susceptible to severe snowstorms. Because these storms occur regionally, they would impact the entire town thus making the location of occurrence “large”. There are no known areas with site-specific snow and ice problems.

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.

Table 18 Northeast Snowfall Impact Scale Categories

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

While the Town of Ludlow has not tracked snowfalls in the community, the weather reporters for the local Channel 3 news station produced this summary report of the top 10 snowfalls recorded in the region since 1905.

- 24.0 inches** | January 12, 2011
- 22.8 inches** | Feb 8-9 2013
- 21.9 inches** | February 12, 2006
- 21.0 inches** | February 11-2, 1983
- 18.2 inches** | December 19-20, 1945

- 17.7 inches** | December 29, 1945
- 17.4 inches** | February 19-20, 1934
- 17.0 inches** | February 20-21, 1921
- 16.9 inches** | February 6-7, 1978
- 16.9 inches** | December 26-27, 1947
- 16.3 inches** | March 5, 2001
- 16.2 inches** | February 4, 1926

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, in order of their NESIS severity.

Table 19 Winter Storms Producing Over 10 inches of Snow

Winter Storms Producing Over 10 inches of Snow in the Pioneer Valley, 1958-2013			
Date	NESIS Value	NASIS Category	NESIS Classification
3/12/1993	13.2	5	Extreme
3/2/1960	8.77	4	Crippling
2/15/2003	7.5	4	Crippling
2/2/1961	7.06	4	Crippling
1/21/2005	6.8	4	Crippling
1/19/1978	6.53	4	Crippling
12/25/1969	6.29	4	Crippling
2/10/1983	6.25	4	Crippling
2/14/1958	6.25	4	Crippling
2/5/1978	5.78	3	Major
2/23/2010	5.46	3	Major
2/8/1994	5.39	3	Major
1/9/2011	5.31	3	Major
2/18/1972	4.77	3	Major
12/11/1960	4.53	3	Major
2/7/2013	4.35	3	Major
2/22/1969	4.29	3	Major
1/18/1961	4.04	3	Major
2/8/1969	3.51	2	Significant
2/5/1967	3.5	2	Significant
4/6/1982	3.35	2	Significant

Winter Storms Producing Over 10 inches of Snow in the Pioneer Valley, 1958-2013			
3/4/2013	3.05	2	Significant
3/15/2007	2.54	2	Significant
3/31/1997	2.29	1	Notable
2/2/1995	1.43	1	Notable
1/25/1987	1.19	1	Notable

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

PROBABILITY OF FUTURE EVENTS

Based upon the availability of records for Hampden County, the likelihood that a severe snow storm will hit Ludlow in any given year is “very high,” greater 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 Town faces a “critical” impact, or more than 25 percent of total property damaged, from snowstorms.

To approximate the potential impact to property and people that could be affected by this hazard, the total value of all residential property in town, \$3,222,075,300 is used. An estimated 20 percent of damage would occur to 10 percent of structures, resulting in a total of \$64,441,506 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, Ludlow faces a hazard index rating of “1 – very high risk” from severe snowstorms and ice storms.

The entire town is vulnerable to the impacts of severe snow and ice. The town’s energy and communication infrastructure could be vulnerable to heavy snow or ice, which has been known to cause power outages across the region. Ice buildup on roadways has been known to make winter travel challenging and could impact evacuation efforts if ever needed.

SEVERE THUNDERSTORMS/WIND/TORNADOES

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 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.

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 County. 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 actual area potentially affected by these storms, is "large," with more than 50 percent of the Town affected.

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.

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

Table 20 Enhanced Fujita Scale

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

Because thunderstorms and wind affect the town regularly on an annual basis, there are not significant records available for these events. As per the Massachusetts Hazard Mitigation Plan, there are approximately 10 to 30 days of thunderstorm activity in the state each year.

In western Massachusetts, the majority of sighted tornadoes have occurred in a swath east of Ludlow, known as “tornado alley.” Sixteen incidents of tornado activity (all F2 or less) occurred in Hampden County between 1959 and 2014. No tornadoes have touched down in Ludlow.

Because tornadoes rarely occur in this part of the country, assessing damages is difficult. Furthermore, buildings have not been built to Zone 2, Design Wind Speed Codes.

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 Hampden County to determine the Tornado Index Value as shown in the table below.

Table 21 Tornado Index for Hampden County

Tornado Index for Hampden County	
Hampden County	138.23
Massachusetts	87.60
United States	136.45

Source: USA.com <http://www.usa.com/hampden-county-ma-natural-disasters-extremes.htm>

As per the Massachusetts Hazard Mitigation Plan, there are approximately 10 to 30 days of thunderstorm activity in the state each year. Based upon the available historical record, as well as Ludlow's location in a high-density cluster of state-wide tornado activity, it is reasonable to estimate that there is a "low" frequency of tornado occurrence in Ludlow in any given year.

IMPACT

The potential for locally catastrophic damage is a factor in any tornado, severe thunderstorm, or wind event. Most buildings in the Ludlow 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 most of the Town's housing build before this date.

Using a total value of \$3,222,075,300 of all residential units in Ludlow, and an estimated 10 percent of structures damaged each by 20 percent, yields a total damage of \$64,441,506. This estimate does not include building contents, land values or damages to utilities.

VULNERABILITY

Based on the above assessment, Ludlow has a hazard index rating of "4 – low risk" from severe thunderstorms and winds, and a "1 – very high risk" from tornadoes.

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 falls during a severe thunderstorm. Additionally, high winds could impact the town's energy and communication infrastructure.

WILDFIRE/BRUSH FIRE/URBAN FIRE

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 3 different classes 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

While much of Ludlow is developed, it still contains a large proportion of forested acreage that is undeveloped. Generally, Hampden County has approximately 273,000 acres of forested land, which accounts for 67 percent of total land area. The total amount of the Town that could be affected by a wildfire is categorized as “medium,” between 10 and 50 percent of the total land mass, depending on the wildfire’s scope.

EXTENT

Wildfires can cause widespread damage to the areas that they affect. 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. Ludlow has approximately 7,000 (50% of the Town) acres of forest along the Mt. Tom/East Mountain range and into West Ludlow. However, wildfire is unlikely to affect large areas of Ludlow as most forest areas are fragmented. Large tracts of land west of Interstate Route 91 are heavily forested. Difficult access to remote areas due to topography and lack of roads are factors in this risk. Based on wildfires that have occurred in western Massachusetts, it is estimated that wildfires will destroy around 50 to 500 acres of forested area.

The overall extent of wildfires is shown in the table below:

FIGURE: Extent of Wildfires

Rating	Basic Description	Detailed Description
CLASS 1: Low Danger (L) Color Code: Green	Fires not easily started	Fuels do not ignite readily from small firebrands. Fires in open or cured grassland may burn freely a few hours after rain, but wood fires spread slowly by creeping or smoldering and burn in irregular fingers. There is little danger of spotting.

<p>CLASS 2: Moderate Danger (M)</p> <p>Color Code: Blue</p>	<p>Fires start easily and spread at a moderate rate</p>	<p>Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Woods fires spread slowly to moderately fast. The average fire is of moderate intensity, although heavy concentrations of fuel – especially draped fuel -- may burn hot. Short-distance spotting may occur, but is not persistent. Fires are not likely to become serious and control is relatively easy.</p>
<p>CLASS 3: High Danger (H)</p> <p>Color Code: Yellow</p>	<p>Fires start easily and spread at a rapid rate</p>	<p>All fine dead fuels ignite readily and fires start easily from most causes. Unattended brush and campfires are likely to escape. Fires spread rapidly and short-distance spotting is common. High intensity burning may develop on slopes or in concentrations of fine fuel. Fires may become serious and their control difficult, unless they are hit hard and fast while small.</p>
<p>CLASS 4: Very High Danger (VH)</p> <p>Color Code: Orange</p>	<p>Fires start very easily and spread at a very fast rate</p>	<p>Fires start easily from all causes and immediately after ignition, spread rapidly and increase quickly in intensity. Spot fires are a constant danger. Fires burning in light fuels may quickly develop high-intensity characteristics - such as long-distance spotting - and fire whirlwinds, when they burn into heavier fuels. Direct attack at the head of such fires is rarely possible after they have been burning more than a few minutes.</p>
<p>CLASS 5: Extreme (E)</p> <p>Color Code: Red</p>	<p>Fire situation is explosive and can result in extensive property damage</p>	<p>Fires under extreme conditions start quickly, spread furiously and burn intensely. All fires are potentially serious. Development into high-intensity burning will usually be faster and occur from smaller fires than in the Very High Danger class (4). Direct attack is rarely possible and may be dangerous, except immediately after ignition. Fires that develop headway in heavy slash or in conifer stands may be unmanageable while the extreme burning condition lasts. Under these conditions, the only effective and safe control action is on the flanks, until the weather changes or the fuel supply lessens.</p>

PREVIOUS OCCURRENCES

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 Litchia 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

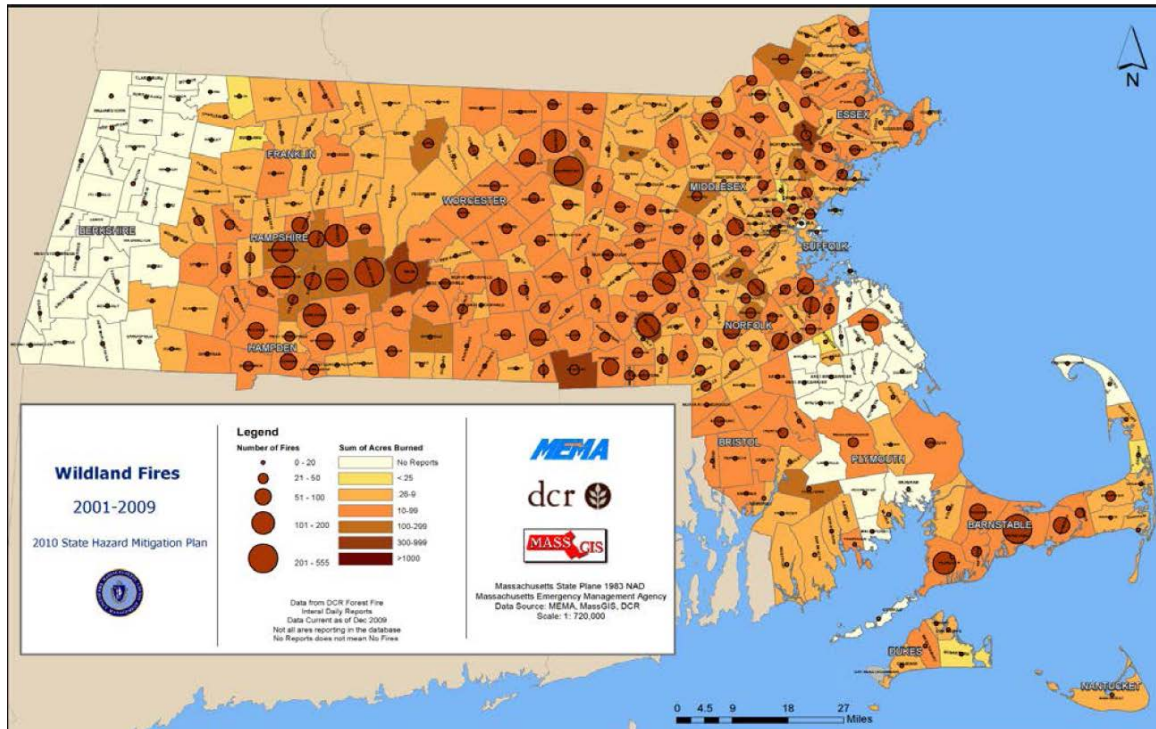


Figure 4 Wildland Fires in Massachusetts

Source: Massachusetts Hazard Mitigation Plan

PROBABILITY OF FUTURE EVENTS

In accordance with the Massachusetts Hazard Mitigation Plan, the Town Hazard Mitigation Workgroup found it is difficult to predict the likelihood of wildfires in a probabilistic manner because 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 “low.”

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.

IMPACT

2016 Hazard Mitigation Plan Update

The impact from a wildfire would be “limited.” Using a total value of \$3,222,075,300 of all structures in Ludlow, and an estimated 1 percent of structures damaged each by 50 percent, an estimated damage due to wildfire is \$16,110,377. This estimate does not include building contents, land values or damages to utilities.

VULNERABILITY

Based on the above assessment, Ludlow faces hazard index rating of “2 – high risk” from wildfires.

