

THE TOWN OF LUDLOW, MASSACHUSETTS



MUNICIPAL VULNERABILITY PREPAREDNESS HAZARD MITIGATION PLAN (MVP-HMP) 2022 UPDATE

Prepared by:
The Ludlow MVP/HMP Committee
and
The Pioneer Valley Planning Commission



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Marc Strange, Town Administrator
Jim Goodreau, Assistant Town Engineer
Paulina Matusik, Public Health Coordinator
Penny Lebel, Vice-Chair, Conservation Commission Administrative Assistant
Jocelyn Zepke, Council on Aging
Seth Falconer, Captain, Ludlow Fire Department
Brian Shameklis, Sergeant, Ludlow Police

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The Pioneer Valley Planning Commission

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CHAPTER 1: INTRODUCTION AND PLANNING PROCESS

INTRODUCTION

The Town of Ludlow prepared a Municipal Vulnerability Preparedness and Hazard Mitigation Plan (MVP-HMP) to create an action roadmap to increase resilience to natural hazards and climate change within the community and the region.

Development of this plan meets two requirements:

- The requirements of 44 CFR § 201.6 pertaining to local hazard mitigation plans. A local government must have a mitigation plan approved pursuant to this section in order to apply for and receive mitigation project grants under all other mitigation grant programs. In accordance with Title 44 Code of Federal Regulations (CFR) § 201.6, the local mitigation plan is the representation of Ludlow's commitment to reduce risks from natural hazards.
- The requirements of the MVP Planning Grant, which enabled Ludlow to integrate the local effects of climate change into their hazard mitigation action plan. By completing the Community Resilience Building (CRB) workshop process, Ludlow will be an MVP-certified community eligible to apply for MVP Action Grants to adapt to climate change impacts on the community. Appendix A of this plan includes a list of references and resources used to develop the plan, and Appendix B contains a list of acronyms used herein.

The Ludlow MVP-HMP was adopted by the Select Board on **DATE** to update and replace The Town of Ludlow Hazard Mitigation Plan from 2016.

WHAT IS A HAZARD MITIGATION PLAN?

The Federal Emergency Management Agency (FEMA) and the Massachusetts Emergency Management Agency (MEMA) define Hazard Mitigation as any sustained action taken to reduce or eliminate long-term risk to people and property from natural hazards such as flooding, storms, high winds, hurricanes, wildfires, 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. Hazard mitigation planning uses a multi-step process with the participation of a wide range of stakeholders to define local hazards, assess vulnerabilities and risks, review current mitigation measures and develop priority action items.

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.

- Assessing Hazard Mitigation strategies identified in the 2016 HMP and establishing goals for updating, revising, or adopting new strategies.
- Developing an Action Plan with a prioritized implementation schedule.
- Adopting and implementing the final HMP.

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 a local natural hazards mitigation plan every five years 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. For every dollar spent on federal hazard mitigation grants, an average of six dollars are saved (FEMA, 2018-a). There are many additional benefits of mitigation planning. HMPs increase public awareness of natural hazards that may affect the community. They help state, local, and tribal governments to collaborate and combine hazard risk reduction with other community goals and plans.

Once an HMP is completed, hazard mitigation funding is available to address the community's top mitigation priorities through FEMA. FEMA requires that a community adopt a hazard mitigation plan as a condition for mitigation funding. For example, the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance Program (FMA), and the Building Resilient Infrastructure and Communities (BRIC) Program are FEMA hazard mitigation assistance grant programs with this requirement.

WHAT IS A MUNICIPAL VULNERABILITY PREPAREDNESS PLAN?

A Municipal Vulnerability Preparedness (MVP) plan identifies priority action items to address vulnerabilities and utilize strengths in preparation for climate change. In 2017, the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA) initiated the state's MVP grant program to help communities become more resilient to the impacts of climate change. The program has two grant phases:

1. The first phase of grants are Planning Grants, which fund the vulnerability analyses, engagement, and planning processes. Towns convene a team of municipal staff, engage stakeholders in a Community Resilience Building (CRB) Workshop, and engage community members in developing the plan. Communities that complete the Planning Grant program and prepare an MVP plan are eligible for the second phase of MVP grant funding and receive increased standing for other state grants.
2. The second phase of the MVP program are Action Grants, which fund the implementation of priority climate adaptation actions described in the MVP plan. Action grants are competitive, however they are less competitive than some similar grants awarded at the national level.

CRB Workshop Process

The CRB Workshop Process was developed by the Nature Conservancy and provides a process for developing resilience action plans with stakeholder input. The process has been successfully implemented in over 450 communities across 12 states (<https://www.communityresiliencebuilding.com/>).

The CRB Workshop Process's central objectives are to:

- Define top local natural and climate-related hazards of concern
- Identify existing and future strengths and vulnerabilities
- Develop prioritized actions for the Community
- Identify immediate opportunities to collaboratively advance actions to increase resilience

Each step in the process (below) is rich in information and dialogue and results in actionable plans and strong collaboration.



MVP-HMP REPORT LAYOUT

The report presents the results of the planning process, which was informed by input received from the Core Team and during the CRB Workshops and Public Listening Sessions. This report is organized as follows:

Chapter 1: Project introduction and overview; summary of planning process

Chapter 2: Hazard mitigation and climate adaptation goals

Chapter 3: Community profile; societal, economic, infrastructural, and environmental features; land use and development, critical facilities, and vulnerable populations

Chapter 4: Detailed assessment of the Town's vulnerability and strengths by hazard type. The hazard types include flooding, wind-related risks (such as hurricanes, tropical storms, tornadoes, nor'easters, and severe thunderstorms), winter storms, geological hazards (such as earthquakes and landslides), brush fires, extreme temperatures, and drought. Each profile also describes the hazards' historic occurrences and impact, frequency, level of risk, and climate change projections.

Chapter 5: Summary of the Town's existing mitigation capabilities and mitigation measures

Chapter 6: An action plan for next steps

Chapter 7: Plan adoption, maintenance, and implementation

COMBINING HAZARD MITIGATION AND MUNICIPAL VULNERABILITY PREPAREDNESS PLANNING IN LUDLOW

In 2021, the Town of Ludlow received an MVP Planning Grant and a FEMA Grant to simultaneously prepare an MVP plan in conjunction with an HMP plan. This combined approach enabled Ludlow to consider the impacts of climate change in addition to historic hazard events as part of its planning process. Also, many of the required steps of the MVP process satisfy FEMA requirements for updating an HMP. For example, an MVP requires convening a Core Team and hosting a CRB Workshop and Public Listening Session, which are not required specifically by FEMA, but do meet the public input requirements of the hazard mitigation planning process. Figure 1.1 below shows the overlaps between the two processes, as well as some of the unique features of each.

Figure 1.1: Comparison of the MVP and HMP Processes



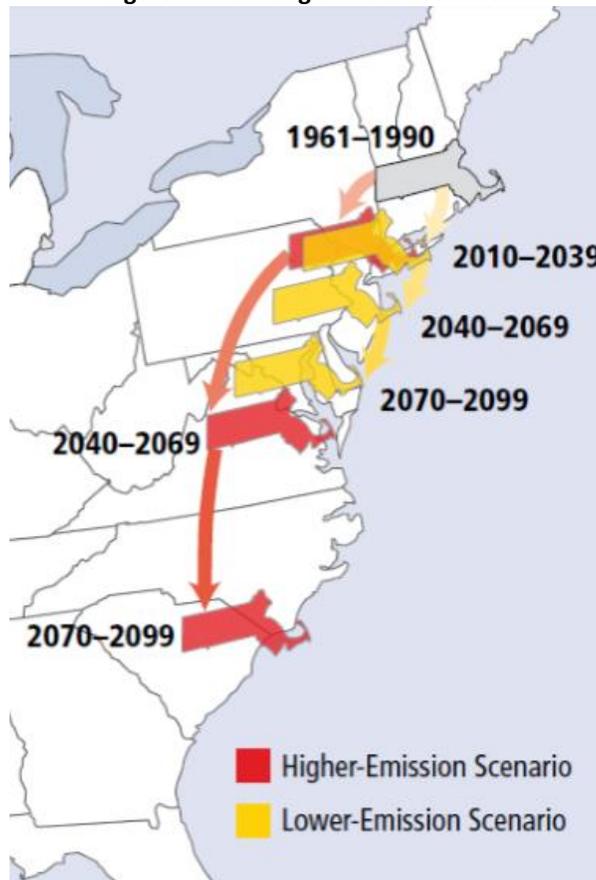
Source: <https://www.mass.gov/doc/mvp-planning-grant-municipal-training-slides-january-2020/download>

The Town prepared this joint MVP-HMP in accordance with FEMA guidelines for hazard mitigation planning (44 CFR § 201.6) and with the EOEEA's requirements for MVP plans. This approach followed the state's lead in adopting the first-ever Massachusetts State Hazard Mitigation and Climate Adaptation Plan (SHMCAP; EOEEA, MEMA, and EOPSS, 2018). By completing a joint MVP-HMP, Ludlow was able to fulfill the requirements and enhance the impact of both processes. 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.

IMPACTS OF CLIMATE CHANGE

Climate change is impacting communities around the world, and residents of Massachusetts are seeing these changes and their impacts almost every day. At current rates of greenhouse gas accumulation and temperature increases, the climate of Massachusetts is projected to become similar to that of present-day New Jersey or Virginia by 2040-2069, depending on future greenhouse gas (GHG) emissions. These possible scenarios are shown in Figure 1.2 below.

Figure 1.2: Shifting Climate Scenarios



Source: NECA 2006

Climate projections from the Northeast Climate Adaptation Science Center (NE CASC) at the University of Massachusetts show with more certainty than ever that these changes can be expected to continue. Projections are based on simulations from the latest generation of climate models from the Intergovernmental Panel on Climate Change and scenarios of future GHG emissions, and are downscaled to the watershed and county level across the Commonwealth of Massachusetts.¹

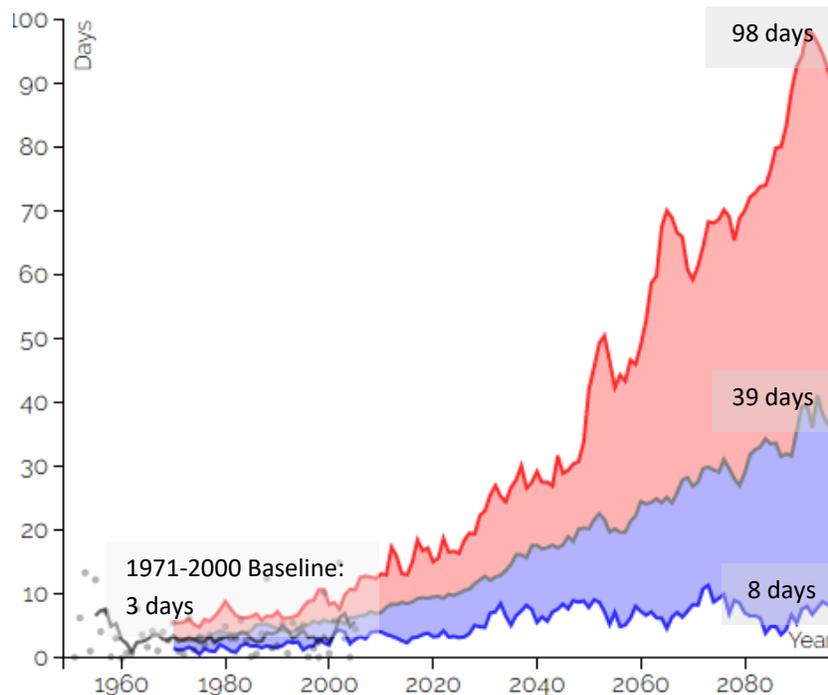
Ludlow lies primarily within the Chicopee River Basin, where projections show that by the end of this century, communities could see between 3.5 and 5.5 inches of additional rainfall annually over a 1971-2000 baseline of 46.64 inches per year. The winter season is expected to experience the greatest seasonal increase both in total precipitation and the frequency of heavy downpours, or days receiving precipitation over one inch.

Despite this increase in precipitation, especially large precipitation events, primarily in winter and spring, projections also indicate that there could be an increase in consecutive days without rain during the summer and fall.