The northeast corner of Ludlow and the Ludlow State Forest are most vulnerable to the impacts of wildfire. These lands make up most of the town’s contiguous parcels of forested lands. There are no critical facilities located in these parts of town that would be impacted.

IMPACTS OF CLIMATE CHANGE

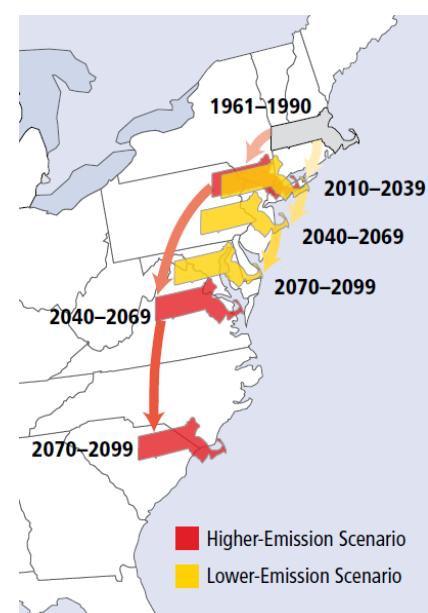
Climate change is already causing natural hazards to have more of an impact on Ludlow, with hotter summers, wetter winters, more severe storms, and more frequent flooding. In the future, general climatic changes are projected to result in Ludlow experiencing higher temperatures and more precipitation. There will also be wider variability in weather extreme and more days of extreme heat above 90 degrees, more heat waves, more floods, more droughts, and more tornados, hurricanes and heavy storms.

This change in climate will expand the area of Ludlow that is within the 100-year and 500-year floodplain, affect critical resources and vulnerable populations, alter local food production, increase the risk of wildfires, and result in increased damage to people and property.

This section identifies the impacts that climate change will have to the various identified hazards affecting Ludlow. The information included is derived from several accepted sources:

- The 2007 report of the Northeast Climate Impacts Assessment (NECIA)
- The Pioneer Valley Planning Commission’s *Our Next Future: An Action Plan for Building a Smart, Resilient Pioneer Valley*, which includes climate change projections
- The Massachusetts Climate Change Adaptation Report
- The Massachusetts Multi-Hazard Mitigation Plan

The mitigation strategies included in the Mitigation Strategy also take into account the impacts of climate change and provide adaptation strategies where appropriate.



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

INCREASED FLOODING

By the end of the 21st century, annual precipitation is expected to increase by 14 percent – however, this increase will be a result of more winter precipitation – an increase of 30 percent– while summer precipitation will actually slightly decrease. Additionally, most of this winter precipitation is projected to be in the form of rain rather than snow. This will result in a continuation of the current trend of an overall decrease in total snowfall, as well as the number of days that have snow cover. The increased amount of strong precipitation events and overall increase in rainfall will likely result in more flooding in the region.

Table 22 Expected Climatic Variations 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

Sources: Massachusetts Climate Adaptation Report 2011, NECIA

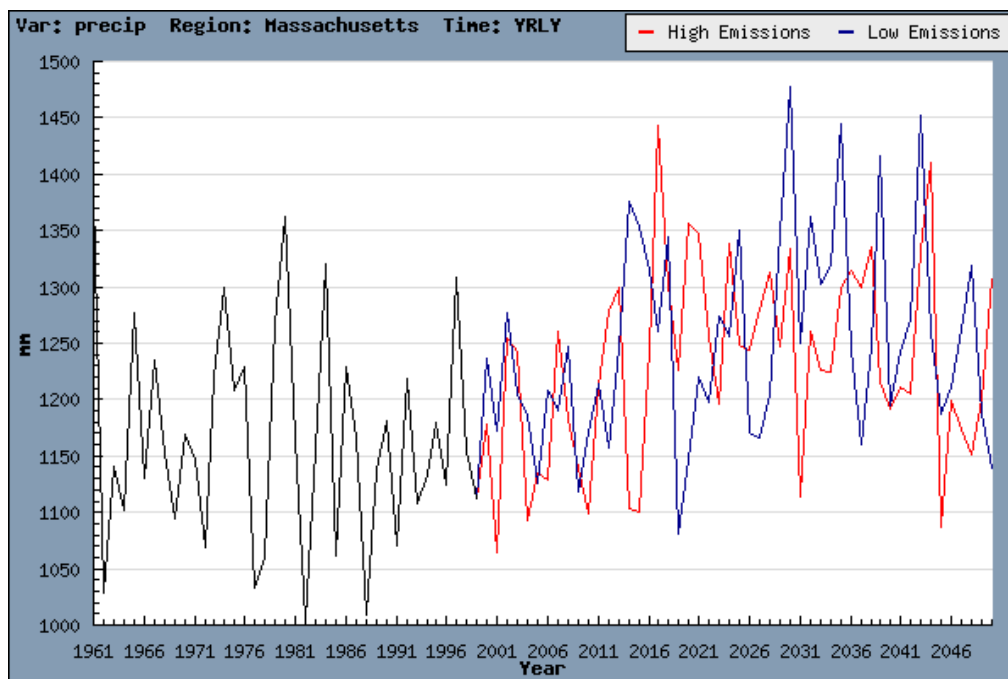


Figure 5 Massachusetts Rainfall 1961-2050

Rainfall has increased approximately 10% during the past 50 years, and is expected to continue to increase.

Source: NECIA

INCREASED TEMPERATURES

Average temperatures in the Pioneer Valley have been increasing over time in the Pioneer Valley due to climate change, and this trend is likely to continue in the future. Higher temperatures due to climate change will likely have an effect on future drought risk in Ludlow. The climate of the Pioneer Valley is strongly influenced by the weather patterns of the larger Northeast United States, a region ranging from Pennsylvania to Maine. Average temperatures in the Northeast have been increasing since the late 1800s. The overall average annual temperature increase in this area has been approximately .9 degrees C (1.5°F) since approximately 1900.

According to records of the United States Historical Climatology Network, most of this temperature increase has occurred recently, with an average increase of about 0.2 degrees C (0.5°F) per decade since 1970. These higher average temperatures have primarily been the result of warmer winters (December through March), during which there has been an increase of 1.3°F per decade since 1970. In addition to average temperature increases, the number of extremely hot and record heat days has also increased: the number of days with temperatures of 90°F and higher throughout the Northeast has doubled during the past 45 years. The northern portion of the Northeast currently sees about 5 days per year with temperatures over 90°F and no days over 100°F, while the southern portion sees up to 20 days over 90°F and 2 days over 100°F.

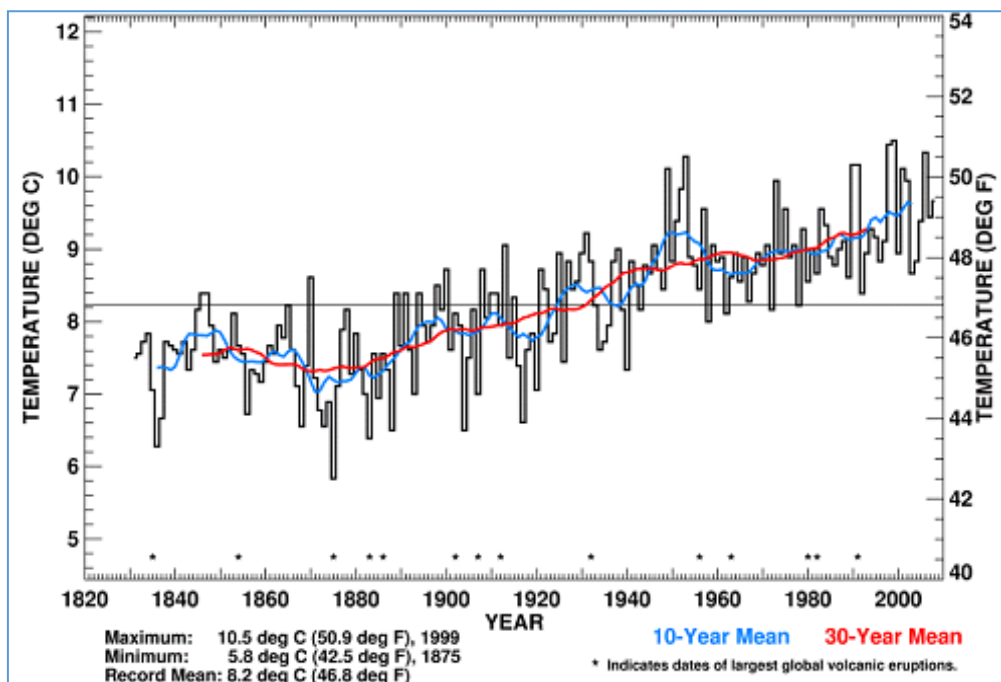


Figure 6 Northeast U.S. Region Annual Average Temperatures 1831-2008

From 1831 to 2008, there was a trend in temperatures steadily increasing at the National Weather Service's Blue Hill Observatory, the home of the oldest continuously recorded weather records in the U.S. Source: Michael J. Iacono, Atmospheric and Environmental Research, Inc./ Blue Hill

Observatory, MA. Plot includes temperature data for 1831–1884 from Milton and Canton that were adjusted to the Blue Hill summit location.

Increased temperatures will have the following projected impacts to people and property:

- Increased temperatures will put stress on current food production and require farming operations to adjust by planting new varieties of crops.
- Changes are also likely to introduce new insect species, pests, and invasive plant species to the region, which will result in further threats to food production and also adversely affect natural systems and biodiversity. Additional prominence of ticks may potentially also lead to more occurrence of Lyme disease.
- Increased energy usage in order to cool buildings in the summer and long-term electrical needs will increase.
- Greater stress on special populations, such as senior citizens, without access to air conditioning during heat waves.

SEVERE WEATHER

Temperature and precipitation changes in the region will lead to increased severe and extreme weather events, including:

- Slight decrease in summer precipitation that will result in an increase in the number of droughts. Short-term (1 to 3 month) droughts are likely to increase in their frequency in the Northeast to the level of once per year. According to the Connecticut Climate Adaptation Report, “Facing Our Future,” the occurrence of drought in that state is already increasing, with shallower lakes drying up.⁵
- Decreased rainfalls will potentially create more occurrences of wildfires.
- Less dependable rainfall will also impact the Pioneer Valley’s food systems, in the form of less dependable rainfall and require the region’s farming operations to evolve.
- Increased occurrences of major snowstorms, especially during times previously considered unseasonably warm. Should storms occur when there are still leaves on trees, there could be great damage due to broken limbs, as happened during the snowstorm of 2011.
- Increased occurrences of severe thunderstorms and hurricanes, which will result in more wind damage from major storms and greater flooding.

SECONDARY EFFECTS

- Disruption of communications services due to damage to cellular phone towers and other communications devices.
- Increased costs of home ownership due to higher flood insurance premiums, which will disproportionately affect low income residents.
- Higher difficulty in the ability of residents to obtain basic services that are heavily reliant on electricity after severe weather events, including gasoline and perishable food items.

⁵ State of Connecticut Department of Environmental Protection. Facing Our Future: Adapting to Connecticut’s Changing Climate. March 2009.

CHAPTER 4. CRITICAL FACILITIES

A Critical Facility is defined as a building, structure, or location which:

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

CRITICAL FACILITIES WITHIN HAZARD AREAS

Hazards identified in this plan are regional risks and, as such, all critical facilities fall into the hazard area. There are several critical facilities that fall within specific hazardous areas as shown in the table at the end of this section.

The Critical Facilities List for the Town of Ludlow has been identified utilizing a Critical Facilities List provided by the State Hazard Mitigation Officer. Ludlow's Hazard Mitigation Committee has broken up this list of facilities into four categories. The first category contains facilities needed for Emergency Response in the event of a disaster. The second category contains 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 Ludlow. The third category contains Facilities/Populations that the Committee wishes to protect in the event of a disaster. The fourth category contains 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 a table following this list.

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. Please note all buildings marked with * have a generator.

1) Emergency Operations Center

- *Ludlow Public Safety Complex – 612 Chapin Street
- *Department of Public Works, Highway Division (back-up EOC) – 198 Sportsmans Road

2) Fire Station

- *Ludlow Public Safety Complex – 612 Chapin Street

3) Police Station

- *Ludlow Public Safety Complex – 612 Chapin Street

4) Highway Garage

- *Department of Public Works, Highway Division (back-up EOC) – 198 Sportsmans Road

5) Emergency Electrical Power Facility

- Mass Municipal Wholesale Electric Company (MMWEC) – Moody Street

6) Emergency Shelters

- *Baird Middle School – 109 Sportsmen Road
- *Health South – 222 State Street
- Ludlow Senior Center – 37 Chestnut Street
- *Ludlow High School – 500 Chapin Street
- *Chapin Street School – 766 Chapin Street
- *East Street School – 508 East Street
- Town Hall (a vaccine distribution site for the Board of Health) – 488 Chapin Street
- Veterans Park Elementary School -486 Chapin Street

7) Dry Hydrants - Fire Ponds - Water Sources

- Springfield Reservoir
- Leland Drive (cistern)
- Jared Drive (cistern)
- Parker Lane (cistern)

8) Transfer Station

- *Department of Public Works, Highway Division – 198 Sportsmans Road, includes transfer station and curbside pick-up

9) Utilities

- Bay State Gas LNG Plant (abuts the Chicopee river and transports LNG daily) – 5 Ravenwood Drive
- Buckeye Pipeline – Tank Farm Road
- Hydroelectric Dam – 1 Putts/Ludlow Bridge
- Hydroelectric Dam – 1 Miller Street
- Hydroelectric Dam – 1 Red Bridge
- Mass Municipal Wholesale Electric Company – Westover Industrial Park
- Power Substation – Center Street

10) Airports

- Westover Air Base

11) Communications

- *Cell Tower – 1 State Street
- *Cell Tower – 145 Carmelina’s Circle
- *Cell Tower – 1709 Center Street
- *Cell Tower – 183 Ravenwood Drive
- *Cell Tower – 34 Carmelina’s Circle
- *Cell Tower – 653 Moore Street
- *Cell Tower – Miller Street
- *Cell Tower – West Street
- *Cell Tower – Poole Street
- *Cell Tower – Nash Hill Road
- Charter Communications Hub Site – Ludlow High School, 500 Chapin Street
- *Public Safety Complex – 612 Chapin Street

12) Primary Evacuation Routes

- Cady Street
- Chapin Street
- Church Street
- East Street
- Fuller Street
- Holyoke Street
- Kendall Street
- Massachusetts Turnpike (I-90)
- Miller Street
- Pool Street
- Rood Street
- Route 21 (Center Street)
- Russell Street
- West Avenue
- West Street

13) Bridges Located on Evacuation Routes

- Collins Bridge/Miller Street
- East Street – over Chicopee River
- Fire Station Bridge
- Holyoke Street – over Harris Pond
- Interstate 90 (Mass Pike) – over Chicopee River
- Putts/Ludlow Bridge
- Red Bridge Road (Wilbraham) – over Chicopee River
- West Street – one over Chicopee River

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 Ludlow.

1. Water Supply (50% of town has well water)

- Nash Hill Covered Reservoir, part of Massachusetts Water Resources Authority – Chicopee Valley Aqueduct carries water through Nash Hill Reservoir. Supply for Fuller Street residents and hydrants through South Hadley water line.
- Springfield Water and Sewer Commission – delivers water to Ludlow
- Springfield Reservoir (Back up water supply)
- Wilbraham Water line (Miller Street Residents)

2. Problem Culverts

- Bondsville Road
- Center Street & Alden
- Piney Lane
- Pool Street
- Randall Road – impacted by beavers
- West Street/Brook Street

Note: Ludlow does not have a wastewater treatment plant. All wastewater goes to Springfield for treatment.

CATEGORY 3 – FACILITIES/POPULATIONS TO PROTECT

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

1. Hospitals

- *Health South – 222 State Street– rehabilitation hospital

2. Special Needs Population

- *Hampden County House of Correction – 627 Randall Road

3. Elderly Housing/Assisted Living

- *Assisted Living – 460 West Street, Keystone Commons
- Chestnut Street Housing (disabled/elderly) – 39 Chestnut Street
- Colonial Sunshine Manor (disabled/elderly) – 114 Wilson Street
- State/Meadow Street Housing for Elderly – 69 State Street
- *Steven’s Memorial Building (disabled/elderly) – 12 Chestnut Street
- HAP Housing may build a new facility at 188 Fuller Street
- World Development Senior Housing building a 75 unit building at Mill #10

4. Recreation Areas

- Camp White – Munsing Street
- Children’s Playground – across from 47 Sewall Street
- Facing Rock Wildlife Management Area – Lyon St.
- Ludlow Country Club – Tony Lema Drive & East Street
- Memorial Park – Chestnut Street & Sewall Street
- Springfield Reservoir – Center St.
- West Street Park – Cady & West Street
- Westover Golf Course – South Street
- Whitney Park – 167 Howard Street

5. Schools

- *Baird Middle School – 109 Sportsmen Road
- Chapin Street Elementary School – 766 Chapin Street (may get replaced by a new school on the same street)
- Early Childhood Partnership and Integrated Preschool Program – 54 Winsor St
- East Street Elementary School – 508 East Street
- Ludlow Community Center/Randall Boys & Girls Club – 91 Claudias Way
- *Ludlow High School – 500 Chapin Street
- St. John the Baptist School – 181 Hubbard Street & Oak Street
- Tiny Explorers Daycare – 658 Center Street
- Veterans Park Elementary School – 486 Chapin Street

6. Churches

- *Church of Latter Day Saints – 584 West Street
- Christ the King Church – 41 Warsaw Avenue
- Community Faith Chapter – 12 Cedar & East Street
- First Church – 859 Center Street
- Jehovah’s Witnesses – Fuller Street
- Love/Div/Prayer Church – Hampden/Windsor East
- Our Lady of Fatima – 438 Winsor Street
- St. Elizabeth’s Church – 181 Hubbard Street & Oak Street
- St. Paul’s Methodist Church – Hubbard & Sewall Street
- St. Peter & Paul Ukranian Catholic Church – 45 Newbury Street
- Union Church – Center Street

7. Historic Buildings/Sites

- 1st Meeting House
- Clock Tower
- Ludlow Center Historic District – along Center, Church and Booth Streets
- Ludlow Village Historic District – roughly bounded by Winsor, Sewall and State Streets and the Chicopee R. and crossing the Chicopee Road Above Red Bridge Road

8. Mobile Home Parks

- 229 Miller Street
- 350 West Street

CATEGORY 4 – POTENTIAL RESOURCES

Contains facilities that provide potential resources for services or supplies.

1. Food/Water

- Big Y Supermarket Complex – 433 Center Street

2. Hospitals/Medical Supplies

- CVS Pharmacy – 433 Center Street
- Walgreens - 54 East Street
- *Health South – 222 State Street
- Dialysis Center – Old Health South, 14 Chestnut Place

3. Heating Fuel

- Ludlow Heating and Cooling – 1056 Center Street

4. Gas

- *Department of Public Works, Highway Division – 198 Sportsmen’s Road
- Pride 478 Center Street

5. Building Materials Suppliers

- C&A Smith Lumber and Feed – 84 Hubbard Street

6. Heavy & Small Equipment Suppliers

- Carmelina's Circle – Construction Companies
- United Rentals – 562 Holyoke Street

7. Gravel Pits

- Banas Concrete - 246 Fuller Street
- Chenier's Gravel Bank – 405 Munsing Street
- Daniel's Gravel Bank – 466 Miller Street
- Gomes/Gyn Mar
- Libbys – Center Street
- Nowrsky – Lyon Street
- Ray Haluch Gravel Co. – 1014 Center Street

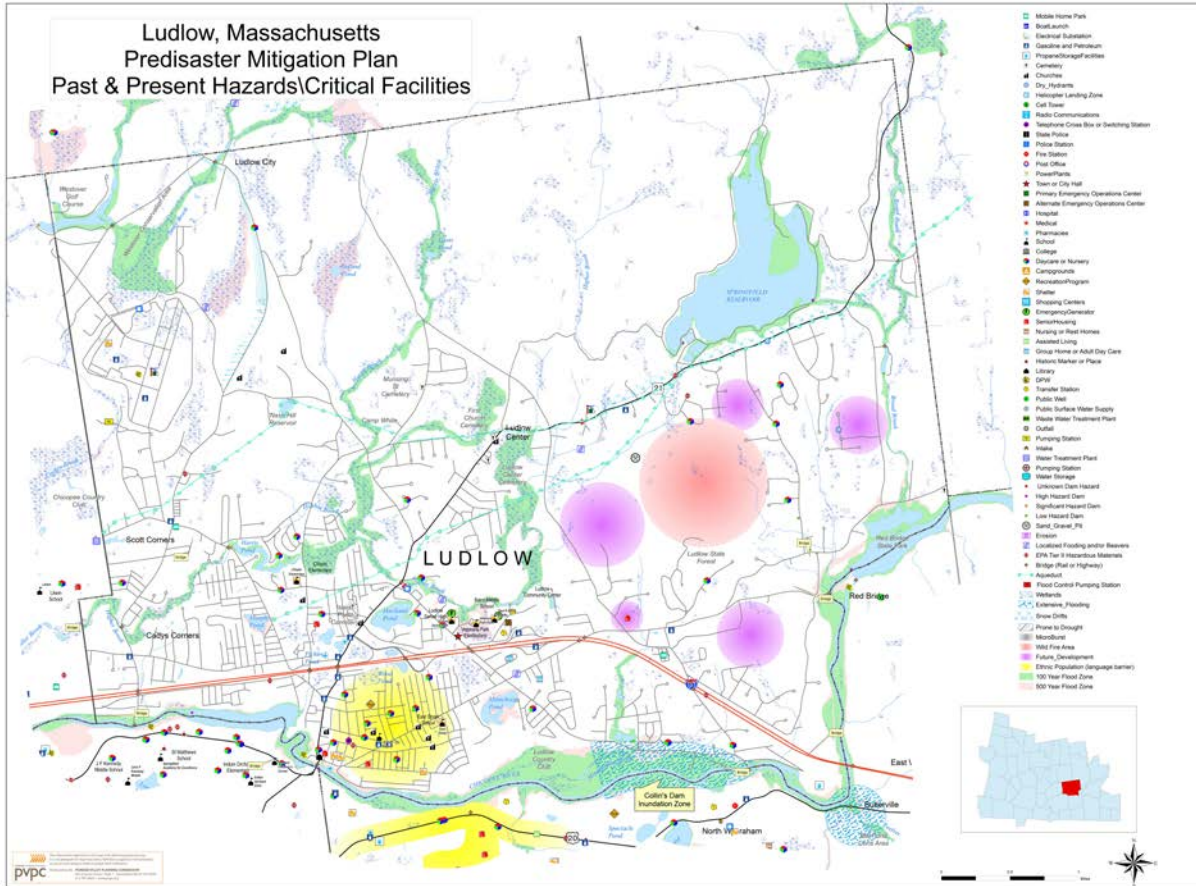


Figure 7 Ludlow Critical Facilities Map

CRITICAL FACILITIES IN HAZARD AREAS

The table below lists critical facilities in high hazard areas.

Table 23 Critical Facilities in Hazard Areas

Hazards	Critical Facilities Impacted
Dam Failure	Dependent on which dam were to fail
Drought	Water Supply could be impacted depending on severity.
Earthquake	Older constructions more vulnerable. 8 bridges have evacuation routes that could be vulnerable.
Extreme Temperatures	None.
Flood	Ludlow Senior High School, Baird Middle School, Veteran’s Park Elementary School, Town Hall and the Chapin Elementary School could be impacted if Higher Brook sees severe flooding.
Hurricane/Tropical Storm	See Flooding. Wind could damage energy and communication infrastructure
Severe Snowstorm/Ice Storm	Energy and Communication Infrastructure
Severe Thunderstorm/Wind/Tornado	See Flooding. Wind could also damage energy and communication infrastructure and older buildings.
Wildfire	None.

CHAPTER 5. MITIGATION STRATEGY

The hazard mitigation strategy is the culmination of work presented in the previous sections of this plan. It is also the result of multiple Hazard Mitigation Committee meetings and public outreach. 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 Committee developed a set of hazard mitigation strategies it would like to implement.

CAPABILITY ASSESSMENT

The first step in the mitigation strategy portion of the 2016 Hazard Mitigation Plan Update process was to evaluate all of the Town's existing policies and practices related to natural hazards and identify potential gaps in protection. Ludlow's local Hazard Mitigation Committee worked with Ms. Caplan to complete the FEMA Capability Assessment worksheet. A summary of those findings is below.

PLANNING AND REGULATORY

Ludlow has a Master Plan in place and a Local Emergency Operations Plan. They are currently developing a Capital Improvements Plan. Transportation is covered in the Master Plan. The Town does not have a specific Stormwater Management Plan or a Wildlife Protection Plan, however the Zoning Bylaws and Subdivision Regulations include stormwater regulations. They adhere to current State level building codes. Their Zoning Ordinance covers floodplain management. They do have a specific Subdivision Ordinance and a Wetlands Protection plan.