Projections show that annual average and maximum temperatures will continue to rise. Even a very small rise in average temperatures can have major impacts on species and ecosystem health and the relative proportion of precipitation that falls as rain or snow. In addition to an increase in average temperatures, there is projected to be a significant increase in the number of extreme heat days, meaning days with the temperature above 90°F. Heat-related illnesses and mortality show a marked increase at temperatures rise above this threshold.

Projections for the Chicopee River Basin from NE CASC, shown in Figure 1.3 below, indicate an increase in 90°F days per year of up to 98 days by the end of the century from a baseline average of 3.35 days per year. Heat waves can lead to illness and death, particularly among vulnerable individuals such as the elderly, the very young, and those with existing health risk factors.

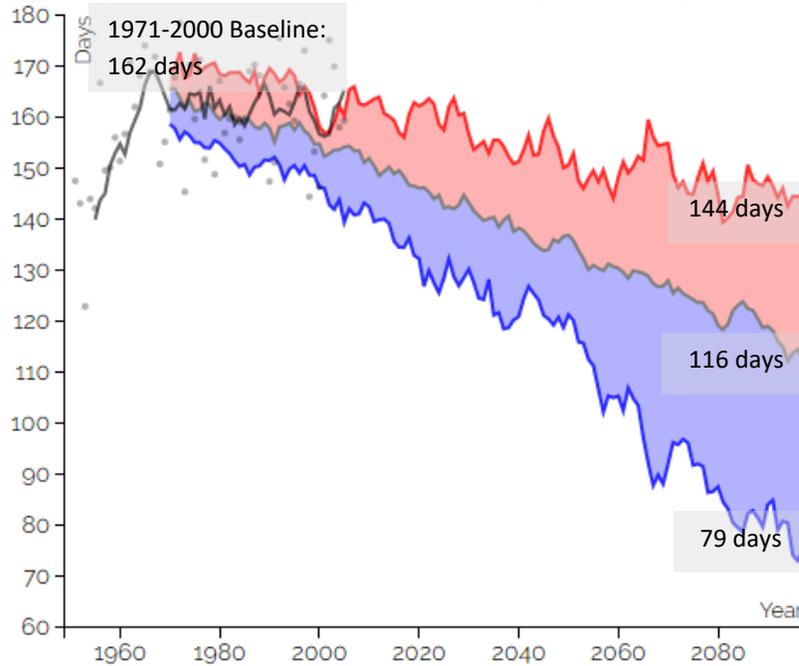
Figure 1.3: Projections for Annual Days Above 90°F in the Chicopee River Basin



Source: NE CASC, MA Climate Change Clearinghouse, <https://resilientma.org>

There are also significant temperature changes projected for the winter. The days below freezing are projected to decrease from a baseline average of 162 days to possibly only 79 days by the end of the century, as shown in Figure 1.4 below.

Figure 1.4: Projections for Annual Days Below Freezing in the Chicopee River Basin



Source: NE CASC, MA Climate Change Clearinghouse, <https://resilientma.org>

These significantly warmer winter temperatures will likely have a number of impacts on the Town, including the following:

- More rain, sleet, and ice and less snow in winter – possibly more damage from flooding and ice.
- Increased freezing and thawing of roads, and longer mud season impacting dirt roads in particular.
- Impacts to winter tourism and activities that rely on snow, such as snowmobiling and skiing.
- Impacts to agricultural operations that rely on cold weather such as maple sugaring.
- Stress on native species that are adapted to freezing weather.
- More beneficial conditions for many invasive species as well as disease vectors such as ticks.
- Less snowpack to replenish groundwater.

Finally, projections indicate an increase in the frequency and magnitude of extreme weather. This could come in the form of tropical storms, or other high intensity wind and rain events. Here, too, the greatest changes are expected to occur in the spring and winter. The planning process utilized by the Town of Ludlow’s Core Team included public outreach on the anticipated impacts of climate change to the Town and on the types and severity of natural hazards that impact the Town.

PLANNING PROCESS

Facilitating discussion among stakeholders about creating a safer, more resilient community is an important aspect of the natural hazard and climate change impact mitigation planning processes.

The involvement of a variety of stakeholders in identifying mitigation strategies helps reflect the Town's values and priorities and builds greater community support and success in implementing actions that reduce risk. The planning and outreach strategy used to develop this MVP-HMP collected input from three categories of stakeholders:

1. The Core Team, which includes representation from municipal and local leadership.
2. Local, regional, and state-level stakeholders who could be vulnerable to, or provide strength against, natural hazards and climate change.
3. Residents, business owners, and all those who are interested in the Town's future.

MVP/HMP Committee (Core Team)

The Town of Ludlow convened the MVP/HMP Committee (referred to herein as the "Core Team") to act as a steering committee for the development of the MVP-HMP. The Core Team also provided regular input through email and interviews. The Core Team played an important role in identifying critical infrastructure, involving key stakeholders, and assessing the Town's capacity to mitigate hazards alongside ongoing operations. Members of the Core Team are listed below.

- Doug Stefancik, Town Planner
- Marc Strange, Town Administrator
- Jim Goodreau, Assistant Town Engineer
- Penny Lebel, Vice-Chair, Conservation Commission Administrative Assistant
- Jocelyn Zepke, Director, Council on Aging
- Paulina Matusik, Public Health Coordinator
- Seth Falconer, Captain, Ludlow Fire Department
- Brian Shameklis, Sergeant, Ludlow Police

CORE TEAM MEETINGS

Core Team meetings took place both at the Ludlow Town Hall and virtually over Zoom and were held on the dates listed below. Agendas for each meeting are included in Appendix C. While not all members of the Core Team were able to attend each meeting, all members collaborated on the plan and were updated on progress by fellow Core Team members after meetings occurred as necessary.

December 17, 2021

At the kickoff meeting, the Core Team reviewed the project scope, the MVP planning process and the HMP update process. Emily Tully of PVPC gave a presentation summarizing the MVP program, the timeline, and the similarities and differences between the HMP update process and the MVP process, as well as climate change impacts on natural hazards. There was group discussion about Town vulnerabilities and priorities for reducing vulnerabilities and strengthening resilience.

January 21, 2022

During this meeting, the Core Team reviewed past, present and future natural hazards in Ludlow and decided on the top four hazards to focus on during the workshops, updated hazard locations, previous occurrences, and development since 2016, and planned for the CRB workshops, including reviewing and updating the stakeholder list and discussing the outreach plan. The team also updated the level of risk for each identified hazard and discussed preliminary thoughts on infrastructure, environmental, social, and economic assets in Town.

February 17, 2022

This Core Team meeting also served as the first public meeting for the HMP update process. The meeting took place in-person at Town Hall and on Zoom, and was broadcast on Ludlow Community TV. Emily Tully gave an overview of the MVP/HMP planning process, requirements and timelines, provided an introduction to climate change and natural hazards at the national, state and local level, and also provided a natural hazards risk assessment for Ludlow. The Core Team then reviewed and updated the list of existing mitigation capabilities as well as the status of the 2016 HMP mitigation measures. The Core Team assessed whether actions had been completed, were in progress, were ongoing, or had not been addressed yet, as well as which actions to carry forward to the 2022 plan, and prioritized those actions. Stakeholder outreach for the CRB workshops was discussed, as well as workshop dates and times.

June 21, 2022

Prior to the Public Listening Session, the Core Team 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 Town Planner 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 Core Team 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.

STAKEHOLDER INVOLVEMENT: COMMUNITY RESILIENCE BUILDING (CRB) WORKSHOPS AND PUBLIC LISTENING SESSIONS

The Town held the CRB workshops on March 23, March 31 and April 7, 2022. The workshops were organized around the topic areas of developing vulnerabilities and strengths in the categories of infrastructure, environment, and society (Workshop 1), brainstorming mitigation actions for all vulnerabilities and strengths identified in Workshop 1 (Workshop 2) and finalizing/prioritizing the mitigation actions (Workshop 3). Stakeholders with subject matter expertise and local knowledge and experience, including town staff and board members, public officials, local and regional organizations, neighboring communities, media organizations, environmental and social service organizations, and local businesses, were invited to attend. Leadership from neighboring communities of Springfield, Chicopee, Wilbraham, Palmer, Monson, and Granby, Massachusetts were invited to participate in the workshops.

During the workshops, PVPC provided information about the MVP program, HMP program, climate change, and natural hazards and impacts, including the top four hazards impacting Ludlow as identified by the Core Team (described below). Participants generated a list of infrastructural, societal, and environmental features in Town that are vulnerable to these climate change hazards or provide strength and resilience in the face of these hazards, and discussed potential natural hazard impacts to climate vulnerable populations and the Town's Environmental Justice (EJ) community. Participants also identified and prioritized key actions that would improve the Town's resilience to natural and climate-related hazards.

A full list of community representatives who were invited and those who participated in the process are presented in Appendix C, along with the materials from the workshops. The broad representation of local and regional entities that participated in these workshops ensures that the MVP-HMP aligns with the operational policies and hazard mitigation strategies at different levels of government and implementation.

A list of all participants at the three workshops is provided below:

Workshop #1:

- Doug Stefancik, Town Planner, Core Team
- Marc Strange, Town Administrator, Core Team
- Seth Falconer, Fire Department, Core Team
- Penny Lebel, Conservation Commission Administrative Assistant, Core Team
- Jim Goodreau, Assistant Town Engineer, Core Team
- Bob Weaver, Springfield Water and Sewer Commission (SWSC)
- Jake Oliveira, Massachusetts State Representative
- Justin Larivee, Building Commissioner
- Amy Ollari, Ludlow Community TV
- Andrew Smith, MVP Regional Coordinator
- Emily Tully, PVPC
- Mimi Kaplan, PVPC
- Jacinta Williams, PVPC

Workshop #2

- Elaine Hodgman, resident/ Pond Management Committee member
- Paulina Matusik, Health Department, Core Team
- Aimee Henderson, Eversource Energy
- Seth Falconer, Fire Department, Core Team
- Penny Lebel, Conservation Commission Administrative Assistant, Core Team
- Marc Strange, Town Administrator, Core Team
- Doug Stefancik, Town Planner, Core Team
- Bob Weaver, SWSC
- Jeff McDonald, Hampden County Sherriff's Department (by phone)
- Amy Ollari, Ludlow Community TV
- Emily Tully, PVPC
- Mimi Kaplan, PVPC
- Jacinta Williams, PVPC

Workshop #3

- Elaine Hodgman, resident/ Pond Management Committee member
- Doug Stefancik, Town Planner, Core Team
- Penny Lebel, Conservation Commission Administrative Assistant, Core Team
- Seth Falconer, Fire Department, Core Team
- Jeff McDonald, Hampden County Sherriff's Department
- Amy Ollari, Ludlow Community TV
- Emily Tully, PVPC
- Jacinta Williams, PVPC

PARTICIPATION BY THE PUBLIC AND NEIGHBORING COMMUNITIES

Two public meetings were held as part of the mitigation planning process – on February 17, 2022 and June 21, 2022. Both meetings occurred after the Core Team had provided input on hazards and Town vulnerabilities. The first public meeting was held during the planning process, after two meetings with the Core Team and prior to the CRB workshops. The second public meeting, in the format of an MVP public listening session, was held on June 21, 2022 during a regularly scheduled Board of Selectmen meeting and occurred after the CRB workshops had been held and the draft plan developed. Notice of both public meetings was posted in the Town Hall in compliance with the Commonwealth of Massachusetts' open meeting law. Public meeting materials, including materials presented and public meeting notices, can be found in Appendix C.

Notices of the public meetings were sent to Emergency Management Directors of neighboring Towns via email as well as to local media outlets. On June 16, 2022, the PVPC sent a press release to all area media outlets to inform the public that a draft of the Ludlow MVP-HMP plan had been placed on the Ludlow MVP Committee's website, and to invite interested parties to participate in the public listening session at the Ludlow Board of Selectmen meeting on June 21, 2022. The release also indicated that hard copies are available by request, and that all residents, businesses, and other concerned parties of Ludlow and adjacent communities were encouraged to comment on the plan by emailing or calling staff contacts at PVPC or the Town of Ludlow. The PVPC press release, a screenshot of PVPC's website showing the link to the press release, list of media organizations that were sent the media release, and associated newspaper articles can be found in Appendix C.

Businesses and neighboring communities were also provided with an opportunity to provide feedback through the PVPC. PVPC is regularly involved in land use, transportation, and environmental planning initiatives in Ludlow and surrounding communities. Regular feedback received from these other initiatives were incorporated into the HMP and MVP planning processes.

Public participation will be a critical component of the HMP maintenance process. The Core Team has held all meetings in accordance with Massachusetts open meeting law, and will continue to do so.

February 17, 2022 Public Meeting

The first public meeting was held in person and over Zoom in conjunction with an MVP/HMP Committee meeting. Participants included members of the Core Team as well as the general public. As with the previous Core Team meetings, the meeting was broadcast on Ludlow Cable Access Television and call-in and virtual meeting options were available for participants. Emily Tully delivered a PowerPoint presentation that included an overview of the MVP/HMP planning processes, timelines and requirements, climate change projections, a natural hazards risk assessment for Ludlow, and a review of the 2016 HMP and updates thus far. A public comment period during the meeting was provided for any attendees to share thoughts, concerns, comments or to ask questions.

June 21, 2022 Public Meeting

Nine people participated in the second public meeting, held as part of a regular Board of Selectmen meeting. Participants included members of the Core Team as well as the Board of Selectmen, Ludlow Community TV, and 22 News. This meeting was also broadcast on Ludlow Community TV and had call-in and virtual meeting options available. Emily Tully presented a review of the MVP and HMP update processes, CRB workshops, 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 before it is finalized for MEMA and FEMA review.

PARTICIPATION BY ADDITIONAL STAKEHOLDERS

A variety of stakeholders were provided with an opportunity to be involved in the development of the 2022 MVP and 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 PVPC is a regional planning agency for 43 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 2022 HMP update by PVPC ensured that the information from these plans was incorporated into the HMP update 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 HMP. 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 MVP and HMP, 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.

PVPC staff also 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 a result, all the communities in the region were informed of Ludlow's 2022 HMP Update process and encouraged to comment.

AGENCIES THAT HAVE THE AUTHORITY TO REGULATE DEVELOPMENT

The Ludlow Planning Board is the primary Town board responsible for regulating development in Town. The participation of the Town Planner on the Core Team ensured feedback to the Planning Board. Other Town commissions, boards, and committees that have the authority to regulate development in Town include the Zoning Board of Appeals, Board of Selectmen, Conservation Commission, and the Finance Committee. Feedback from these stakeholder agencies was ensured through the participation of the Core Team, who regularly meet and collaborate with members of these entities and Town staff who regularly staff meetings of these commissions, boards, and committees.

The PVPC, as a regional planning authority, works with all agencies that regulate development in Ludlow, including the municipal entities listed above and state agencies, such as MassDEP, the Massachusetts Department of Conservation and Recreation (DCR), and the Massachusetts Department of Transportation (MassDOT). This regular involvement ensured that the operational policies and any mitigation strategies or identified hazards from these entities were incorporated into the MVP-HMP.

PLAN ADOPTION

In 2021, 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 on **DATE** and adopted it. 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: HAZARD MITIGATION AND CLIMATE ADAPTATION GOALS

The Town of Ludlow’s Core Team convened to discuss, review, and endorse the following hazard mitigation and climate adaptation goals for the MVP-HMP.

The Town of Ludlow aims to minimize the loss of life, damage to property, and the disruption of governmental services and general business activities due to flooding, severe snowstorm and ice storms, severe thunderstorms, hurricanes, tornadoes, brushfires, earthquakes, dam failures, drought, and global health crises through the following avenues:

Protection: Develop programs, strategies, and actions to protect the following Town assets from natural hazards and climate change impacts:

- | | |
|---|--|
| <ul style="list-style-type: none">• Residents, with an emphasis on supporting the elderly, young, and low-income populations• Cultural and historic resources• Critical infrastructure• Utilities, including electric power, water, and wastewater | <ul style="list-style-type: none">• Public facilities and services• Homes and businesses• Open space and other environmental features• Future development |
|---|--|

Planning: Incorporate climate adaptation and hazard mitigation measures into local plans, bylaws, regulations, and practices to protect critical infrastructure and property and to encourage resilient development, based on up-to-date information on climate change projections and emerging risks.

Nature-based Solutions: Investigate, design, and implement hazard mitigation and climate adaptation measures that employ nature-based solutions and protect the natural environment.

Coordination: Collaborate in hazard mitigation planning and climate adaptation with utility providers, local businesses, institutions, non-profits, surrounding communities, and state, regional and federal agencies.

Capacity: Increase the capacity for all Town departments, committees, and boards to respond to climate change impacts and natural hazard events with adequate data, guidance, staff, training, and equipment.

Public Outreach: Increase awareness and provide resources for hazard mitigation and climate resilience to businesses and residents through outreach and education.

Funding: Identify and seek funding for measures to mitigate or eliminate each known significant hazard area and reduce the impacts of climate change.

CHAPTER 3: LOCAL PROFILE

GEOGRAPHY

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.

Ludlow is a part of the Chicopee River Watershed Basin. The Chicopee River, along the southern border of Town, and the Ludlow 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 or 28 square miles. Approximately a third of the land in Ludlow has been developed, of which 3,878 acres are residential.

GROWTH AND DEVELOPMENT

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 Fatima Festa 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 Manufacturing remained the primary employer in Town until the early 1900s. According to the Ludlow Open Space and Recreation Plan (2006), at one time the company owned more than three-quarters of all real and personal property assessed by the Town. The company constructed municipal, commercial, recreational, and health facilities, and supported the formation of the local bank and the library.¹

Ludlow is proximate to the employment centers of Chicopee and Springfield, and there is 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.

While it is a residential community, Ludlow is more than a bedroom community. It has an established factory district, a shopping plaza, and along with neighboring Chicopee, it is home to the Westover Industrial Park. Ludlow is also the site of the Hampden County Correctional Center. Recreational opportunities are provided at Memorial Park, Memorial Field, Whitney Park, and a Town beach at Haviland Pond.

POPULATION CHARACTERISTICS

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. As of the 2020 Census, the population was 21,002.

¹ Ludlow Open Space and Recreation Plan, 2006.

Ludlow has a population density of 772 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.

As Table 3.1 below shows, a significant percentage of Ludlow’s population, over 20%, is older than 65, and about 12% is under age 18. The median household income is \$35,215 and the poverty rate is 8.3%. According to 2020 US Census data, there is one Environmental Justice (EJ) population in the northwest corner of the Town that meets the criteria for a minority block group, with 35% of the population in that block group identifying as a minority. Although the majority of Ludlow residents are white, almost 10% are Latino, 2.6% African American, and 1% Asian. According to the Core Team, there are pockets of limited-English households, although not enough to comprise an Environmental Justice block group.

Table 3.1: Ludlow Population Demographics

Ludlow Population Demographics		
	Population	21,002
	Below Age 18	12.1%
65+	Above Age 65	20.4%
	Bachelor’s degree or higher	22.2%
	Median household income	\$35,215
	Poverty Rate	8.3%
	With a Disability	15.9%
	Occupied Housing Units	8,310
	Renter-Occupancy Rate	24.8%

Source: US Census Bureau, 2020 Census and American Community Survey 2020 5-year Estimates

INFRASTRUCTURE FEATURES

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, the construction of the Ludlow Reservoir, I-90, and the Westover Air Force Base. With a growing residential population, Ludlow’s infrastructure has more recently developed in relationship to these core areas.

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 Exit 54. The majority of Ludlow’s road network is concentrated in the southwestern corner of town, allowing access to I-90, Springfield, and Chicopee, as well as the Airpark East industrial park located on the former property of the Westover Air Force Base.

Other key thoroughfares and evacuation routes include Fuller Street, West Street, Holyoke Street, Lyons Street, Cady Street, Chapin Street, East Street, Bondsville Road, Poole Street, Rood Street, and Miller Street.

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 30 trains per day, both freight and passenger rail.

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 does provide commuting options to larger employment centers from a park-and-ride lot located behind McDonalds restaurant off Exit 54 off of I-90. Paratransit, a door-to-door demand responsive van service, is provided in Ludlow by PVTA through MV Transportation.

The Springfield Water and Sewer Commission (SWSC) provides water service to approximately 50% of the 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 Ludlow Reservoir, located in the northeastern portion of Ludlow, is a reserve water supply.

A small percentage of Ludlow households in the Fuller Street/West Street/Miller Street area are served by the Massachusetts Water Resources Authority (MWRA), which draws supply from the Quabbin Reservoir. In the Miller Street area, they are serviced through Wilbraham Water Department and in the Fuller Street/West Street area, they are serviced by South Hadley Fire District #1. The remaining almost half of households in Ludlow rely on private well water.

Ludlow is served by public sewer, with wastewater treatment provided by Springfield Water and Sewer Commission. In addition, approximately 40% of residents rely on private on-site septic systems for sewage disposal.

ENVIRONMENTAL FEATURES

Ludlow is situated on the western edges of the Pioneer Valley's rugged uplands that dominate central Massachusetts. The westerly flowing Chicopee River forms the southern border. The western portion of the Town consists of dry and marshy lowlands while the eastern part of town is covered in rugged uplands. Development has followed topographical cues, with much of the density along the southern edge of town. Working farms and pastureland are scattered throughout Town and reflect Ludlow's history as an agricultural community.

Ludlow's topography is gently sloping agricultural lands with large tracts of forested hills. The lowest point lies in the central portion of Town, the location of the historic Ludlow Center, at an elevation of 230 feet. Ludlow Reservoir, the largest body of water in Town, lies at an elevation of 373 feet. The highest point, in Ludlow State Forest, is about 720 feet, located west of Tower Rd.

There are two major area of extreme relief in Ludlow, Minnechoag Mountain, in the Ludlow State Forest 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.

The highest point, in Ludlow State Forest, is about 720 feet, located west of Tower Road. The Ludlow Reservoir, the largest body of water in Ludlow, lies at an elevation of 373 feet. The 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 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 toward the Massachusetts Turnpike are extremely flat and dry, but are broken up occasionally by wetlands and large ponds along Minnechoag 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.

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, although it was closed in 2020 due to impacts of the Covid-19 pandemic and in 2021 due to staffing shortages. 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.

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 Stoney 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.

The Ludlow Reservoir is the largest body of water in Ludlow. This water resource, owned by the Springfield Water and Sewer Commission (SWSC), is not currently being utilized for public drinking water, but as a reserve water supply. A series of aqueducts connect the Reservoir to other sections of Town. Ludlow Reservoir has several areas in which passive recreation is encouraged.

The MWRA replaced Nash Hill Reservoir with two 12.5 million gallon circular tanks in 1999. The Nash Hill covered reservoir, located south of Nash Hill Road, is connected by an aqueduct to Ludlow Center. This parcel is approximately 40 acres, and 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.

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.

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 pool sites.

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 yearly 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 12 policies in force as of January 11, 2022.

Portions of Ludlow are heavily forested with a mixture of hemlock, pine, oak, maple, and birch trees. There are significant climax forests, plant communities that are dominated by trees representing the last stage of natural succession for that specific locality and environmentally, 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.

The wooded watershed area around the Ludlow Reservoir was affected by a spongy moth (formerly known as gypsy moth) infestation in 2016, resulting in the mortality of a large number of oak trees. The SWSC's consulting forester developed a report with recommended tree management activities to minimize damage to the watershed. The SWSC conducted forest management activities, including tree harvesting, in 2019 and 2020 to remove affected trees and promote greater species diversity within the watershed.²

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.

SOCIETAL FEATURES

Ludlow is rich in history and culture, with both an agricultural and industrial past. As mentioned earlier, Ludlow developed around the Ludlow Manufacturing Company and other mills, and the character of the community was formed by the many immigrants that came to work in the mills, as well as by more recent immigrants. As a result of this ethnic diversity, there are a number of residents who speak a primary language other than English, such as Portuguese, Spanish, Polish, and Turkish. Much of this ethnic heritage is still present today in the Town's neighborhoods, churches, and community centers.

Ludlow has a mix of commercial, residential, and open space areas. It has an established factory district, a shopping plaza, an Industrial Park, and the Hampden County Correctional Center. There are many historical and cultural structures in Ludlow, particularly in the center of the Town. There are a small number of working farms remaining in Ludlow, including Randall's Farm, which also has a farm store and holds seasonal activities.

² <https://waterandsewer.org/projects/watershed-projects/ludlow-reservoir-forest-management/>

While there are many places of employment in Ludlow, many residents commute to Springfield or other cities for work. There has been significant growth in Town due to Ludlow's many attractions, its proximity to places of employment as well as to the Mass Turnpike, and relatively inexpensive housing.