ADMINISTRATIVE AND TECHNICAL

The Ludlow Planning Board and Selectboard are the primary leadership groups within the Town. The Hazard Mitigation Committee was revived for the purposes of updating this plan. Ludlow has a fully staffed local government, including an Emergency Management Director, a Building Official, an engineer and a Planner. The Town relies on contract support from Tighe Bond for the majority of their Geographic Information System (GIS) needs. Memorandums of Understanding (MOUs) with bordering communities are in place. They use a reverse 911 system to warn Town residents of impending disasters. Grant writing is shared by all departments.

FINANCIAL

The Town is sound financially and they collect fees for sewer. They have not received Community Development Block Grant Funding.

EDUCATION AND OUTREACH

In terms of education and outreach the Town is working on educating their constituents about hazard mitigation and preparedness. The Fire and Police Departments have a relationship with the School Department and provide education services on a regular basis. The Town website includes mitigation and preparedness information.

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

- Comprehensive Emergency Management Plan

- Conservation Bylaws
- Proposed Zoning
 - Ch.40R Smart Growth Zoning District
 - 40R Bylaw and Design Standards
- Subdivision Rules and Regulations
- Town Bylaws
- Town Open Space and Recreation Plan
- Zoning Bylaws

NATIONAL FLOOD INSURANCE PROGRAM

The Town of Ludlow participates in the National Flood Insurance Program. As of February 9, 2016, there were 24 policies in effect in Ludlow for a total of \$5,573,600 in coverage and \$23,471 premium.⁶ Ludlow entered the NFIP on July 6, 1974, their current NFIP map is dated July 16, 2013.⁷ Ludlow has had a total of six claims as of February 29, 2016 for total payments of \$14,991.88.⁸ As of January of 2016, there have been no repetitive loss properties in Ludlow.

The Town will maintain compliance with the NFIP throughout the next 5-year hazard mitigation planning cycle by monitoring its Flood Plain Overlay District and ensuring that the district accurately reflects the 100-year floodplain and FEMA Flood Insurance Rate Map.

The town is not a member of the Community Rating System (CRS), which entitles policyholders to a discount on flood insurance premiums. The CRS reduces flood insurance premiums to reflect what a community does above and beyond the National Flood Insurance Program's (NFIP) minimum standards for floodplain regulation. The objective of the CRS is to reward communities for what they are doing, as well as to provide an incentive for new flood protection activities. To participate in the CRS, a community must fill out an application and submit documentation that shows what it is doing and that its activities deserve at least 500 points. More information including instructions and applications is available at <http://training.fema.gov/EMIWeb/CRS/m3s1main.html>

Given the lack of recurring loss properties in the Town, singular participation in the program would not likely be cost-effective; however, the Town sees potential benefit in a regional effort. A regional effort would require partnering with local towns and the Pioneer Valley Planning Commission to pool resources in order to fulfill the CRS requirements. For example, a region-wide public information campaign could be created and used by multiple communities, as opposed to each community creating their own in order to fulfill the community outreach component of the CRS. Therefore, the Town of Ludlow has added a mitigation action to this plan that they would participate in a regional CRS effort if there were interest from other communities and funding available.

⁶ <http://bsa.nfipstat.fema.gov/reports/1011.htm#MAT>

⁷ <http://www.fema.gov/cis/MA.html>

⁸ <http://bsa.nfipstat.fema.gov/reports/1040.htm#25>

MITIGATION CAPABILITIES BY HAZARD

DAM FAILURES

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.

MANAGEMENT PLANS AND REGULATORY MEASURES

The Ludlow Comprehensive Emergency Management (CEM) Plan contains the following mitigation measures for dam failure:

- Develop and conduct public education programs concerning dam hazards.
- Maintain up-to-date plans to deal with threat and actual occurrence of dam over-spill or failure.
- Emergency Management and other local government agencies should familiarize themselves with technical data and other information pertinent to the dams which impact Ludlow. This should include determining the probable extent and seriousness of the effect to downstream areas.
- Dams should be inspected periodically and monitored regularly.
- Repairs should be attended to promptly.
- As much as is possible burdens on faulty dams should be lessened through stream re-channeling.
- Identify dam owners.
- Determine minimum notification time for downstream areas.
- Contaminate-laden waste (including dams that hold back pollution from traveling downstream).

PERMITS REQUIRED FOR NEW DAM CONSTRUCTION

Massachusetts State Law (M.G.L. Chapter 253 Section 45) regulates the construction of new dams. A permit must be obtained from the Department of Conservation and Recreation (DCR) before construction can begin. One of the permit requirements is that all local approvals or permits must be obtained. All new dams must adhere to seismic requirements set forth in the 8th Edition of the Massachusetts State Building Code.

DAM INSPECTIONS AND REMOVAL OF DAMS

The DCR requires that dams rated as Low Hazards are inspected every ten years and dams that are rated as Medium/Significant Hazards are inspected every five years. High Hazard dams must be inspected every two years. The Town has carried out inspection of Lower Reservoir Dam, Middle Reservoir Dam, and Upper Reservoir Dam and determined that Upper Reservoir Dam is in poor condition. The Town is currently beginning the process of permitting and design to remove this structure.

RESTRICTIONS ON DEVELOPMENT

There are no Town restrictions on dam locations. The DCR issues permits for new dams and does have the authority to deny a permit if it is determined that the design and/or location of the dam is not acceptable.

Existing Action	Description	Area Covered	Effectiveness	Potential Changes
Comprehensive Emergency Management Plan	The CEM Plan includes a variety of public education and regular maintenance initiatives for dam safety.	Entire Town.	Effective.	None.
Permits required for new dam construction	State law requires a permit for the construction of any dam.	Entire Town.	Effective. Ensures dams are adequately designed.	None.
Dam Inspections	DCR has an inspection schedule that is based on the hazard rating of the dam (low, medium, high hazard).	Entire Town.	Dams located on private land must be inspected by property owner. The Town's Conservation Commission is responsible for inspecting two Town-owned dams and DPW for three Town-owned dams.	None.
Evacuation Plans	Comprehensive evacuation plans ensure the safety of the citizens in the event of dam failure.	Inundation areas in Town.	Effective.	None.

Table 24 Dam Failure Mitigation Capabilities

DROUGHT CAPABILITIES

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.

STATE REGULATIONS

The Town of Ludlow follows the state's Water Management Act, which limits the amount of water consumption during a state-issued Water Emergency Declaration. For more information, visit:

www.mass.gov/eea/agencies/massdep/water/drinking/the-massachusetts-water-management-act-program.html.

TOWN OPERATIONS

The Town of Ludlow routinely works to identify and repair water system leaks. Current water loss due to leakage is less than 10 percent of the total consumption.

Existing Action	Description	Area Covered	Effectiveness	Potential Changes
Massachusetts Water Management Act	Regulates amount of water that can be used during a Water Emergency Declaration.	Entire Town.	Effective.	None.
Identification and reduction of water system leaks	The Department of Public Works routinely inspects and repairs water system leaks.	Entire Town.	Effective.	None.

Table 25 Drought Mitigation Capabilities

EARTHQUAKE MITIGATION CAPABILITIES

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. 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.

MANAGEMENT PLANS

The Ludlow Comprehensive Emergency Management Plan lists the following mitigation measures for earthquakes:

- Community leaders in cooperation with Emergency Management Personnel maintain an assessment of structures and land areas that are especially vulnerable to earthquake.
- Strict adherence should be paid to land use and earthquake resistant building codes for all new construction.
- Periodic evaluation, repair, and/or improvement should be made to older public structures.
- Emergency earthquake public information and instructions should be developed and disseminated.

STATE BUILDING CODE

State and local building inspectors are guided by regulations put forth in the Massachusetts State Building Code. The first edition of the Massachusetts State Building Code went into effect on January 1, 1975 and included specific earthquake resistant design standards. These seismic requirements for new construction have been revised and updated over the years and are part of the current, 8th edition of the Massachusetts State Building Code. Given that most structures in Massachusetts were built before 1975, of many buildings and structures do not have specific earthquake resistant design features. In addition, built areas underlain by artificial fill, sandy or clay soils are particularly vulnerable to damage during an earthquake.

RESTRICTIONS ON DEVELOPMENT

There are no seismic-related restrictions on development beyond that in the building code.

Existing Action	Description	Area Covered	Effectiveness	Potential Changes
Comprehensive Emergency Management Plan	The CEM Plan includes measures for earthquake preparation that include keeping an assessment of structures and land areas that are especially vulnerable to earthquakes, strict adherence to building code, periodic evaluation, repair, and/or improvement to older public structures, and dissemination of public information about how to prepare for earthquakes.	Entire Town.	Effective.	None.
State Building Code	The Town of Ludlow has adopted the 8 th Edition of the State Building Code.	Entire Town.	Effective for new buildings only.	None.
Subdivision Regulations: Design Standards for Utilities	Utility lines are to be placed underground.	Entire Town.	Somewhat effective for ensuring that utility service in new subdivisions remain interrupted, as well as reducing the likelihood of damage incurred from falling utility lines.	None.

Table 26 Earthquake Mitigation Capabilities

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 zoning ordinance, and subdivision regulations. Infrastructure like dams and culverts are in place to manage the flow of water.

MANAGEMENT PLANS

The Comprehensive Emergency Management (CEM) Plan for Ludlow lists the following measures for flood planning:

- Identify areas in the community that are flood prone and define methods to minimize the risk. Review National Flood Insurance Maps.
- Disseminate emergency public information and instructions concerning flood preparedness and safety.
- Community leaders should ensure that Ludlow continues to be enrolled in the National Flood Insurance Program.
- Strict adherence should be paid to land use and building codes, (e.g. Wetlands Protection Act), and new construction should not be built in flood-prone areas.
- Ensure that flood control works are in good operating condition at all times.
- Natural water storage areas should be preserved.
- Maintain plans for managing all flood emergency response activities including addressing potentially hazardous dams.

SUBDIVISION RULES AND REGULATIONS

Ludlow's Subdivision Rules and Regulations, which govern the subdivision of land, were adopted for the purpose of protecting the safety and welfare of residents by regulating the planning, design, and construction of subdivisions. The Subdivision Rules and Regulations contain several provisions that mitigate the potential for, and impact of, flooding.

LUDLOW ZONING ORDINANCE

The Town of Ludlow has adopted several land use regulations that serve to limit or regulate development in floodplains, to manage stormwater runoff, and to protect groundwater and wetland resources, the latter of which often provide important flood storage capacity. To review the Town of Ludlow's Zoning Ordinance, visit www.Ludlow.org.

THE ZONING ORDINANCE INCLUDE SEVERAL PROVISIONS THAT MITIGATE THE POTENTIAL FOR FLOODING, INCLUDING:

- Floodplain Overlay District restricts development in flood zones, permitting only single-family residential and other open space uses. Substantial modifications to existing structures, or the construction of new structures, may only occur if the basement/ground flood is set above the baseline flood elevation and the foundation is constructed to withstand the pressure, velocity, and rate of a flood event.
- Storm Water and Erosion Control Ordinance and Performance Standards ensure that post-development peak discharge does not exceed the pre-development rate during a 24 hour, 2-year frequency storm. Adequate drainage, including vegetative swales and impervious pavement, and other low impact design technologies are encouraged as part of Massachusetts's Low Impact Development Incentive that is a component of these performance standards.
- The site plan review process shall: have all stormwater systems approved according to the Storm Water Performance Standards floodplains and water bodies must be delineated, an erosion control plan that prevents infill of water bodies must be approved, in addition to delineation of adjacent topography, slope, and natural vegetation.
- Commercial, industrial, and planned unit development are required to present a plan for approval that illustrates topography, water resources and wetlands, stormwater discharge rates and pathways, drainage basins and swales, natural vegetation, and existing and proposed slope (which requires Planning Board approval if it exceeds 15%).
- The Flexible Development Ordinance provides an alternative to traditional subdivisions by encouraging the preservation of open space and natural vegetative features that can act as infiltration for storm water. Proposed development must have a plan that illustrates the surrounding topography, natural vegetation, water resources and wetlands, stormwater and drainage pathways and rates, and slope/grade of proposed lots, roadways, and other pathways. All development is required to have a 50' vegetative buffer circumscribing it in an effort to maintain natural land that can control against flooding.
- The Water Resources Protection District prohibits the use of toxic chemicals and restricts the excavation land within those lands that are critical to the Town's drinking water supplies. This works to maintain natural hydrology.