The Ludlow Public School System includes East Street Elementary, Harris Brook Elementary, Paul R. Baird Middle School, and Ludlow High School, as well as the Integrated Preschool Program at the East Street Elementary School. There is a private Catholic school, St. John the Baptist, as well as a number of private preschools and daycare centers.

There are many churches in Ludlow representing different denominations. Our Lady of Fatima is a center of the Portuguese community in Town and also functions as an emergency shelter. The Ludlow Community Center/Randall Boys and Girls Club has athletic facilities and provides both youth and adult athletic programs, as well as a preschool and before and after school programs for children.

There is an active Council on Aging and Senior Center, which provides activities as well as services to senior residents. There are two large pharmacies (CVS and Walgreens) in Town, as well as a Big Y supermarket. There is one hospital in Ludlow, Encompass Health Rehabilitation Hospital, as well as a number of small medical offices.

Vulnerable populations in Ludlow include limited or non-English speaking residents, as well as low-income residents and the senior population. As mentioned earlier, there is one Environmental Justice block group in the northwest corner of Town that meets the criteria for minority population, while according to the Core Team, the majority of the low-income and limited or non-English speakers reside in the Town center.

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 the 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 six 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 for residential purposes and 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 and IC: Areas of town which are best suited for manufacturing and industrial uses, as well as any use permitted in the Business District.
- Mill Redevelopment District - MRD: This district provides for “large-scale developments of at least 50 acres gross which are master-planned with flexibility within the bounds of a district and which require a minimum of three separate permitted land uses situated in locations favorable to the accommodation of such developments.”

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.
- Smart Growth Overlay District: This overlay encourages new development close to existing infrastructure and services in order to protect open space and farmland in the outer reaches of town to support private developers in their efforts to provide a range of safe, quality housing options for individuals and families of all ages and incomes.
- Floodplain District Bylaw: The purpose of the Floodplain District is to protect the public health, safety, and general welfare, to protect human life and property from the hazards of periodic flooding, to preserve the natural flood control characteristics, and the flood storage capacity of the floodplain and to preserve and maintain the groundwater table and water recharge areas within the floodplain.
- East Street Revitalization Overlay District: The purpose of the East Street Revitalization District is to encourage the preservation and revitalization of the East Street Corridor. The East Street Revitalization Zone is that portion of East Street running from its intersection with State Street to its intersection with King Street on its northerly side and Stevens Street on its southerly side. This district includes non-industrial parcels that abut East Street and lie partly or completely within 200 feet of East Street.

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

RECENT AND POTENTIAL DEVELOPMENT

Per the 2020 Census, Ludlow is home to approximately 21,002 residents. Over half 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 HMP, Ludlow has seen both residential and commercial development. Residential development has included two apartment complexes aimed at housing senior citizens—Keystone Commons, Mill # 10 Senior Housing and Stevens Memorial Senior Housing—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 34 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 significant and 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 processes, which involve a fire prevention 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.

CRITICAL FACILITIES

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

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

The Critical Facilities List for the Town of Ludlow has been identified utilizing a Critical Facilities List provided by the State Hazard Mitigation Officer. Ludlow’s Core Team has broken up this list of facilities into four categories:

- Facilities needed for emergency response in the event of a hazard event.
- Facilities that are not needed for emergency response, but are considered essential to the everyday operation of the Town.
- Facilities or institutions that include special populations that would need additional attention in the event of a hazard event.
- Facilities that have potential supplies and resources needed for response.

The critical facilities and evacuation routes potentially affected by hazard areas are identified in Table 3-1 and on the Past and Potential Hazards/Critical Facilities Map provided in Appendix D.

Table 3-1: Critical Facilities in Ludlow

Critical Facilities		
Feature Type	Name	Address
Category 1: Emergency Response Services		
Fire/Police/Emergency Response	Public Safety Complex – Primary Emergency Operations Center (EOC)	612 Chapin Street
	Highway Garage – Backup EOC	198 Sportsmen’s Road
	Mass Municipal Wholesale Electric Company (MMWEC) - Emergency Electrical Power Facility	327 Moody Street
	Airport/Helicopter Landing Area	Westover Air Base – 975 Patriot Ave, Chicopee
Emergency Shelters	Baird Middle School	One Rooney Road
	Encompass Health	222 State Street
	Ludlow Senior Center	37 Chestnut Street

Critical Facilities		
Feature Type	Name	Address
Emergency Shelters (cont.)	Ludlow High School	500 Chapin Street
	Harris Brook Elementary School	209 Fuller Street
	East Street School	508 East Street
	Town Hall	488 Chapin Street
	Our Lady of Fatima Parish – can accommodate FEMA trailer	438 Winsor Street
	Emergency Management Trailer (Traffic emergencies)	198 Sportsmen’s Road
Emergency Fuel	Highway Garage	198 Sportsmen’s Road
Utilities		
Electricity	Eversource	Power Substation – Center Street
Electricity – Back up	MMWEC	Westover Industrial Park
Natural Gas	Eversource	76 Ravenwood Drive
	Baystate Gas LNG Plant	5 Ravenswood Drive
	Buckeye pipeline	Tank Farm Road
Dams	Hydroelectric dam	Putts/Ludlow Bridge
	Hydroelectric dam	Miller Street
	Hydroelectric dam	Red Bridge
Communications		
Cell Towers		1 State Street 145 Carmelina’s Circle 1709 Center Street 183 Ravenswood Drive 34 Carmelina’s Circle 653 Moore Street Miller Street West Street Poole Street Nash Hill Road
Internet	Charter Communications Hub Site	500 Chapin Street (Ludlow High School)
Town Communications	Public Safety Complex Town of Ludlow Communications Tower	612 Chapin Street Center Street
Transportation		
Public Transportation	Pioneer Valley Transit Authority	The B6 bus route makes stops at four locations in Ludlow along Bay Road, including at Encompass Health on weekdays
Evacuation Routes	Primary Evacuation Routes and Bridges on Evacuation Routes	Bondsville Road Cady Street Chapin Street Church Street East Street - Chicopee River Bridge Fuller Street Holyoke Street - Harris Pond Bridge

Critical Facilities		
Feature Type	Name	Address
Evacuation Routes (cont.)	Primary Evacuation Routes and Bridges on Evacuation Routes (cont.)	Kendall Street Lyon Street Mass Turnpike (I-90) – Chicopee River Bridge Miller Street – Collins Bridge Poole Street Rood Street Route 21 (Center Street) – Putts Bridge over Chicopee River Russell Street West Avenue West Street – Chicopee River Bridge
Critical Needs		
Potable Water Supplies	Nash Hill Covered Reservoir	MWRA, serves Fuller Street residents
	SWSC	Serves +/- 50% of Town
	Ludlow Reservoir	SWSC Back-up Water Supply
	Wilbraham Water Line	Serves Miller Street residents
	South Hadley Fire District #1	Serves Fuller Street/West Street residents
Non-Potable Water Sources	Ludlow Reservoir	Center Street
	Cistern	Leland Drive
	Cistern	Jared Drive
	Cistern	Parker Lane & Balsam Hill Road
	Cistern	Sunset Ridge
	Cistern	Avalino Way
Wastewater	SWSC	Serves +/- 60% of Town
Category 2: Non-Emergency Response Facilities		
Transfer Station	Highway Garage	198 Sportsman's Road
Bridges/Culverts	Location of Problematic Culverts (frequent flooding)	Fuller Street Bondsville Road Center Street and Alden Piney Lane Poole Street Randall Road West Street/Brook Street
Category 3: Potential Resources		
Food/Grocery	Big Y Supermarket Complex	433 Center Street
	CVS Pharmacy	451 Center Street
	Walgreens	54 East Street
Gasoline/Gas Station	Highway Garage	198 Sportsman's Road
	Pride	478 Center Street
	Cumberland Farms	320 East Street
	Cumberland Farms	463 Center Street
	Cumberland Farms	101-105 West Street

Critical Facilities		
Feature Type	Name	Address
Gasoline/Gas Station (cont.)	O'Connell Oil Associates	227 Center Street
	Mobil	341 West Street
	Sunoco	425 Center Street
Heating Fuel	Ludlow Heating and Cooling	1056 Center Street
Hospitals/Medical Supplies	CVS Pharmacy	433 Center Street
	Walgreens	54 East Street
	Encompass Rehabilitation Hospital	222 State Street
	Dialysis Center	14 Chestnut Place
	Baystate Noble	115 W Silver Street, Westfield
	Baystate Springfield	759 Chestnut Street, Springfield
	Mercy Medical Center	271 Carew Street, Springfield
Building Material Suppliers	C&A Smith Lumber and Feed	84 Hubbard Street
Heavy and Small Equipment Suppliers	United Rentals	562 Holyoke Street
Gravel Pits	Banas Concrete	246 Fuller Street
	Chenier's Gravel Bank	405 Musing Street
	Daniel's Gravel Bank	466 Miller Street
	Haluch's Landscaping Products	1014 Center Street
Category 4: Populations and Facilities to Protect		
Special Needs Population	Hampden County Correctional Center	627 Randall Road
Elderly/Assisted/Disabled Housing	Keystone Commons	460 West Street
	Chestnut Street Housing	39 Chestnut Street
	Colonial Sunshine Manor	114 Wilson Street
	State/Meadow Street Housing for Elderly	69 State Street
	Steven's Memorial Building	12 Chestnut Street
	Wayfinders Housing (2023)	188 Fuller Street
	Winn Development Senior Housing	Mill 10, 68 State Street
	Paradise Creek	Miller and East Street
Schools/Youth Programs	Harris Brook Elementary School	209 Fuller Street
	East Street Elementary School	508 East Street
	Baird Middle School	One Rooney Road
	Ludlow High School	500 Chapin Street
	St. John the Baptist School	181 Hubbard Street and Oak Street
	Tiny Explorers Daycare	658 Center Street
	Ludlow Community Center / Randall Boys and Girls Club	91 Claudia's Way
	Parkside Early Learning Center	33 Norwood Street
Recreation Areas	Camp White	Musing Street
	Children's Playground	Opposite 47 Sewell Street
	Facing Rock Wildlife Management Area	Lyon Street
	Ludlow Country Club	Tony Lema Drive and East Street

Critical Facilities		
Feature Type	Name	Address
Recreation Areas (cont.)	Memorial Park	Chestnut Street and Sewell Street
	Electric Park	13 Watt Ave.
	Gazebo Park	East Street
	West Street Park	Cady and West Street
	Westover Golf Course	South Street
	Whitney Park	167 Howard Street
	Ludlow Reservoir	Center Street
Places of Worship	Church of Latter Day Saints	584 West Street
	Christ the King Church	41 Warsaw Avenue
	Community of Faith Chapter	12 Cedar and East Street
	First Church	859 Center Street
	Jehovah's Witnesses	Fuller Street
	Love/Div/Prayer Church	Hampden and Windsor East
	Our Lady of Fatimah Parish	438 Winsor Street
	St Elizabeth's Church	181 Hubbard Street and Oak Street
	St. Paul's Methodist Church	Hubbard and Sewall Street
	St. Peter and Paul Ukrainian Catholic Church	45 Newbury Street
	Union Church	Center Street
Historic Buildings/Sites	Ludlow Center Historic District	Approximately 27 acres bounded by Center, Church and Booth Streets
	Ludlow Village Historic District	Approximately 190 acres bounded by Winsor, Sewall, State Street and the Chicopee River
Mobile Home Parks	Mountainview MHC Manufactured Housing	229 Miller Street
	Scott's Mobile Home Park	350 West Street

CHAPTER 4: HAZARD IDENTIFICATION AND ANALYSIS

The following section includes a summary of hazards that have affected or could affect Ludlow. Historical research, conversations with local officials and emergency management personnel, available hazard mapping, and weather-related databases were used to develop this list. Each hazard profile contains information on the areas vulnerable to the hazard, documentation of historic events, a risk and vulnerability assessment, and related climate change projections. The risk and vulnerability assessment examines both the frequency and severity of hazards and their potential impact to the Town of Ludlow.

Each hazard risk and vulnerability assessment use previous occurrences and climate projections to identify high risk areas and the likelihood that a hazard will occur. The vulnerability analysis takes into consideration various factors in the community, including existing and future buildings, infrastructure, and critical facilities. In some cases, an estimate of the potential dollar loss to vulnerable structures is available. Land uses and development trends were also considered as part of the flood vulnerability assessment.