RIVER AND STREAM PROTECTION

The Town of Ludlow follows the standards established by the Wetlands Protection Act, which protects water bodies and wetlands through the Town Conservation Commission. The Town also has instituted its Water Resources Protection District, an overlay district that provides restrictions on use categories, the use of septic tanks and leach fields, as well as on the impacting of the flood storage capacity of the land.

Existing Action	Description	Area Covered	Effectiveness	Potential Changes
Comprehensive Emergency Management Plan	The CEM Plan lists the following measures for flood planning: Identify areas in the community that are flood prone, review National Flood Insurance Maps, disseminate emergency public information and instructions concerning flood preparedness and safety, adhere to land use and building codes, ensure that flood control works are in good condition, and preservation of natural are in good operating condition at all times.	Entire Town.	Effective.	None.
Subdivision Rules and Regulations	<p>Subdivision plan requires delineating natural waterways and floodways</p> <p>The subdivision regulations must comply with zoning protections for natural features.</p> <p>Subdivision drainage must be designed to withstand peak discharge rates from storms</p> <p>New utilities must be buried.</p> <p>Design Standards for stormwater management systems - requiring easements, retention ponds, and other flood control infrastructure.</p>	Entire Town.	<p>Somewhat effective for mitigating or preventing localized flooding of roads and other infrastructure.</p> <p>Somewhat effective for controlling impacts from stormwater runoff.</p> <p>Prevents flood damage to infrastructure.</p> <p>Somewhat effective for controlling impacts from stormwater runoff.</p>	None.

Existing Action	Description	Area Covered	Effectiveness	Potential Changes
<p>Zoning Ordinance: Special Permit</p> <p>Floodplain Overlay</p> <p>Water Supply Protection District</p>	<p>Requires the site plan to show slope and elevation, erosion control, drainage facilities, and other methods of addressing flood hazards</p> <p>Preserves and protects development by limiting uses and requiring new construction or modifications to be set above baseline flood elevation</p> <p>Preserves primary and secondary recharge areas through preventing the use of hazardous chemicals— either through strict conditions or outright prohibitions.</p>	<p>Entire Town.</p> <p>Area designated on Zoning Map.</p> <p>Area designated on Zoning Map.</p>	<p>Somewhat effective.</p> <p>Somewhat effective.</p> <p>Somewhat effective.</p>	<p>None.</p>
<p>Stormwater Project Priority List</p>	<p>Prioritized list of culvert replacements, repairs, and other stormwater management needs.</p>	<p>Entire Town.</p>	<p>Effective at managing necessary improvements to flood prone areas,</p>	<p>None.</p>

Existing Action	Description	Area Covered	Effectiveness	Potential Changes
River and Stream Protection	Required enforcement standards established by the Wetlands Protection Act	Entire Town.	Effective at protecting water bodies and wetlands.	None.
Ludlow Open Space and Recreation Plan	Inventories natural features and promotes natural resource preservation in the Town, including areas in the floodplain; such as wetlands, aquifer recharge areas, farms and open space, rivers, streams and brooks.	Entire Town.	Effective in identifying sensitive resource areas, including floodplains. Encourages open space protection, which will help conserve the Town's flood storage capacity.	None.
Participation in the National Flood Insurance Program	As of 2014, there were 26 homeowners with flood insurance policies.	Areas identified by the FEMA maps.	Somewhat effective, provided that the Town remains enrolled in the National Flood Insurance Program.	None.
Flood Control System	Extensive system of concrete and earthen walls and related structures.	Areas Adjacent to Connecticut River.	Effective at Mitigating Flood Waters.	None.

Table 27 Flooding Mitigation Capabilities

HURRICANES / SEVERE THUNDERSTORMS / WIND / TORNAOES

Hurricanes, severe thunderstorms, and tornadoes all generate high winds that can fell trees, down electrical wires, and generate hurtling debris. This common characteristic means that the same set of mitigation strategies applies equally to all four hazards. For example, current land development regulations, such as restrictions on the height of telecommunications towers, can help prevent wind damages from all four types of hazards. In addition to wind damage, hurricanes can generate significant flooding that damages buildings, infrastructure and threatens human lives. All of the existing mitigation measures listed in the Flooding section are also hurricane mitigation measures.

The Comprehensive Emergency Management (CEM) Plan for Ludlow includes the following mitigation measures for hurricanes, severe thunderstorms, wind, and tornadoes:

- Develop and enforce building codes to enhance structural resistance to high winds.
- Develop and disseminate emergency public information and instructions concerning disaster safety, especially guidance regarding in-home protection and evacuation procedures, and locations of public shelters.

ZONING

The Design Standards for wireless communication facilities requires that telecommunications towers be setback from adjacent property lines and not exceed the height of surrounding buildings.

RESTRICTIONS ON DEVELOPMENT

The Town's Subdivision Ordinance requires that all new subdivisions have buried utility lines.

MOBILE HOMES

According to the Ludlow Zoning Bylaws, mobile homes are permitted only in the RA-Residential District after receiving a special permit from Town Council. However, all regulations and legal protections given to victims of fires or other natural disasters must be followed, and such regulations are located in M.G.L. Chapter 40A.

STATE BUILDING CODE

For new or recently built structures, the primary protection against wind-related damage is construction that adheres to the State Building Code, which, when followed, results in buildings that withstand high winds. The Town of Ludlow employs a building inspector for all inspection duties and responsibilities.

Existing Action	Description	Area Covered	Effectiveness	Potential Changes
Comprehensive Emergency Management Plan	The CEM includes the following mitigation measures: 1) Develop and enforce building codes to enhance structural resistance to high winds and 2) develop and disseminate emergency public information and instructions concerning disaster safety, especially guidance regarding in-home protection and evacuation procedures, and locations of public shelters.	Entire Town.	Effective.	None.
Zoning regulations for tele-communications facilities	<p>No facility shall exceed 200 feet in height as measured from the mean finished grade at facility base.</p> <p>No tower exclusive of any attachments, shall be erected nearer to any property line than a distance exceeding the vertical height</p>	Entire Town.	Effective.	None..
Subdivision Regulations – Utilities (electric and telephone)	The Town requires all utilities for new subdivisions to be underground.	Entire Town.	Somewhat effective for ensuring that utility service is uninterrupted by severe storms in new areas of residential development.	None.

Existing Action	Description	Area Covered	Effectiveness	Potential Changes
Trailer/Mobile Homes Regulations	Mobile homes are an allowed use in all districts.	Entire Town.	Does not address the potential for wind-related damage to mobile homes.	None.
State Building Code	The Town of Ludlow has adopted the Massachusetts State Building Code.	Entire Town.	Effective.	None.

Table 28 Hurricane, Thunderstorm, High Wind, Tornado Mitigation Capabilities

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. 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.

The Comprehensive Emergency Management (CEM) Plan for Ludlow lists the following mitigation measure for severe winter storms:

- Develop and disseminate emergency public information concerning winter storms, especially material which instructs individuals and families how to stock their homes, prepare their vehicles, and take care of themselves during a severe winter storm.

To the extent that some of the damages from a winter storm can be caused by flooding, all of the flood protection mitigation measures undertaken by the Town can also be considered as mitigation measures for severe snowstorms/ice storms.

There are no restrictions on development that are directly related to severe winter storms. However, the Subdivision Rules and Regulations do set grade limits on driveways and address frontage variances for flag lots to ensure that roads and driveways will be passable in the winter.

The Town of Ludlow Subdivision Rules and Regulations, Planned Unit Development Ordinance, and Flexible Development Ordinance set grade limits on streets with a 6-12% maximum. Furthermore, burying utility systems, which, although not specified as weather hazard mitigation, can serve to minimize accident potential and power loss from severe winter storms. The Town of Ludlow Zoning Ordinance also regulates common driveways.

STATE BUILDING CODE

For new or recently built structures, the primary protection against snow-related damage is construction according to the State Building Code, which addresses designing buildings to withstand snow loads. Ludlow has a full-time, professional building inspector on its staff.

Existing Action	Description	Area Covered	Effectiveness	Potential Changes
Comprehensive Emergency Management Plan	The CEM Plan lists the following mitigation measure for severe winter storms: Develop and disseminate emergency public information concerning winter storms, especially material which instructs individuals and families how to stock their homes, prepare their vehicles, and take care of themselves during a severe winter storm.	Entire Town.	Effective.	None.
Subdivision Regulations – Design Standards for Roads	Standards include street grade regulations (6 to 8 percent maximum)	Entire Town.	Effective.	None.
Subdivision Regulations – Utilities (electric and telephone)	The Town requires all utilities for new subdivisions to be underground.	Entire Town.	Somewhat effective for ensuring that utility service is uninterrupted by severe storms in new areas of residential development.	None.
State Building Code	Ludlow follows the Massachusetts State Building Code.	Entire Town.	Effective.	None.
Urban Preservation Plan	Plan to manage trees in town – pruning, planting, etc., coordinated with WMECO	Entire Town.	Effective.	None.

Table 29 Severe Snowstorms/Ice Storms Mitigation Capabilities

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.

MANAGEMENT PLANS

The Ludlow Comprehensive Emergency Management Plan does not include any specific information on wildfires.

RESTRICTIONS ON DEVELOPMENT

There are currently no restrictions on development that are based on the need to mitigate the hazards of wildfires/brushfires. However, the Fire Department is involved in subdivision and site plan review.

Subdivision and Site Plan Review

Providing supplemental water supply is a required improvement necessary for subdivision review. A Fire Control Plan is a component of this, and involves review from the Ludlow Fire Department. In addition, the Fire Department is able to review site plans if the Planning Board enlists its expertise.

REGULATORY MEASURES

Burn Permits: The Town of Ludlow does allow open burning under the guidelines of the Department of Environmental Protection. Open Burning is authorized from January 15 to May 1. Burning is permitted between the hours of 10 a.m. and 4 p.m. The Officer in Charge of the Fire Department will determine if burning will be allowed at the beginning of the shift and can suspend burning if weather conditions change.

Subdivision Review: The procedures for the submission of preliminary and definitive subdivision plans require that the fire department be an active participant in the review of proposed subdivision plans. This involves verifying that proficient water supplies exist and that access routes to and from a given subdivision adequately meet public safety needs.

Public Education/Outreach: The Ludlow Fire Department maintains a public outreach program that targets children and seniors with the intention of spreading information about fire safety within these two populations. Furthermore, the Town has a safety inspection program that works to ensure that fire safety standards are being met.

Existing Action	Description	Area Covered	Effectiveness	Potential Changes
Burn Permits	Residents are permitted to obtain burn permits over the phone. State police personnel provide information on safe burn practices.	Entire Town.	Effective.	None.
Subdivision Review: Fire Safety	The Fire Department reviews Subdivision Plans and Site Plans for fire access and safety including revising road widths, parking policies, and installation of sprinklers in new residential construction.	Entire Town.	Effective. Would be effective in providing for an increase in fire suppression capacity. Effective.	None.
Public Education/Outreach	The Fire Department has an ongoing educational program in the schools.	Entire Town.	Effective.	None.

Table 30 Wildfire Mitigation Capabilities

In summary, the Town of Ludlow has proven they are aware of potential risks to natural hazards and mitigate them with multiple planning and land use systems. As a community they came together to actively work on updating this 2016 Hazard Mitigation Plan Update. They are committed as well as capable of mitigating risk. As a small Town they rely on Mutual Aid Agreements with MEMA and with surrounding communities to respond to disasters. They actively participate with the PVPC and take advantage of their no cost technical assistance by PVPC's professional planning staff.

Ludlow needs hazard mitigation funding to implement their prioritized actions. The Town itself is fiscally sound, however they are limited in the amount of money they can raise on their own. The Town is capable and committed to matching HMGP grant funding.

MITIGATION STRATEGY

After reviewing existing policies and the hazard identification and risk assessment, the Town Hazard Mitigation Committee developed a set of hazard mitigation strategies it would like to implement.

The Hazard Mitigation Committee reviewed the 2007 Mitigation Plan goal statement:

To minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to the following hazards: flooding, severe snowstorms/ice storms, severe thunderstorms, hurricanes, tornadoes, wildfires/brushfires, earthquakes, dam failures, and drought.

They decided to amend their goal statement to reflect all natural hazards. The previous statement limits the Town by opening the possibility that they are mitigating only the hazards named in the goal statement.

The 2016 Hazard Mitigation Plan Update goal statement is below.