FEDERALLY DECLARED DISASTERS IN MASSACHUSETTS

Tracking historic hazards and federally declared disasters that occur in Massachusetts, and more specifically Hampden County, helps planners understand the possible extent and frequency of hazards. Historically, Massachusetts has experienced multiple types of hazards, including flooding, blizzards, and hurricanes. Since 2000, there have been 29 storms in Massachusetts that resulted in federal disaster declarations. Eighteen disaster declarations have occurred in Hampden County (two were related to the Covid-19 Pandemic). Federally declared disasters present additional FEMA grant opportunities for regional recovery and mitigation projects. The hazard profiles included in this chapter contain more information about federally declared disasters.

VULNERABILITY AND RISK

To understand risk, one must first understand vulnerability. Vulnerability is determined by the amount of exposure, sensitivity, and adaptive capacity of an asset in the social, natural, and built environment and is the predisposition to being negatively affected by a natural hazard. Exposure is influenced by the location of the asset and the severity of the event. Sensitivity refers to the impact of a natural hazard due to the existing conditions or characteristics of the assets. For example, a building with an older roof may be more sensitive to wind damage and may lose its ability to function or keep rain out of the building. Adaptive capacity is the ability of a system, service, or asset to adapt or prepare for an anticipated hazard or climate impact.

Risk, or the possible adverse outcome, is determined through the consideration of vulnerability, the severity of an event, and the probability of that event occurring. In some instances, risk can be calculated in dollar amount or other metrics. In other cases, risk can be conveyed through the consequence and follow-on impacts. The consequence may be the amount of damage, length of service disruption, and the loss of life or number of injuries. Follow-on impacts could include public health concerns and environmental damage.

MASSACHUSETTS STATE HAZARD MITIGATION AND CLIMATE ADAPTATION PLANS

The 2018 Massachusetts SHMCAP identified the natural hazards that can occur in the state along with the climate change interaction for each, and the representative climate change impacts. The one hazard without a climate change interaction is earthquakes. These are shown in Table 4.1 below from the SHMCAP.

Table 4-1: Natural Hazards and Climate Change Interactions

Primary Climate Change Interaction	Natural Hazard	Other Climate Change Interactions	Representative Climate Change Impacts
 <p>Changes in Precipitation</p>	Inland Flooding	Extreme Weather	Flash flooding, urban flooding, drainage system impacts (natural and human-made), lack of groundwater recharge, impacts to drinking water supply, public health impacts from mold and worsened indoor air quality, vector-borne diseases from stagnant water, episodic drought, changes in snow-rain ratios, changes in extent and duration of snow cover, degradation of stream channels and wetland
	Drought	Rising Temperatures, Extreme Weather	
	Landslide	Rising Temperatures, Extreme Weather	
 <p>Sea Level Rise</p>	Coastal Flooding	Extreme Weather	Increase in tidal and coastal floods, storm surge, coastal erosion, marsh migration, inundation of coastal and marine ecosystems, loss and subsidence of wetlands
	Coastal Erosion	Changes in Precipitation, Extreme Precipitation	
	Tsunami	Rising Temperatures	
 <p>Rising Temperatures</p>	Average/Extreme Temperatures	N/A	Shifting in seasons (longer summer, early spring, including earlier timing of spring peak flow), increase in length of growing season, increase of invasive species, ecosystem stress, energy brownouts from higher energy demands, more intense heat waves, public health impacts from high heat exposure and poor outdoor air quality, drying of streams and wetlands, eutrophication of lakes and ponds
	Wildfires	Changes in Precipitation	
	Invasive Species	Changes in Precipitation, Extreme Weather	
 <p>Extreme Weather</p>	Hurricanes/Tropical Storms	Rising Temperatures, Changes in Precipitation	Increase in frequency and intensity of extreme weather events, resulting in greater damage to natural resources, property, and infrastructure, as well as increased potential for loss of life
	Severe Winter Storm / Nor'easter	Rising Temperatures, Changes in Precipitation	
	Tornadoes	Rising Temperatures, Changes in Precipitation	
	Other Severe Weather (Including Strong Wind and Extreme Precipitation)	Rising Temperatures, Changes in Precipitation	
<p>Non-Climate-Influenced Hazards</p>	Earthquake	Not Applicable	There is no established correlation between climate change and this hazard

Source: 2018 SHMCAP (EOEEA, MEMA, and EOPSS)

Not all hazards included in the 2018 SHMCAP apply to the Town of Ludlow. Given Ludlow’s inland location, coastal hazards and tsunamis would not affect the Town. The core team did not include landslides in their natural hazard inventory, as they have not previously occurred in the Town. The plan also does not include invasive species as a natural hazard, although they are identified as a vulnerability.

It is assumed that the entire Town of Ludlow and its critical facilities are exposed to earthquakes, high wind events, hurricanes, winter storms, snow and ice, temperature extremes, and drought, to a similar extent. Flood risk from riverine flooding is elevated in the vicinity of flood zones.

NATURAL HAZARD ANALYSIS METHODOLOGY

This chapter examines the hazards in the SHMCAP that are identified as likely to affect Ludlow. The hazard profiles were updated with information from the 2018 SHMCAP and additional research and assessment conducted by the project team. Feedback provided during Core Team meetings, CRB workshops, and Public Listening Sessions provided local accounts of hazards that have impacted Ludlow in the past and those that are currently impacting the Town. The analysis is organized into the following sections:

- Hazard Description
- Location
- Extent
- Previous Occurrence
- Probability of Future Events
- Impact
- Vulnerability

A description of each of these analysis categories is provided below.

HAZARD DESCRIPTION

The natural hazards identified for Ludlow are the following:

- Hurricane / Tropical Storm
- Severe Winter Storm / Nor'easter
- Severe Thunderstorm / Wind / Tornado / Microburst
- Flood
- Wildfire/Brushfire/Urban Fires
- Extreme Temperature
- Drought
- Dam Failure
- Earthquake

Many of these hazards result in similar impacts to the community. For example, hurricanes, tornadoes, severe thunderstorms, and severe snowstorms may cause wind-related damage.

TOP HAZARDS AS DEFINED IN THE CRB WORKSHOPS

Core team members identified the top four hazards/climate change impacts that Ludlow faces, as required for the CRB Workshops. Extensive discussion led to the selection of the following as the top hazards that are likely to impact Ludlow (highlighted in green in Table 4-2):

- Hurricane / Tropical Storm
- Severe Winter Storm / Nor'easter
- Severe Thunderstorm / Wind / Tornado / Microburst
- Flooding

The workshops were designed to bring stakeholders together to brainstorm action items that will result in a more climate resilient future while also supporting the Town's unique features and characteristics. Concerns related to hazardous events such as flooding, severe storms, and snow and ice storms were topics of discussion. Workshop participants cited multiple areas throughout town that experience localized flooding during both extreme and more regular precipitation events. Localized flooding is due to culverts unable to handle the additional flow, blocked storm drains, and low elevation roads. Workshop participants discussed possible improvements to these issues and vulnerabilities.

Workshop participants discussed concerns about the public and private dams in Town regarding uncertainty about the dam ownership and maintenance responsibility. Pond water quality concerns related to stormwater pollution and increasing temperatures were discussed, as was the overall abundance of wetlands throughout Town. There was also discussion about ensuring vulnerable populations have needed supplies if cut off due to flooding or during power outages from severe storms.

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 the table below:

Percentage of Town Impacted by Natural Hazard	
Land Area Affected by Occurrence	Percentage of Town Impacted
Large	More than 50% of the Town affected
Medium	10 to 50% of the Town affected
Small	Less than 10% of the Town affected

EXTENT

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

PREVIOUS OCCURRENCES

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

PROBABILITY OF FUTURE EVENTS

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

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 below:

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 4-2 below shows the hazard risk rankings the Core Team identified for Ludlow based on these four criteria.

Table 4-2: Hazard Identification and Risk Analysis for Ludlow

Type of Hazard	Location of Occurrence	Probability of Future Events	Impact	Vulnerability
Hurricane/Tropical Storm	Large	High	Critical	1
Severe Winter Storm / Nor'easter	Large	Very High	Critical	1
Severe Thunderstorm / Wind / Tornado / Microburst	Small	Moderate	Limited	2
Flooding	Medium	Low	Limited	2
Wildfire/Brushfire/Urban Fire	Medium	Low	Limited	2
Extreme Temperatures	Large	Very High	Limited	3
Drought	Large	Moderate	Limited	3
Dam Failure	Medium	Very Low	Limited	4
Earthquake	Large	Low	Critical	5

The ratings have not changed significantly since the previous plan, however the categories were revised slightly: Ice storms and nor'easters were combined with severe winter storms, severe storms / wind were combined with tornadoes and microbursts, and climate change was removed as a stand-alone hazard.

HURRICANES / TROPICAL STORMS

HAZARD DESCRIPTION

Hurricanes are classified as cyclones and defined as any closed circulation developing around a low-pressure center in which the winds rotate counter-clockwise in the Northern Hemisphere (or clockwise in the Southern Hemisphere) and whose diameter averages 10 to 30 miles across. The primary damaging forces associated with these storms are high-level sustained winds and heavy precipitation..

Tropical cyclones (tropical depressions, tropical storms, and hurricanes) form over the warm, moist waters of the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico, and are classified into one of three categories:

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

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. Climate change increases the threat of hurricanes and severe wind as oceans and the atmosphere warms. Warmer water fuels more intense and longer-lasting storms and expands the area in which hurricanes can form. Warmer air can hold more moisture than cool air, increasing potential rainfall rates.

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. Hurricane intensity is classified by the Saffir-Simpson Scale as shown below, which rates hurricane wind intensity on a scale of 1 to 5, with 5 being the most intense.

Saffir-Simpson Scale – 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 is Hurricane Dolly in 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 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 is Hurricane Ivan in 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 is Hurricane Charley in 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 is Hurricane Andrew in 1992.	157+
	Catastrophic damage will occur		

Source: National Hurricane Center, 2012

PREVIOUS OCCURRENCES

In 1960, Hurricane Brenda tracked through the NW corner of Ludlow. According to the National Oceanic and Atmospheric Administration’s (NOAA’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. According to NOAA’s Historical Hurricane Tracks tool, Hurricane Irene is the only hurricane or tropical storm that tracked within 50 nautical miles of Ludlow since 2010. While Hurricane Irene did not track directly through Ludlow, it dropped a significant amount of rain and caused flooding and road closures throughout the region.

Between 1954 and 2020, Hampden County was included in 5 FEMA-declared severe Hurricane/Tropical Storm-related disasters (DR) or emergencies (EM) classified as one or a combination of the following hazards: hurricane and tropical storm. Ludlow may not have been impacted by all of these events. Hurricanes that have affected the Pioneer Valley are shown in the following table.

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

Major Hurricanes in the Pioneer Valley		
Hurricane/Storm Name	Year	Saffir/Simpson Category (when reached MA)
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

Source: National Hurricane Center, 2021

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 or tropical storms in Ludlow.

According to NOAA’s Global Warming and Hurricanes: An Overview of Current Research Results³, a review of existing studies, including studies conducted as recently as 2020, led to the conclusion that “it is likely that greenhouse warming will cause hurricanes in the coming century to be more intense globally and have higher rainfall rates than present-day hurricanes.” NOAA further concluded that “it is likely that climate warming will cause Atlantic hurricanes in the coming century to have higher rainfall rates than present-day hurricanes, and medium confidence that they will be more intense (higher peak winds and lower central pressures) on average.”

IMPACT

The Town faces a “critical” impact from hurricanes and tropical storms, 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 residential structures in town of \$2,333,574,210, wind damage of 5 percent with 10 percent of structures damaged would result in an estimated \$11,667,871 of damage. Estimated flood damage to 10 percent of the structures with 20 percent damage to each structure would result in \$46,671,484 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 and tropical storms.

³ NOAA (last revised May 11, 2022), <https://www.gfdl.noaa.gov/global-warming-and-hurricanes/>

The entire town would be vulnerable to the impact of a hurricane or tropical storm. Areas prone to flooding are particularly vulnerable. Additionally, high wind could impact the Town's communication and energy infrastructure. The Core Team was uncertain about how individual critical facility structures would fair in high wind scenarios.

SEVERE WINTER STORM / NOR'EASTER

HAZARD DESCRIPTION

Snow is characterized as frozen precipitation in the form of six-sided ice crystal. In order for snow to occur, temperatures in the atmosphere (from ground level to cloud level) must be at or below freezing. The strongest form of a severe snowstorm 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:

- Disrupt power and phone service
- Increase traffic accidents on unsafe roadways
- Damage to infrastructure and other property from severe winter storms and the associated flooding that can occur following heavy snow melt
- Damage to utility lines and blockage of roadways from tree damage and fallen branches
- Damage to telecommunications structures
- Reduce the 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 and the location of occurrence is "large", or more than 50 percent of the Town affected. 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 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: Extreme, Crippling, Major, Significant, and Notable.

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>

The index differs from other meteorological indices in that it uses population information in addition to meteorological measurements. The largest NESIS values result from storms producing heavy snowfall over large areas that include major metropolitan centers. Thus NESIS gives an indication of a storm's societal impacts.

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 also occur from late September through late April. While the Town of Ludlow has not tracked snowfalls in the community, according to data available from NOAA, there have been 14 winter storms since 2010 that have registered on the NESIS scale in the region. Of these, approximately 26 storms resulted in snow falls of at least 10 inches. These storms are listed in the table below, in order of their NESIS severity.

Winter Storms Producing Over 10 inches of Snow in the Pioneer Valley, 2010 -2021			
Date	NESIS Value	NESIS Category	NESIS Classification
2/23/2010	5.46	3	Major
1/29/2015	5.42	3	Major
1/9/2011	5.31	3	Major
2/11/2014	5.28	3	Major
3/12/2017	5.03	3	Major
1/31/2021	4.93	3	Major
2/7/2013	4.35	3	Major
3/5/2018	3.45	2	Significant
3/4/2013	3.05	2	Significant
1/25/2015	2.62	2	Significant
3/11/2018	3.16	2	Significant
10/29/2011	1.75	1	Notable
1/3/2018	1.65	1	Notable
2/8/2015	1.32	1	Notable

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

PROBABILITY OF FUTURE EVENTS

Based upon the availability of records for Hampden County, the likelihood that a severe snowstorm 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 global temperatures increase. Extreme weather events, including extreme precipitation and snowfall events, are anticipated to occur more frequently as climate change continues.

However, as temperatures throughout the year increase on average, it is possible that nor'easter events may become more concentrated in the coldest winter months when atmospheric temperatures are still low enough to result in snowfall rather than rain. The Massachusetts SHMCAP, which has additional information about climate change impacts on natural hazards in Massachusetts, can be found at the Climate Change Clearinghouse for the Commonwealth at <https://www.resilientma.org>.

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 structures in town, \$2,333,574,210 is used. An estimated 20 percent of damage would occur to 10 percent of structures, resulting in a total of \$46,671,484 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 THUNDERSTORM / WIND / TORNADO / MICROBURST

HAZARD DESCRIPTION

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

Wind is air in motion relative to surface of the earth. 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.

The NWS issues advisories or warnings based on event type, location, and wind speed as follows:

- For non-tropical events over land, the NWS issues:
 - A Wind Advisory for sustained winds of 31 to 39 mph for at least 1 hour or any gusts 46 to 57 mph
 - A High Wind Warning for sustained winds 40+ mph or any gusts 58+ mph
- For non-tropical events over water, the NWS issues:
 - A Small Craft Advisory for sustained winds 25-33 knots
 - A Gale Warning for sustained winds 34-47 knots

- A Storm Warning for sustained winds 48 to 63 knots
- A Hurricane Force Wind warning for 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 for any areas (inland or coastal) that are expecting sustained winds of 74 mph

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.

Microbursts are sudden down drafts of air that hit the ground and disperse outwards. Microbursts most commonly occur during strong thunderstorms. The scale and suddenness of microbursts make them difficult to predict with certainty, but it is possible to forecast the conditions that make microbursts much more likely. The high winds associated with microbursts can knock over full-grown trees, damage buildings and are especially problematic for aircrafts.

LOCATION

The entire Town of Ludlow is susceptible to severe thunderstorms, high winds, tornadoes, and microbursts. A tornado might touch down in a localized area, or it could travel a large distance through the Town. However, the actual location of occurrence affected by thunderstorms, wind, or tornadoes is "small," with less than 10 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. Ludlow typically experiences 10 to 15 days per year with severe thunderstorms. Thunderstorms can cause hail, wind, and flooding. The extent of hail that can be present in severe thunderstorms can be found in the table below.

Hail Extent	
Hail Size	Object Analog
.50	Marble, moth ball
.75	Penny
.88	Nickel
1.00	Quarter
1.25	Half dollar
1.50	Walnut, ping pong
1.75	Golf ball
2.00	Hen egg
2.50	Tennis ball

Hail Extent	
Hail Size	Object Analog
2.75	Baseball
3.00	Teacup
4.00	Grapefruit
4.50	Softball

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

Microbursts are typically less than three miles across. They can last anywhere from a few seconds to several minutes. Microbursts cause damaging winds up to 170 miles per hour in strength and can be accompanied by precipitation.

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

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

Source: National Weather Service

PREVIOUS OCCURENCES

Because thunderstorms and wind affect the Town regularly on an annual basis, there are not significant records available for these events. On average, since 1993, there have been between 5-6 severe thunderstorms per year (defined as with winds over 50 miles per hour) in the region around Ludlow. According to the Core Team, power outages due to high wind events and branches falling on wires have become more frequent in town. The Core Team also reported that the Town experiences hail storms with baseball-sized hail; such occurrences are not common, but are very damaging to vehicles and property.

Within Massachusetts, tornadoes have occurred most frequently in Worcester County and in communities west of Worcester. In 2011, a tornado ranked F3 (Severe Damage) on the Fujita Scale of Tornado Intensity, blew through the Towns/Cities of West Springfield, Westfield, Springfield, Monson, Hampden, Wilbraham, Brimfield, Sturbridge, Charlton, and Southbridge. The tornado and related storm killed 3 people and resulted in hundreds of injuries across the state. In Western Massachusetts, the majority of sighted tornadoes have occurred in a swath east of Ludlow, known as “tornado alley.” Fourteen incidents of tornado activity occurred in Hampden County between 1963 and 2021. No tornados have touched down in Ludlow.

Tornadoes in Hampden County 1963-2021		
Tornado Date	Location begun and ended, if known	Magnitude
7/21/1963	Unknown	EFO
8/11/1966	Unknown	EF2
7/19/1968	Unknown	EFO
10/3/1970	Unknown	EF1
8/9/1972	Unknown	EF1
9/14/1972	Unknown	EF1
7/24/1975	Unknown	EF2
6/29/1977	Unknown	EF1
8/10/1979	Unknown	EF1
6/24/1992	Unknown	EFO
6/1/2011	Westfield/Holland	EF3
6/1/2011	Indian Orchard/N. Wilbraham	EF1
6/1/2011	Brimfield/Brimfield	EF1
8/3/2020	Ludlow/Blandford	EFO

Source: NOAA National Center for Environmental Information, Storm Events Database⁴

The table below shows thunderstorms with high winds (over 40 knots, or approximately 45 miles per hour) that have been recorded in Hampden County between 2016 and 2022. These are events that have been reported to NOAA; there have likely been other high wind events that were not reported.

Reported Wind Events with Magnitude Greater than 40 Knots in Hampden County Between 2016 and 2022		
Reported Location(s) of High Wind Event	Date	Magnitude (Knots)
East Springfield	2/24/2016	40
East Springfield, Agawam, Monson, Hampden, West Springfield, Westfield, Ludlow, Monson, Palmer, Hampden, North Wilbraham, East Longmeadow	2/25/2016	45-50
Granville	6/21/2016	45
Highlands, Willimansett	7/14/2016	40-50
Monson	7/22/2016	50
Westfield	7/23/2016	40
Montgomery, Westfield, Southwick	8/12/2016	50
West Springfield, North Wilbraham, Hampden, Blandford, Chester, Monson	8/13/2016	50
Chester	9/11/2016	50
(BAF) Barnes Airport WST, North Agawam, Smith Highlands, Feeding Hills	6/19/2017	50
Westfield, Feeding Hills	7/12/2017	50
Southwick, North Agawam	8/2/2017	50
North Agawam	8/22/2017	50
Monson	8/2/2018	50
Blandford, Holyoke	8/3/2018	50
West Granville, Longmeadow, East Longmeadow	9/6/2018	50
Southwick	5/19/2019	50
North Wilbraham, Longmeadow, East Longmeadow, Three Rivers	7/6/2019	50-61

⁴

https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Tornado&beginDate_mm=01&beginDate_dd=01&beginDate_yy=1963&endDate_mm=03&endDate_dd=31&endDate_yyyy=2022&county=HAMPDEN%3A13&hailfilter=0.00&tornfilter=0&windfilter=000&sort=DT&submitbutton=Search&statefips=25%2CMASSACHUSETTS

Reported Wind Events with Magnitude Greater than 40 Knots in Hampden County Between 2016 and 2022		
Westfield, Willimansett, East Springfield, Agawam	7/31/2019	50
Blandford	8/3/2019	50
Rock Valley	8/7/2019	50
Chester, Southwick, West Springfield, Agawam Bowles Field AR	8/8/2019	50-54
West Springfield, Agawam, Agawam Bowles Field AR, Longmeadow, Forest Park, Brightwood	8/19/2019	50
Smith Highlands	5/15/2020	65
Highlands, Longmeadow	6/6/2020	50
North Wilbraham	6/28/2020	50
Highlands, Aldenville	6/29/2020	50
North Monson, Fentonville, North Blandford	7/13/2020	50-56
Highlands	7/14/2020	50
Whipples	8/23/2020	50
Feeding Hills, (CEF) Westover AFB CHI, (BAF) Barnes Airport WST, East Springfield, Westfield, East Longmeadow, Ludlow	10/7/2020	55-64
Monson, Agawam Bowles Field AR, Willimansett, Mundale, Palmer	11/15/2020	50-56
Woronoco, Congamond, Agawam, Ingleside	4/21/2021	50-63
Southwick, East Springfield, Hosmer Corner, Agawam, Indian Orchard, Longmeadow, Wyben	6/29/2021	50
Vining Hill, Woronoco	7/6/2021	50
Armory	7/16/2021	50
Vining Hill	7/17/2021	50
Russell, West Springfield	7/27/2021	50
Westfield, Barnes Airport West, Woronoco, Aldenville, North Agawam, Ingleside	8/12/2021	56
West Springfield, Aldenville, Westfield	8/27/2021	50
Longmeadow, Palmer, Three Rivers	11/13/2021	50
Highlands, Holland	3/7/2022	50

Source: NOAA National Center for Environmental Information, Storm Events Database⁵

Several trees in Ludlow were downed by thunderstorm winds in 2016, including a tree limb that was downed onto house on Holyoke Street. In October of 2020, a thunderstorm resulted in downed trees on Colonial Drive.

PROBABILITY OF FUTURE EVENTS

There are on average eight tornadoes per year in New England, with two or three of those in Massachusetts. As per the 2018 SHMCA, there are approximately 10 to 30 days of thunderstorm activity in the state each year. There is evidence that rising temperatures will increase convective available potential energy (CAPE) which is one of the two ingredients needed for severe thunderstorms. The other is strong wind shear. It is projected that by warming the surface and putting more evaporation in the air CAPE will increase providing more raw fuel to produce rain and hail, and vertical wind shear, resulting in an increased amount of severe thunderstorm activity (NASA, 2021).

⁵

https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28C%29+Thunderstorm+Wind&beginDate_mm=01&beginDate_dd=01&beginDate_yyyy=2000&endDate_mm=06&endDate_dd=15&endDate_yyyy=2022&county=HAMPDEN%3A13&hailfilter=0.00&tornfilter=0&windfilter=040&sort=DT&submitButton=Search&statefips=25%2CMASSACHUSETTS

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.

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>

Based upon the available historical record, the estimated probability of a tornado or microburst in Ludlow is "very low," or less than 1 percent in any given 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.

As per the Massachusetts SHMCAP, there are approximately 10 to 30 days of thunderstorm activity in the state each year. Thus, there is a "moderate" probability (10 to 40 percent chance in any given year) of a severe thunderstorm or winds affecting the Town.