**To reduce or eliminate the loss of life, property and government
disruption to all natural hazards.**

IDENTIFICATION AND ANALYSIS OF 2007 MITIGATION ACTIONS

The Town of Ludlow reviewed the mitigation actions from the 2007 Hazard Mitigation Plan. The table below is taken from the 2007 Hazard Mitigation Plan. The shaded rows indicate that the mitigation action has been completed. Each mitigation action includes a brief description regarding its current status. Some of the mitigation actions, those indicated, have moved forward into this 2016 Hazard Mitigation Plan Update.

Table 31 Analysis of 2007 Mitigation Actions

MITIGATION ACTION	RESPONSIBLE DEPARTMENT/BOARD	PROPOSED COMPLETION DATE	2016 STATUS
Remove floodplain regulations from Conservation Commission bylaw replace with and move into zoning bylaws to create new Floodplain Zone District in Zoning Bylaw.	Planning Board, BOS	2007	This has been completed.
Seek funding from the HMGP to replace priority culverts on Stormwater Management Project List.	DPW	2007	DPW continues to need to maintain culverts on their Stormwater Management Project List. This mitigation action moves forward.
Work to certify Local Emergency Planning Committee with full status for Hazardous Materials emergency planning.	LEPC	Ongoing	This has been completed.
Review with municipal boards the hazard mitigation purposes of bylaws, zone districts, and subdivision regulations.	Conservation Commission, Agricultural Commission, DPW, LEPC	2008	This mitigation action moves forward with a wording revision. Bylaws, zone districts and subdivision regulations are reviewed on a quarterly basis to ensure hazard mitigation measures are up to date.
Collect, update, disseminate emergency information to the public ('home survival kit'; home preparation for natural disasters, evacuation procedures, etc.)	LEPC	2008	This has been completed. In addition, the Town of Ludlow now has Reverse 911 in place and there are part of the Western Mass Ready campaign.

MITIGATION ACTION	RESPONSIBLE DEPARTMENT/BOARD	PROPOSED COMPLETION DATE	2016 STATUS
Establish arrangements with local vendors to supply shelters in case of natural disaster.	LEPC, EMD, School Department	Ongoing	This has been completed.
Identify sources of funding for dam safety inspections. Obtain all most recent maps of inundation areas and evacuation routes for high hazard dams.	EMD	2008	Dam safety inspections are done annually and the owners of dams update an annual inspection report.
Evaluate the older structures to be used as emergency shelters (Public Safety building and high school) to determine if they are earthquake resistant.	Building Inspector, EMD	2008	This has been completed and shelters have been identified.
Revisit feasibility of implementing Reverse 911.	BOS, LEPC	2009	This has been completed.
Implement Beaver Management Strategy.	Board of Health, Conservation Commission	Ongoing	Beaver deceivers have been utilized, however, the need to manage beavers is ongoing so this mitigation action must move forward.
Consider revising the Water Supply Protection District Bylaw.	Planning Board, Conservation Commission	2009	This mitigation action is no longer considered relevant.

MITIGATION ACTION	RESPONSIBLE DEPARTMENT/BOARD	PROPOSED COMPLETION DATE	2016 STATUS
Initiate process to become a part of FEMA's Community Rating System.	BOS, Board of Assessors, EMD	2009	This has not been done because of the amount of work required by the Town. However, the Town would like to be part of a regional effort if one presents itself. For that reason this mitigation action moves forward with a slight revision.
Educate citizens living in the floodplain about the NFIP.	LEPC, Building Inspector	2009	This mitigation action is no longer considered relevant. All new homeowners are made aware of the NFIP requirements with the purchase of a mortgage.
Ensure that all identified shelters have sufficient back-up utility service in case of primary power failure.	EMD	2009	This has been completed.
Work with maps of inundation zones for high hazard dams and analyze development trends in these locations.	Planning Board	2009	This mitigation action is no longer considered relevant.
Educate citizens living in inundation zones about evacuation routes in case of dam failure.	LEPC	2009	This mitigation action is no longer considered relevant.
Draft water conservation plan.	DPW, Conservation Commission	2009	This mitigation action is no longer considered relevant.

MITIGATION ACTION	RESPONSIBLE DEPARTMENT/BOARD	PROPOSED COMPLETION DATE	2016 STATUS
Identify zoning tools needed to provide incentives for guiding development to the most suitable and least hazardous areas of Town.	Planning Board	2010	This mitigation action is no longer considered relevant. This information is included in the town's Master Plan.
Consider adding more specific language in the Special Permit approval process and Subdivision Design Standards.	Planning Board; Conservation Commission	2010	This mitigation action is no longer considered relevant. With a special permit building is allowed in the floodplain. The permit process is revised as necessary.
Identify all pre-FIRM structures that need flood prevention modifications.	Building Inspector	2010	This mitigation action is no longer considered relevant.
Consider participation in the creation of a Regional Debris Management Plan.	DPW	2010	Plans for debris management exist. This has been completed.
Implement recommendations in Open Space and Recreation Plan.	Conservation Commission, Planning Board, BOS, Agricultural Commission	Ongoing	This has been completed. The Open Space plan is relevant until 2020.
Work with WMECO and communication companies to underground new utilities; existing utilities in problem spots, when feasible.	DPW	Ongoing	All new subdivisions have underground utilities. This mitigation action will be revised to specifically to state East Street and Center Street where the power lines are above ground and power outages do occur.

MITIGATION ACTION	RESPONSIBLE DEPARTMENT/BOARD	PROPOSED COMPLETION DATE	2016 STATUS
Inventory dams, bridges, power lines, telephone lines and develop estimate of what would cost to replace with major events.	DPW, Board of Assessors	2010	This mitigation action is no longer considered relevant.
Obtain information on location of dikes owned by Western Massachusetts Electric and areas protected from flooding.	DPW	2010	This mitigation action is no longer considered relevant.

MITIGATION ACTIONS BY HAZARD

After a review of the previous plan, the Hazard Mitigation Committee considered the natural hazards the Town faces a risk from and considered possible ways to mitigate those risks. A general overview of the concepts underlying mitigation strategies for each of the hazards identified in this plan is as follows:

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.

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. 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.

EXTREME TEMPERATURES

Extreme temperatures include extreme heat as well as extreme cold and each poses threats to the population. The best way to mitigate the risk of extreme temperatures is to prepare buildings to withstand the extreme. In terms of heat this means air conditioning, in terms of cold this means building insulation and heating. Each may require generators to insure an improved environment can be maintained. Increasing awareness of temperature extremes and their safety risks may improve public health. Educating homeowners about property maintenance and freezing pipes may reduce the impact of extreme cold. Vulnerable populations must be considered due to their susceptibility to succumb to extreme temperatures.

FLOODS

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

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.

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. 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.

SEVERE THUNDERSTORMS/WIND/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. In addition, current land development regulations, such as restrictions on the height of telecommunications towers, can also help prevent wind damages.

WILDFIRE/BRUSH FIRE

Wildfire and brushfire mitigation strategies involve educating people about how to prevent fires from starting, as well as controlling burns within the town.

2016 MITIGATION ACTIONS IN DETAIL

The Hazard Mitigation Committee developed a list of mitigation actions based on the need for mitigation actions to address current and future hazards. Several of the action items previously identified in the 2007 Hazard Mitigation Plan are currently continuing, either because they require more time to secure funding or their construction process is ongoing. The new mitigation actions are based on experience with currently implemented actions, as well as the hazard identification and risk assessment in this plan.

The table below identifies all of the mitigation actions for this plan. As the Hazard Mitigation Committee discussed each mitigation action, they identified a responsible party or agency responsible for securing funding and implementing the mitigation action. Many of the mitigation actions require a collaborative effort as indicated by the listing of several departments or organizations. They also identified potential funding sources, also indicated in the table below. Finally, the Hazard Mitigation Committee sought to mitigate risk to all of the hazards the Town may experience so the list of hazards that each mitigation action addresses is included. Several actions are considered relevant to “all hazards” and are so indicated.

The mitigation actions are listed in priority order. This order was developed by the Hazard Mitigation Committee. The Town of Ludlow recognizes that projects may be implemented in the order they are funded, not necessarily in the order of priority. The following categories are used to define the priority of each mitigation strategy:

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.

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

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

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.

These categories were developed utilizing 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

In addition to the priority order, a projected completion date was given for each mitigation action. It is difficult to estimate a start date for each mitigation action because several actions can only begin when funding is secured. However, the Hazard Mitigation Committee considered the length of time it takes to secure funding when estimating the target completion date for each action.

Finally, the estimated cost of each mitigation action is included. The exact cost of mitigation actions was not identified, for this reason the following cost range was developed, Low represents projects under \$25,000, Medium represents projects between \$25 - \$50,000 and High represents projects over \$50,000.

The table below identifies all of the mitigation actions for this plan. Also included in the table is the estimated time frame for implementation, the responsible town department, the potential funding source for the project, and its estimated cost. The exact cost of mitigation actions was not identified, for this reason the following cost range was developed, Low represents projects under \$25,000, Medium represents projects between \$25 - \$50,000 and High represents projects over \$50,000. Mitigation actions with a 2016 timeframe are expected to begin immediately and take up to the remainder of the calendar year. Gathering all of this data was a necessary step toward identifying all of the mitigation actions and preparing to rank them according to priority.

Table 32 Prioritized List of Mitigation Actions

PRIORITY RANK	STATUS	MITIGATION ACTION	HAZARDS ADDRESSED	RESPONSIBLE DEPARTMENT/BOARD	START AND END DATES	POTENTIAL FUNDING SOURCE	ESTIMATED COST
High #1	New	Replace Town emergency communication system.	All Hazards	Town	March 2016 – April 2018	FEMA	High
High #2	New	Replace Green Town Bridge.	All Hazards	DPW	April 2016 – March 2021	Department of Transportation/PDM	High
High #3	New	Purchase a generator for the Town Hall.	All Hazards	Town	April 2016 – March 2019	HMGP	High
High #4	New	Replace or Retrofit (based on current study determination) West Street Bridge .	All Hazards	Town/City of Springfield	March 2017 – March 2021	Department of Transportation/PDM	High
High #5	New	Upgrade generator at the DPW building.	All Hazards	Town	April 2016 – March 2019	HMGP	High
High #6	New	Purchase generators for each elementary school.	All Hazards	Town	April 2018 – March 2021	HMGP	High
High #7	New	Develop and implement a tree trimming and maintenance program.	High Winds Winter Storms	DPW/Eversource	April 2016 – March 2021	HMGP/Eversource	High

Medium	New	Establish and maintain emergency access to right of way and easement areas.	Wildfires	Fire Department	May 2016 – April 2021	HMGP	Medium
Medium	New	Clear sewer easement areas.	Floods	DPW	May 2016 – April 2021	HMGP	Medium
Medium	New	Replace Putts Bridge.	All Hazards	Town/DPW	April 2018 – March 2021	HMGP/Department of Transportation	Medium
Medium	New	Replace the Piney Lane Culvert.	Flooding	DPW	March 2016 – April 2018	HMGP	High
Medium	Ongoing	Replace, repair or upgrade priority culverts on the Stormwater Management Project List.	Flooding	DPW	March 2016 – March 2021	HMGP	High
Low	Ongoing	Bylaws, zone districts and subdivision regulations are reviewed on a quarterly basis to ensure hazard mitigation measures are up to date.		Conservation Commission, DPW	March 2016 – March 2021	Town	Low
Low	Ongoing	Maintain Beaver Management Strategy.	Flooding	Board of Health, Conservation Commission	March 2016 – March 2021	Town	Low

Low	Ongoing	Participate in a regional effort to implement the Community Rating System.	Flooding	Board of Assessors, EMD, PVPC	March 2020- March 2021	MEMA	Low
Low	Ongoing	Work with Eversource and communication companies to underground utilities on East Street and on Center Street.	High Winds Hurricanes Severe Thunderstorms Tornados Winter Storms	DPW	March 2017 - March 2021	Eversource/HMGP	High
Low	New	Implement an outreach and education program for homeowner associations regarding maintaining culverts and retention ponds on their property.	Flooding	Conservation Commission/DPW	March 2018- April 2021	Town	Low
Low	New	Educate home and business owners how to prepare and mitigate the hurricane and tornado risk.	Hurricane Tornado	Fire Department	April 2018 – March 2021	Town/HMGP	Low

FEMA GRANT FUNDING SOURCES

FEMA has three grant funding sources for mitigation actions.

HAZARD MITIGATION GRANT PROGRAM (HMGP)

“The purpose of the HMGP program is to help communities implement hazard mitigation measures following a Presidential major disaster declaration. Hazard mitigation is any action taken to reduce or eliminate long term risk to people and property from natural hazards. The HMPG is authorized under [Section 404 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act.](#)”⁹

PRE-DISASTER MITIGATION (PDM)

“The PDM Program, authorized by Section 203 of the [Robert T. Stafford Disaster Relief and Emergency Assistance Act](#), is designed to assist States, territories, Federally-recognized tribes, and local communities in implementing a sustained pre-disaster natural hazard mitigation program. The goal is to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on Federal funding in future disasters. This program awards planning and project grants and provides opportunities for raising public awareness about reducing future losses before disaster strikes. PDM grants are funded annually by Congressional appropriations and are awarded on a nationally competitive basis.”¹⁰

FLOOD MITIGATION ASSISTANCE (FMA)

“The FMA program is authorized by Section 1366 of the National Flood Insurance Act of 1968, as amended with the goal of reducing or eliminating claims under the National Flood Insurance Program (NFIP). FMA provides funding to States, Territories, federally-recognized tribes and local communities for projects that reduce or eliminate long-term risk of flood damage to structures insured under the NFIP. FMA funding is available for flood hazard mitigation projects, plan development and management costs. Funding is appropriated by Congress annually.”¹¹

⁹ <http://www.fema.gov/hazard-mitigation-grant-program> Accessed on February 27, 2016.

¹⁰ <https://www.fema.gov/pre-disaster-mitigation-grant-program> Accessed on February 27, 2016.

¹¹ <https://www.fema.gov/flood-mitigation-assistance-grant-program> Accessed on February 27, 2016.

CHAPTER 6. PLAN IMPLEMENTATION

PLAN ADOPTION

Upon completion of the draft 2016 Hazard Mitigation Plan Update, a public meeting was held by the Hazard Mitigation Committee to present the Plan and to request comments from Town officials and residents. Then a two-week comment period was available for the public as well as Town officials to review the draft plan. The 2016 Hazard Mitigation Plan Update was then submitted to the Massachusetts Emergency Management Agency (MEMA) and the Federal Emergency Management Agency 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 Town 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 Committee will oversee the implementation of the plan with leadership provided by the Director of Public Works.

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:

- *Ludlow Open Space and Recreation Plan* – this Plan was used to identify the natural context within which the Ludlow 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 update, the Town can use the work of the PDM Plan to incorporate identified hazard areas into open space and recreation planning. This could either take the form of acquiring parcels of land that are currently un-developed, but situated within an identified hazard area, as permanent open space, thereby minimizing the likelihood that critical infrastructure components will be constructed in an area prone to damage from natural hazards.
- *Ludlow Zoning Bylaw* - The Town's Zoning Bylaw was used to gather 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.
- *State of Massachusetts -Hazard Mitigation Plan* - This plan was used to insure that the Town's PDM was consistent with the State's Plan.

As the Town of Ludlow 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.

After this plan has been approved by both FEMA and the local government, links to the plan will be emailed to all Town staff, boards, and committees, with a reminder to review the plan periodically and work to incorporate its contents, especially the action plan, into other planning processes and documents. In addition, during annual monitoring meetings for the Hazard Mitigation Plan implementation process, the Hazard Mitigation Committee will review whether any of these plans are in the process of being updated. If so, the Hazard Mitigation Committee will remind people working on these plans, policies etc. of the 2016 Hazard Mitigation Plan Update, and urge them to incorporate the plan into their efforts. The Hazard Mitigation Committee will also review current Town programs and policies to ensure that they are consistent with the mitigation strategies described in this plan. The Hazard Mitigation Plan will also be incorporated into updates of the Town's Comprehensive Emergency Management Plan.

Information on how the 2007 Hazard Mitigation Plan was incorporated into other planning processes and documents was not tracked. Following this plan update, the Hazard Mitigation Committee will not when they reach out to other Town staff about the incorporation of applicable hazard mitigation strategies into plan updates.

PLAN MONITORING AND EVALUATION

The Town's Director of Public Works will call meetings of all responsible parties to review plan progress on an annual basis in each of the following years: 2017, 2018, 2019, 2020, 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 committee 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 committee 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.

The Town's Director of Public Works will call meetings of all responsible parties to review plan progress as needed, based on occurrence of hazard events. 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 involve evaluation and assessment of the plan, regarding its effectiveness at achieving the plan's goals and stated purpose. The following questions will serve as the criteria that is used to evaluate the plan:

Plan Mission and Goal

- Is the Plan's stated goal and mission still accurate and up to date, reflecting any changes to local hazard mitigation activities?

- Are there any changes or improvements that can be made to the goal and mission?

Hazard Identification and Risk Assessment

- Have there been any new occurrences of hazard events since the plan was last reviewed? If so, these hazards should be incorporated into the Hazard Identification and Risk Assessment.
- Have any new occurrences of hazards varied from previous occurrences in terms of their extent or impact? If so, the stated impact, extent, probability of future occurrence, or overall assessment of risk and vulnerability should be edited to reflect these changes.
- Is there any new data available from local, state, or Federal sources about the impact of previous hazard events, or any new data for the probability of future occurrences? If so, this information should be incorporated into the plan.

Existing Mitigation Strategies

- Are the current strategies effectively mitigating the effect of any recent hazard events?
- Has there been any damage to property since the plan was last reviewed?
- How could the existing mitigation strategies be improved upon to reduce the impact from recent occurrences of hazards? If there are improvements, these should be incorporated into the plan.

Proposed Mitigation Strategies

- What progress has been accomplished for each of the previously identified proposed mitigation strategies?
- How have any recently completed mitigation strategies affected the Town's vulnerability and impact from hazards that have occurred since the strategy was completed?
- Should the criteria for prioritizing the proposed mitigation strategies be altered in any way?
- Should the priority given to individual mitigation strategies be changed, based on any recent changes to financial and staffing resources, or recent hazard events?

Review of the Plan and Integration with Other Planning Documents

- Is the current process for reviewing the Hazard Mitigation Plan effective? Could it be improved?
- Are there any Town plans in the process of being updated that should have the content of this Hazard Mitigation Plan incorporated into them?
- How can the current Hazard Mitigation Plan be better integrated with other Town planning tools and operational procedures, including the zoning bylaw, the Comprehensive Emergency Management Plan, and the Capital Improvement Plan?

Following these discussions, it is anticipated that the committee 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 committee will review and update the Hazard Mitigation Plan every five years.

Public participation will be a critical component of the Hazard Mitigation Plan maintenance process. The Hazard Mitigation Committee will hold all meetings in accordance with Massachusetts open meeting laws and the public invited to attend. The public will be notified of any changes to the Plan via the meeting notices board at Town Hall, and copies of the revised Plan will be made available to the public at Town Hall.

APPENDICES

APPENDIX A – TECHNICAL RESOURCES

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 (SRPED).....	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. (NESEC).....781/224-9876

National Oceanic and Atmospheric Administration: National Weather Service.....508/824-5116

US Department of the Interior: US Fish and Wildlife Service413/253-8200

US Geological Survey.....508/490-5000

MITIGATION FUNDING RESOURCES

404 Hazard Mitigation Grant Program (HMGP)MA Emergency Management Agency

406 Public Assistance and Hazard MitigationMA 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)	MA Emergency Management Agency
Emergency Generators Program by NESEC‡	MA Emergency Management Agency
Emergency Watershed Protection (EWP) Program.....	USDA, Natural Resources Conservation
Service Flood Mitigation Assistance Program (FMAP).....	MA Emergency Management Agency
Flood Plain Management Services (FPMS).....	US Army Corps of Engineers
Mitigation Assistance Planning (MAP).....	MA Emergency Management Agency
Mutual Aid for Public Works.....	Western Massachusetts Regional Homeland Security Advisory Council
National Flood Insurance Program (NFIP) †	MA Emergency Management Agency
Power of Prevention Grant by NESEC‡	MA Emergency Management Agency
Roadway Repair & Maintenance Program(s).....	Massachusetts Highway Department
Section 14 Emergency Stream Bank Erosion & Shoreline Protection	US 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 Clearing	US 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 Programs	MA 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.

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://wpx.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.tornadoject.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 – DOCUMENTATION OF THE PLANNING PROCESS

PUBLIC MEETING SIGN-IN SHEET	
Project: <u>Ludlow 2016 PDM UPDATE</u>	Meeting Date: <u>1/13/16</u>
Facilitator: <u>Jamie Caplan</u>	Place/Room: <u>Ludlow Fire House</u>

Name	Title	Organization	Phone	E-Mail
Ryan Poase	Captain	Ludlow Fire Dept.	413-531-6265	fire.safety@ludlowmaine.us
Jamie Caplan	Consultant for PUPC	Jamie Caplan Consulting LLC	413-586-0867	jamie@jamiecaplan.com

HAZARD MITIGATION COMMITTEE MEETING SIGN-IN SHEET	
Project: Ludlow Mitigation Plan	Meeting Date: 1/22/16
Facilitator: Jamie Caplan	Place/Room: Ludlow FD

Name	Title	Organization	Phone	E-Mail
JUSTIN LARIVEE	Building Commissioner		413-583-9605 #1210	JLARIVEE@Ludlow.MA.US
Ryan Pease	Fire Captain	Ludlow FD	413-583-8332	FireSafety@Ludlow.MA.US
Mike Brennan	Police Lieutenant	Ludlow PD	413-583-8305	mbrennan@Ludlowpolice.com
JAMES MACHADO	DEP CHIEF	LUDLOW FD	413-583-8332	
Doug Stefancik	Town Planner	Town of Ludlow	583-5624 X1281	dstefancik@Ludlow.ma.us
Ellie Villano	Town Admin.	T of L.	583-5600 X1201	evillano@Ludlow.ma.us
Kenneth Batista	Town of Ludlow DPW		583-5625	KBatista@Ludlow.ma.us
MARK BABINIEN	FIRE CHIEF	FIRE DEPT	583-8332	LFDCL@LUDLOW.MA.US

HAZARD MITIGATION COMMITTEE MEETING SIGN-IN SHEET	
Project: <u>Ludlow</u>	Meeting Date: <u>2/4/16</u>
Facilitator: <u>Janie Caplan</u>	Place/Room: <u>Fire Dept.</u>

	Name	Title	Organization	Phone	E-Mail
<i>Atty Raele</i>	Ryan Pease	Captain FD	Ludlow Fire Dept.	413 896 7132	firesafety@ludlow.ma.us
<i>SSOS</i>	Ken Batista	operations supervisor	DPW	413-583-5655	KBatista@ludlow.ma.us
<i>63.35</i>	Ellie Villano	Town Admin.	Tn of Lud.	413-583- 5629 x1299	evillano@ludlow.ma.us
	Doug Stefanik	Town Planner	Town of Ludlow	413-583- 5629	dstefanik@ludlow.ma.us
	JAMES MACHADO	DEP. CHIEF F.D.	TOWN OF LUDLOW	413-585 8332	
<i>48.96</i>	DAVID Belanga	Ludlow Police	TOWN OF Ludlow	413-585 8305	DBelanga@ludlowpolice.com
	MARK BABINAY	FIRE CHIEF	LUDLOW	413 583 8332	LFOCI@LUDLOW.MA.US

HAZARD MITIGATION COMMITTEE MEETING SIGN-IN SHEET	
Project: <u>Ludlow</u>	Meeting Date: <u>2/18/16</u>
Facilitator: <u>Jamie Caplan</u>	Place/Room: <u>Ludlow Fire House</u>

Name	Title	Organization	Phone	E-Mail
Ryan Pease	Fire Captain	LFD	413 583 8732	rpease firesafety@ludlow.ma.us
JAMES MACHADO	DEP CHIEF	LFD	413 583-8332	
Kenneth Batista	DPW	DPW	583-5625	kbatista@ludlow.ma.us
Doug Stefaniek	Town Planner	Planning	583-5624	d.stefaniek@ludlow.ma.us
Joe Metcalfe	Police Lieutenant	Police Dept.	583-8305	jmetcalfe@ludlowpolice.com
Ellie Villano	Town Admi	Town.	583-5601	evillano@ludlow.ma.us
MARK BARBIMAN	FIRE CHIEF	LFD	583-8332	LFD02@LUDLOW,MA.US

HAZARD MITIGATION COMMITTEE MEETING SIGN-IN SHEET	
Project: Ludlow Mitigation Plan	Meeting Date: 3/24/16
Facilitator: Jamie Caplan	Place/Room: Fire Dept.