IMPACT

Overall, the Town faces a "limited" impact from severe thunderstorms, winds, or tornadoes with 10 to 25 percent of the Town affected.

The potential for locally catastrophic damage is a factor in any tornado, severe thunderstorm, or wind event. Most buildings in the Town of 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 built before this date.

Using a total value of \$2,333,574,210 of all residential units in Ludlow, and an estimated 20 percent of damage to 10 percent of structures, an estimate of total damage is \$46,671,484. This estimate does not include building contents, land values or damages to utilities.

VULNERABILITY

Based on the above assessment, Ludlow has a vulnerability of "2-High" from severe thunderstorms, wind, and tornadoes. The entire town would be vulnerable to the destruction caused by severe thunderstorms and wind. 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.

FLOODING

HAZARD DESCRIPTION

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) that increase velocities and volumes of flow.

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 major floods recorded in Western Massachusetts during the 20th century have been the result of rainfall alone, or rainfall combined with snowmelt. Ludlow has experienced many flooding events over the last decade. Generally, these small floods have had minor impacts, temporarily impacting roads and residents' yards. However, there have also been some more significant flooding events that have caused damage to homes and properties, and required evacuations.

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

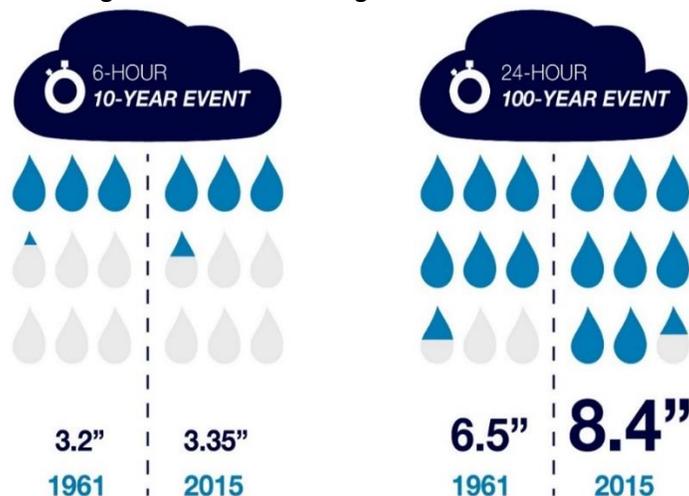
- Continental storms are typically low-pressure systems that can be either slow or fast moving. These storms originate from the west and occur throughout the year.
- Coastal storms, also known as nor'easters, usually occur in late summer or early fall and originate from the south. The most severe coastal 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.

Localized or stormwater flooding occurs during a precipitation event where the rate of rainfall is greater than the capacity of the stormwater management system, or when successive storms saturate the ground to cause flooding. This may be due to undersized culverts, poor drainage, topography, high amounts of impervious surfaces, or debris that causes the stormwater system to function below its design standard. In these cases, the stormwater management system becomes overwhelmed, causing water to inundate roadways and properties. The Town has assessed road/stream crossings in order to identify priorities for repair and replacement. Many culverts are undersized and structurally deficient, and in need of replacement. A list of locations with problematic culverts that are prone to flooding is below.

Most stormwater systems in Massachusetts are aging and have been designed with rainfall data that is no longer accurate. Figure 4.1 shows how anticipated rainfall during design storms has increased from 1961 to 2015, especially for the larger 24-hour, 100-year event.

Figure 4.1 Changes in Stormwater Design Standards between 1961 and 2015



Source: Weston & Sampson, Town of Granville MVP/HMP (2021) (data from NOAA, 1961 and NOAA, 2015)

Green infrastructure or low impact development improvements can help reduce demand on the existing stormwater system by increasing infiltration on-site. Rain gardens and pervious pavement are two examples of possible strategies. Upsizing culverts with new rainfall data is also recommended.

LOCATION

FEMA Flood Insurance Rate Maps (FIRMs) designate areas likely to experience flooding. The FIRMs delineate both the special flood hazard areas and the risk premium zones under the National Flood Insurance Program (NFIP). This includes high risk areas that have a one percent chance of being flooded in any year (often referred to as the “100-year floodplain”), which under the NFIP, is linked to mandatory purchase requirements for federally backed mortgage loans. These flood hazard areas within the 100-year floodplain are identified as Special Flood Hazard Areas (SFHAs). The FIRM also identifies moderate to low-risk areas, defined as the area with a 0.2 percent chance of flooding in any year (often referred to as the “500-year floodplain”). The definitions of these flood zones are provided below⁶.

- **Zone A** (1% annual chance or 100-year flood zone): Zone A is the flood insurance rate zone corresponding to the 100-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. Detailed hydraulic analyses are not performed for such areas, therefore, no BFEs (base flood elevations) or depths are shown within this zone. Mandatory flood insurance purchase requirements apply.
- **Zone AE and A1-A30** (1% annual chance or 100-year flood zone): Zones AE and A1-A30 are the flood insurance rate zones that correspond to the 100-year floodplains that are determined in the FIS by detailed methods. In most instances, BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

⁶ <https://www.fema.gov/flood-zone>

- **Zone X** (0.2% annual chance or 500-year flood zone): Zone X is the flood insurance rate zone that corresponds to the 500-year floodplains that are determined in FIS by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no BFEs or depths are shown within this zone.

According to the FEMA FIRMs for Ludlow (effective 7/16/2013), 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. Ludlow is a participating member of the NFIP, and according to the Community Information System (CIS) of FEMA, there were 20 1-4 family structures and 14 “other” structures located within the SFHA 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 most recently updated FEMA FIRMs.

Areas susceptible to general flooding in Ludlow include land along the Chicopee River, which creates the southern border of the Town, and land within the Westover Wildlife Management Area, which has a number of wetlands and ponds. The Core Team expressed multiple times that Ludlow is generally a “wet” Town, as there are abundant wetland and stream systems throughout.

In addition to the floodplains mapped by FEMA for the 100-year and 500-year flood, Ludlow often experiences localized flooding due to drainage issues or problem culverts. The Core Team and participants of the CRB workshops identified areas of the Town that have experienced localized flooding, particularly Chapin Street near the High School and Circuit Avenue near Electric Park. There are also areas with no record of previous flood incidents that could be affected in the future by heavy rain and runoff. The Core Team also indicated that there are some undersized culverts in Town, and some previous flooding issues related to some of the ponds in Town overflowing after large or back-to-back rain events.

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

Water levels in Ludlow's rivers, streams, and wetlands rise and fall seasonally and during high rainfall events. High water levels are typical in spring, due to snowmelt and ground thaw. This is the period when flood hazards are normally expected. Low water levels occur in summer due to high evaporation and plant uptake (transpiration). At any time, heavy rainfall may create conditions that raise water levels in rivers and streams above bank full stage, which then overflow adjacent lands. The average annual precipitation for Ludlow and surrounding areas in Western Massachusetts is 47 inches.

PREVIOUS OCCURRENCES

The Core Team identified the locations listed under the “location” section where previous occurrences of localized flash flooding have occurred. Randall Road, which leads to the Hampden County Correctional Center, has historically had beaver activity that has been addressed by the Town, but there is the possibility of return as beavers are active throughout much of Hampden County. MassWildlife estimated that the beaver population in the state almost tripled between 1996 and 2004, from an estimated 24,000 to 70,000 (MassWildlife, 2004). There is not more recent data on beaver populations. The exponential growth has been attributed to several factors, including an increase in suitable habitat, an increase in wetland protection and a decrease in the hunting and trapping of the animals.

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 stormwater management systems.

Climate change will increase the frequency and intensity of all storms that can cause flooding. In particular, climate projections indicate that extreme one-day rainfall events will continue to increase, and will be a major cause of flooding. Currently, floods are the costliest natural hazard in the United States, and climate change will only increase this damage.

IMPACT

There are approximately 460 residential structures located within the 100-year floodplain in Ludlow, according to 2022 Assessors data. Utilizing the Town’s median home value of \$240,000, and an average household size of 2.46 people, an estimated 20 percent of damage to each structure in the 100-year flood plain would result in a total of \$22,080,000 worth of damage and 1,131 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. Baird Middle School, Ludlow Senior High School and the Town Hall are located just outside of the flood zone along Higher Brook and Harris Brook Elementary School is adjacent to the flood zone along Harris Brook. If extreme flooding were to happen, these facilities could be vulnerable to damage.

WILDFIRE / BRUSH FIRE / URBAN FIRE

HAZARD DESCRIPTION

Wildland fires are typically larger fires, involving full-sized trees as well as meadows and scrublands. Brushfires are uncontrolled fires that occur in meadows and scrublands, but do not involve full-sized trees. Both wildland fires and brushfires can consume homes, other buildings and/or agricultural resources. Typical causes of brushfires and wildfires are lightning strikes, human carelessness, arson, or an “intentional burn” in a controlled manner, as in the case of a prescribed fire.

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.

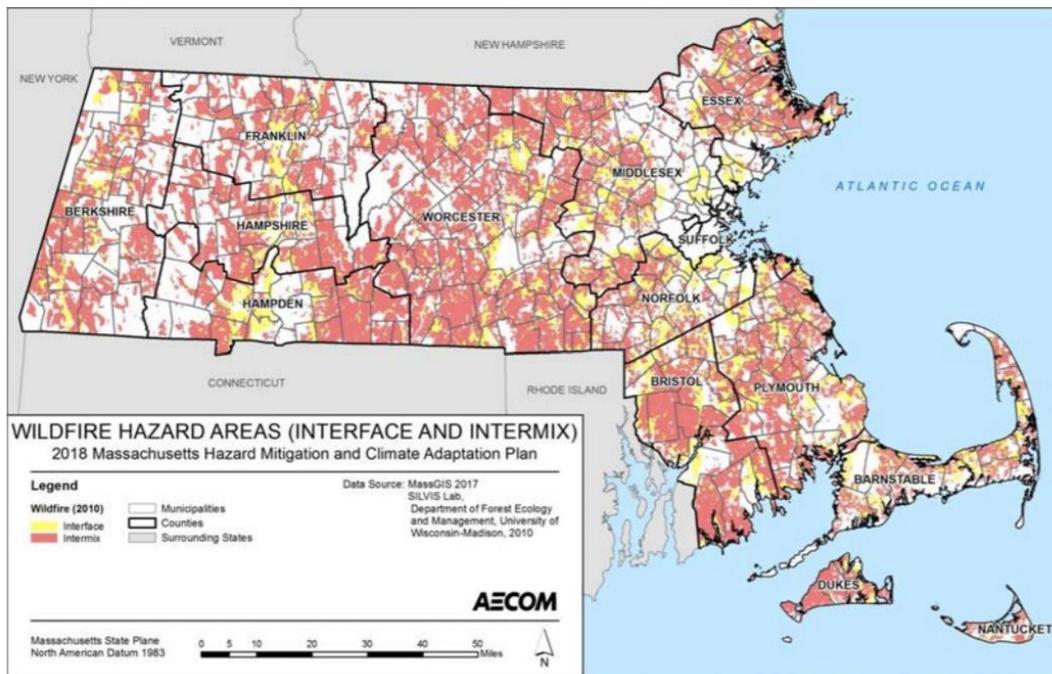
Generally, Hampden County has approximately 273,000 acres of forested land, which accounts for 67 percent of total land area. The total amount of the Town that could be affected by a wildfire is categorized as “medium,” between 10 and 50 percent of the total land mass, depending on the wildfire’s scope.

The 2018 Massachusetts SHMCAP states:

Portions of the Commonwealth susceptible to wildfire, particularly at the urban-wildland interface..., are defined as those in the vicinity of contiguous vegetation, with more than one house per 40 acres and less than 50 percent vegetation, and within 1.5 miles of an area of more than 500 hectares (approximately 202 acres) that is more than 75 percent vegetated.”

Figure 4.2 below shows wildland-urban interface and hazard areas in the state. The areas of Ludlow most vulnerable to brush fire are primarily heavily wooded areas and forests directly adjacent to developed areas.

Figure 4.2: Wildland-Urban Interface and Hazard Areas in Massachusetts



Source: 2018 SHMCAP

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. However, wildfire is unlikely to affect large areas of Ludlow as most forest areas are fragmented. 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 hazard rating system for wildfires used by the USDA Forest Service is shown in the table below:

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.
CLASS 2: Moderate Danger (M) Color Code: Blue	Fires start easily and spread at a moderate rate	Fires can start from most accidental causes. Fires in open cured grassland will burn briskly and spread rapidly on windy days. Wood 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.
CLASS 3: High Danger (H) Color Code: Yellow	Fires start easily and spread at a rapid rate	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.
CLASS 4: Very High Danger (VH) Color Code: Orange	Fires start very easily and spread at a very fast rate	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.
CLASS 5: Extreme (E) Color Code: Red	Fire situation is explosive and can result in extensive property damage	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.