Name	Title	Organization	Phone	E-Mail
Ryan Pease	Captain	LFD	435-83832	Fires.Kty@Ludlow.MA.US
Ken Batista	Operations Supervisor	DPW	583-5765	KBatista@Ludlow.MA.US
Elia Villano	Tn Administrator	BOS	385-1800	evillano@Ludlow.MA.US
JAMES MACHADO	DEP CHIEF	LFD	583-8332	
Joey Stiffneck	Town Planner	Planning Board	583-5634	dstefanick@Ludlow.MA.US
Mike Brennan	Lieutenant	L PD	583-8385	mbrennan@Ludlowpolice.com
MARK BARONIAN	CHIEF	LFD	583-8332	LPOC1@Ludlow.MA.US

HAZARD MITIGATION COMMITTEE MEETING SIGN-IN SHEET	
Project: Ludlow Mitigation Plan	Meeting Date: 4/21/16
Facilitator: Jamie Caplan	Place/Room: Town Hall

Name	Title	Organization	Phone	E-Mail
Kyle Pease	Captain	LFD	413 583-8332	fire.safety@ludlow.ma.us
Ken Batista	operation supervisor	LDPW	413 583-5657	kbatista@ludlow.ma.us
JAMES MACHADO	D CHIEF A. CHIEF	LFD	413 583 8332	
Ellie Villano	Town Admin.	Town of Ludlow	413 583-5600 x1201	quillano@ludlow.ma.us
Doug St. Francis	Town Planner	Town of Ludlow	413-583- 5624 x1280	d.stefano@ludlow.ma.us



MARCH 17, 2016 3:00 PM – 4:00 PM DISASTER PLANNING MEETING

Public Input is Needed

The Town of Ludlow is currently in the process of updating their FEMA Approved Hazard Mitigation Plan. This plan details how the Town may become less vulnerable to disasters caused by natural hazards such as flooding, winter storms and hurricanes. Your participation is important.



March 17, 2016
3:00 pm

Ludlow Town Hall,
488 Chapin Street

Fires, Floods and
Winter Storms

Share Your Ideas
for Reducing Risk

Preparing a Hazard
Mitigation Plan for
FEMA Approval

FOR MORE INFORMATION

Captain Ryan M. Pease
Fire Prevention Officer
Ludlow Fire Department

413-583-8332
firesafety@ludlow.ma.us



MEDIA RELEASE

For Immediate Release
February 24, 2016

Contact: Captain Ryan M. Pease
413-583-8332

Disaster Planning Public Meeting
March 17, 2016, 3:00pm

This meeting is held in conjunction with the LEPC Meeting.

The Town of Ludlow is currently engaged in a planning process to become less vulnerable to disasters caused by natural hazards, and public participation is essential!

Join the Hazard Mitigation Committee at the LEPC Meeting on March 17, 2016 from 3:00 pm – 4:00 pm to share your ideas for reducing risk and becoming less vulnerable to natural hazards such as floods, hurricanes and winter storms. The meeting will be held at the Town Hall, 488 Chapin Street, in the Selectman's Conference Room.

The meeting provides an opportunity for you to share your opinions and participate in the mitigation planning process.

The purpose of the 2016 Hazard Mitigation Plan Update is to identify and assess the community's natural hazard risks and determine how to best minimize and manage those risks. Upon completion, the plan will be presented to the Town of Ludlow 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.

The Pioneer Valley Planning Commission (PVPC) was awarded a grant from MEMA to develop the 2016 Hazard Mitigation Plan Update; the previous plan was developed in 2007. The PVPC hired Jamie Caplan Consulting LLC to work with them and the Town to develop the 2016 Hazard Mitigation Plan Update.

If you have any questions regarding the meeting, or would like to learn about more ways you can participate in the development of the Hazard Mitigation Plan, please contact Captain Ryan M. Pease, Fire Prevention Officer, Ludlow Fire Department, 413-583-8332 or firesafety@ludlow.ma.edu.

LUDLOW EMERGENCY PLANNING COMMITTEE

SIGN IN SHEET

MEETING DATE:

17 MAR 2016

PRINT NAME	COMMUNITY	WORK TELEPHONE #	EMAIL
Bob McLanahan	Worcester / Amherst Area	413.377.2035	bob.mclanahan@comcast.com
Dave Ritchie	Community Center	413-426-7426	darichie@ludlowbc.org
Michael Hill	LCN	413-583-5654	LCN@ludlow.ma.us
Terrina Rusicki	BOH	573-220-1122	terrina@ludlow.ma.us
Penny Leber	CONSERVATION	413 583-5621	Conservation@ludlow.ma.us
HELEN J. GRABOWSKI	COUNCIL ON AGING LUDLOW SENIORS CENTER	413-583-4812	Hgrabow536@aol.com
Ryan Bishop	MMWEC	413-308-1262	rbishop@mmwec.org
Jamie Caplan	Consultant, NIPC	413-586-0867	jamie@jamiecaplan.com
Ellis Villano	Ludlow / To. Adams	413-385-1800	evillano@ludlow.ma.us
Ken Bachtke	Ludlow DPW	413-583-5645	kBachtke@ludlow.ma.us
Michael Brennan	Ludlow PD	413-583-8505	mbrennan@ludlowpolice.com
MARIE BARBERA	LUDLOW PD / EMD	413-583-5332	ludlow@ludlow.ma.us
JT GAUCHER	LUDLOW DPW	413 386 5401	JTGAUCHER@LUDLOW.MA.US
Doug Stfanick	Town Planner	413-583-8224	dstfanick@ludlow.ma.us



APRIL 21, 2016 3:00 PM – 4:00 PM DISASTER PLANNING MEETING

Public Input is Needed

The Town of Ludlow is currently in the process of updating their FEMA Approved Hazard Mitigation Plan. This plan details how the Town may become less vulnerable to disasters caused by natural hazards such as flooding, winter storms and hurricanes. Your participation is important.



April 21, 2016

3:00 pm

**Ludlow Town Hall,
488 Chapin Street**

**Fires, Floods and
Winter Storms**

**Share Your Ideas
for Reducing Risk**

**Preparing a Hazard
Mitigation Plan for
FEMA Approval**

FOR MORE INFORMATION

Captain Ryan M. Pease
Fire Prevention Officer
Ludlow Fire Department

413-583-8332
firesafety@ludlow.ma.us



MEDIA RELEASE

For Immediate Release
 March 21, 2016

Contact: Captain Ryan M. Pease
 413-583-8332

Disaster Planning Public Meeting
April 21, 2016, 3:00pm

This meeting is held in conjunction with the LEPC Meeting.

The Town of Ludlow is currently engaged in a planning process to become less vulnerable to disasters caused by natural hazards, and public participation is essential!

Join the Hazard Mitigation Committee at the LEPC Meeting on April 21, 2016 from 3:00 pm – 4:00 pm to share your ideas for reducing risk and becoming less vulnerable to natural hazards such as floods, hurricanes and winter storms. The meeting will be held at the Town Hall, 488 Chapin Street, in the Selectman's Conference Room.

The meeting provides an opportunity for you to share your opinions and participate in the mitigation planning process.

The purpose of the 2016 Hazard Mitigation Plan Update is to identify and assess the community's natural hazard risks and determine how to best minimize and manage those risks. Upon completion, the plan will be presented to the Town of Ludlow 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.

The Pioneer Valley Planning Commission (PVPC) was awarded a grant from MEMA to develop the 2016 Hazard Mitigation Plan Update; the previous plan was developed in 2007. The PVPC hired Jamie Caplan Consulting LLC to work with them and the Town to develop the 2016 Hazard Mitigation Plan Update.

If you have any questions regarding the meeting, or would like to learn about more ways you can participate in the development of the Hazard Mitigation Plan, please contact Captain Ryan M. Pease, Fire Prevention Officer, Ludlow Fire Department, 413-583-8332 or firesafety@ludlow.ma.edu.

PUBLIC MEETING SIGN-IN SHEET	
Project: Ludlow Mitigation Plan	Meeting Date: 4/21/16
Facilitator: Jimie Caplan	Place/Room: Town Hall

Name	Title	Organization	Phone	E-Mail
Doug Stefancik	Town Planner	Town of Ludlow	413-583-5624 X1280	dstefancik@ludlow.ma.us
HELEN J. GRABOWSKI	LUDLOW COUNCIL ON AGING MEMBER	COA	413-583-4700	hgrabow536@cox.com
Ryan Pease	Fire Captain	LFD	413-583-8332	fire.safety@ludlow.ma.us
Ken Batiste	operation supervisor	DPW	413-583-565	KBatiste@ludlow.ma.us
JAMES MACHADO	DEP CHIEF	LFD	413-583 8332	
JUSTIN LARIVEE	Burien Commissioner	Town of Ludlow	413-583 5605	JLarivee@ludlow.ma.us
Joe Metcalf	Lieutenant Ludlow	Ludlow P.P.	413 583-8305	jmetcalf@ludlowpolice.com
A.J. DOMAIS	Plant Ops Dir./ Safety officer	HealthSouth	(413) 308-3355	alfred.domais@ healthsouth.com
Wave Ritchie	Chairman	Community Center	413 426-7106	writchie@ludlowbc.org
Bob McCormick	WWUP Anchor Radio	→	413 377-0035	Bob.mccormick@wwup.com
Michael Hill	LCTV Manager	LCTV	413 583-5689	LCTV@Ludlow.ma.us
MARK BARNER	FIRE CHIEF FMO	FIRE	583-8332	LFOU3@ludlow.ma.us

MEDIA ORGANIZATIONS SENT PRESS RELEASES

Media Organization	Address	Town	State	Zip Code
African American Point of View	688 Boston Road	Springfield	MA	01119
Agawam Advertiser News	23 Southwick Street	Feeding Hills	MA	01030
Amherst Bulletin	115 Conz Street	Northampton	MA	01060
Belchertown Sentinel	1 Main Street	Belchertown	MA	01007
Berkshire Eagle	75 South Church Street	Pittsfield	MA	01202
Brattleboro Reformer	62 Black Mountain Rd.	Brattleboro	VT	05301
CBS 3 Springfield	One Monarch Place	Springfield	MA	01144
Chicopee Register	380 Union Street	West Springfield	MA	01089
CommonWealth Magazine	18 Tremont Street	Boston	MA	02108
Country Journal	5 Main Street	Huntington	MA	01050
Daily Hampshire Gazette	115 Conz Street	Northampton	MA	01060
El Sol Latino	P.O. Box 572	Amherst	MA	01004
Going Green	PO Box 1367	Greenfield	MA	01302
Hilltown Families	P.O. Box 98	West Chesterfield	MA	01084
Ludlow Sun	138 College Street	Ludlow	MA	01075
Journal Register	24 Water Street	Palmer	MA	01069
La Voz Hispana	133 Maple Street #201	Springfield	MA	01105
Ludlow Register	24 Water Street	Palmer	MA	01069
Massachusetts Municipal Association	One Winthrop Street	Boston	MA	02110
Quaboag Current	80 Main Street	Ware	MA	01082
Recorder	14 Hope Street	Greenfield	MA	01302
Reminder	280 N. Main Street	East Longmeadow	MA	01028
Southwick Suffield News	23 Southwick Street	Feeding Hills	MA	01030
State House News Service	State House	Boston	MA	02133
Tantasqua Town Common	80 Main Street	Ware	MA	01082
The Longmeadow News	62 School Street	Westfield	MA	01085
The Republican	1860 Main Street	Springfield	MA	01102
The Westfield News	62 School Street	Westfield	MA	01085
Town Reminder	138 College Street	Ludlow	MA	01075
Urban Compass	83 Girard Avenue	Hartford	CT	06105
Valley Advocate	115 Conz Street	Northampton	MA	01061
Vocero Hispano	335 Chandler Street	Worcester	MA	01602
WAMC Northeast Public Radio	1215 Wilbraham Road	Springfield	MA	01119
Ware River News	80 Main Street	Ware	MA	01082
West Springfield Record	P.O. Box 357	West Springfield	MA	01098

WFCR-Public Radio	131 County Circle	Amherst	MA	01003
WGBY-Public TV	44 Hampden Street	Springfield	MA	01103
WGGB ABC40/FOX 6 News	1300 Liberty Street	Springfield	MA	01104
WHMP-FM	15 Hampton Avenue	Northampton	MA	01060
Wilbraham-Hampden Times	2341 Boston Road	Wilbraham	MA	01095
Worcester Telegram & Gazette	20 Franklin Street	Worcester	MA	01615
WRNX/WHYN/WPKR Radio	1331 Main Street	Springfield	MA	01103
WWLP-TV 22	PO Box 2210	Springfield	MA	01102