Source: USDA Forest Service, National Fire Danger Rating System

As described in the next section describing previous occurrences of wildfire, there have not been any major wildfires recorded in Ludlow.

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 Lithia Springs Watershed
- 2001 – Ware, 400 acres burned
- 2010 – Russell, 320 acres burned on Mt. Tekoa
- 2012 – Brimfield, dry conditions and wind gusts created a brush fire and burned 50 acres
- 2016 –Montgomery, 60 acres burned on Mt. Tekoa
- 2019 – Russell and Montgomery, 200 acres burned on Mt. Tekoa

The following fire incidents have been reported in Ludlow in the past seven years, including structural fires, vehicle fires, brush fires, and car fires.

Total Fire Incidents in Ludlow	
2012	77
2013	64
2014	45
2015	53
2016	64
2017	58
2018	57
2019	48

Source: Massachusetts Fire Incident Reporting System Annual Reports, <https://www.mass.gov/service-details/fire-data-and-statistics>

PROBABILITY OF FUTURE EVENTS

In accordance with the Massachusetts SHMCAP, the Town Core Team found it is difficult to predict the likelihood of wildfires in a probabilistic manner due to the number of variables involved. However, based on the history of wildfires in and adjacent to the Town, the Core Team 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

The impact from a wildfire would be “limited.”

To approximate the potential impact to property and people that could be affected by a wildfire, the total value of all residential structures in town, \$2,333,574,210 is used. An estimated 50 percent of damage would occur to 1 percent of structures, resulting in a total of \$11,667,871 worth of damage. 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.

EXTREME TEMPERATURES

HAZARD DESCRIPTION

Massachusetts has four clearly defined seasons. Extreme temperatures are considered outliers, or temperatures that fall outside the typical range for each season. Extreme temperatures can last from an afternoon to a few days. Day and nighttime temperature fluctuations also factor into the overall effects of temperature. For example, when the temperature does not cool off at night during an extreme heat wave, the risk of heat related illnesses is intensified.

Extreme Cold

Extreme cold does not have a threshold temperature, but rather is defined as prolonged periods of excessively cold weather. This may vary by region based on average temperatures in the region. In Massachusetts, where temperatures regularly go below freezing during winter months, the community is often accustomed to these temperatures. However, this does not lessen the risk. Extremely cold temperatures can create dangerous conditions for homeless populations, stranded travelers, and residents without sufficient insulation or heat in their homes. The homeless, the elderly, and people with disabilities are often most vulnerable. In Ludlow, 18.1% of the population is over 65 years old and 12% of the population has a disability (American Community Survey, 2019).

Cold weather events can also have significant health impacts such as frostbite and hypothermia. Furthermore, power outages during cold weather may result in inappropriate use of combustion heaters, cooking appliances, and generators in poorly ventilated areas, which can lead to increased risk of carbon monoxide poisoning. During extreme cold, pipes may freeze and burst in many buildings with unreinforced masonry.

Extent

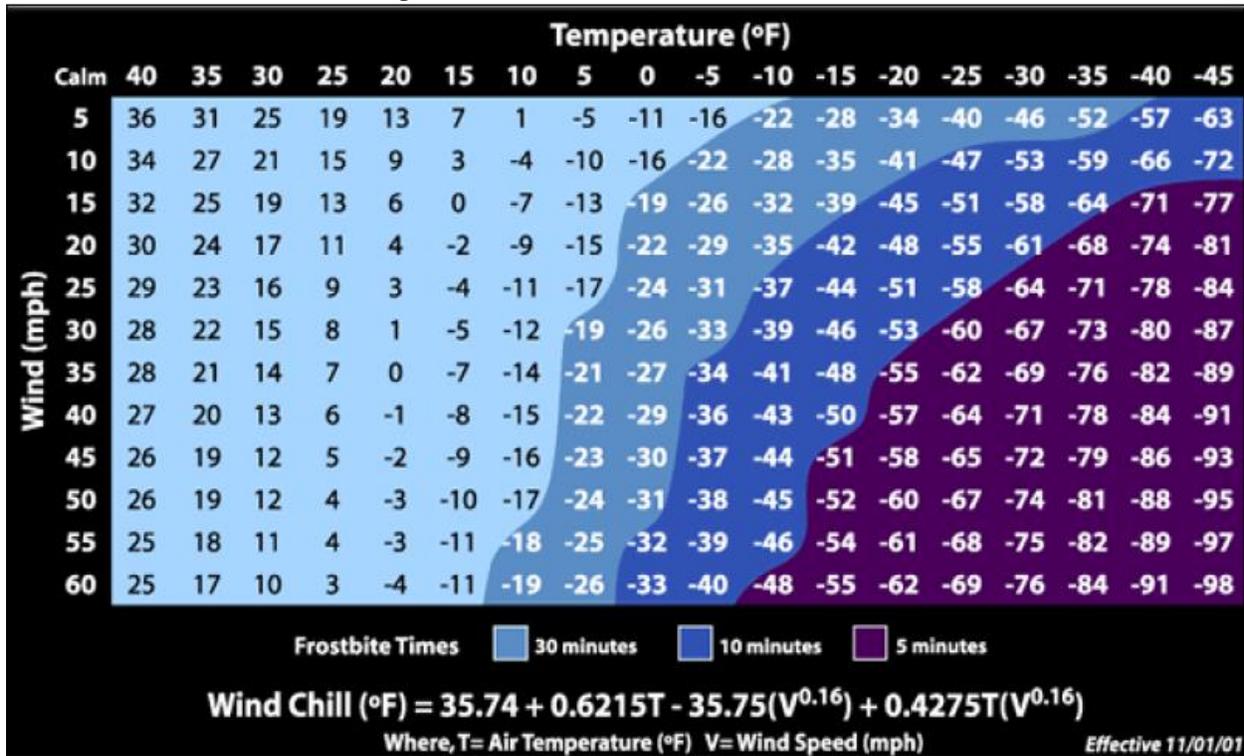
Extremely cold temperatures are measured using the Wind Chill Temperature Index provided by the NWS. The updated index was implemented in 2001 and helps explain the impact of cold temperatures on unexposed skin, as described on Figure 4.3.

According to NOAA’s NCEI Storm Events Database records for extreme cold events Massachusetts experienced 20 extreme cold and wind chill events between 2000 and September 2020. None of these events were reported for Hampden County, however.⁷

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https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%28Z%29+Extreme+Cold%2FWind+Chill&beginDate_mm=11&beginDate_d=01&beginDate_yyyy=1999&endDate_mm=11&endDate_dd=30&endDate_yyyy=2021&county=ALL&hailfilter=0.00&tornfilter=0&windfilter=0.00&sort=DT&submitbutton=Search&statefips=25%2CMASSACHUSETTS

Figure 4.3 Extreme Cold and Wind Chill Index



Source: National Weather Service

Extreme Heat

Extreme heat is when the maximum temperature reaches above 90°F during the day. Projected heat days and heat waves can have an increased impact in areas with a greater amount of impervious surface, such as buildings, roads, parking lots, and driveways. These can become “heat islands” as dark asphalt and roofs store the heat from the sun. Impacts from heat stress can exacerbate pre-existing respiratory and cardiovascular conditions.

Extent

The NWS issues a Heat Advisory when the Heat Index (Figure 4.4) is forecast to reach 100-104° F for two or more hours (NOAA, n.d.). The NWS issues an Excessive Heat Warning if the Heat Index is forecast to reach 105°+F for two or more hours.

Heat waves cause more fatalities in the U.S. than the total of all other meteorological events combined. From 1979-2012, excessive heat exposure caused in excess of 8,000 deaths in the United States (MEMA and DCR, 2013). During this period, more people in this country died from extreme heat than from hurricanes, lightning, tornadoes, floods, and earthquakes combined.

Figure 4.4 Heat Index Chart

		80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	
Relative Humidity (%)	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.											

Source: NOAA, n.d.

Because most heat-related deaths occur during the summer, people should be aware of who is at greatest risk and what actions can be taken to prevent a heat-related illness or death. According to the Centers for Disease Control and Prevention (CDC), the populations most vulnerable to extreme heat impacts include the following:

- People over the age of 65.
- Children under the age of five.
- Individuals with pre-existing medical conditions that impair heat tolerance.
- Individuals without proper cooling.
- Individuals with respiratory conditions.
- Individuals that overexert themselves during extreme heat events.

LOCATION

Because of this hazard’s regional nature, extreme temperatures would impact the entire town, resulting in a “large” location of occurrence, or more than 50 percent of total land area affected.

PREVIOUS OCCURRENCES

NOAA’s NCEI Storm Events Database provides data on excessive heat. Between 2000 and 2021, Massachusetts experienced 16 heat or excessive heat days, which did not result in any injury or property damage.

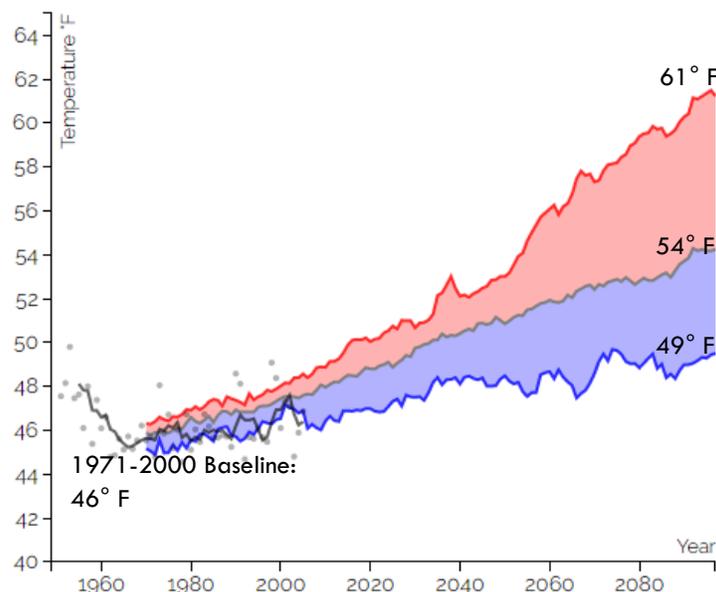
None of these events were reported for Hampden County.⁸ Extreme temperatures are classified as medium frequency events. As defined by the 2013 State Hazard Mitigation Plan, these events occur from once in 5 years to once in 50 years or have a chance of occurrence of 2% to 20% per year. According to the 2018 SHMCAP, between 4 and 5 heat waves (3 or more consecutive days of 90°F temperatures) occur annually in Massachusetts.

July is the hottest month in Ludlow and the average daytime high temperature in July is around 82°F (NEIC, 2021). The Town of Ludlow does not collect data on heat occurrences, but residents noted past experiences with and concerns about extreme heat events in the Town. There has been some use of Stanton Hall by residents as a cooling center during heat waves. The fact that many Ludlow residents do not have air conditioning was discussed during the CRB workshops. While there may not have been a great need for it in the past, as the occurrence of those high heat days increases, the need for air conditioning and the availability of a cooling center for those without it will increase.

PROBABILITY OF FUTURE EVENTS

The baseline (1971-2000) average annual temperature for the Chicopee River Basin was 46°F, and by the end of the century it is predicted to rise between 4 and 15°F from that baseline, depending on greenhouse gas emissions, as shown in Figure 4.5 below. Both the average temperature and number of extreme heat days are predicted to increase in future climate conditions.

Figure 4.5: Projection for Annual Average Temperature in the Chicopee River Basin



Source: NE CASC, Massachusetts Climate Change Clearinghouse: <https://resilientma.mass.gov/>

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.

⁸

https://www.ncdc.noaa.gov/stormevents/listevents.jsp?eventType=%2829+Excessive+Heat&beginDate_mm=11&beginDate_dd=01&beginDate_yyyy=1999&endDate_mm=11&endDate_dd=30&endDate_yyyy=2021&

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. However, it is a hazard the Town needs to make sure residents are prepared for, as the projection is for days over 90° F in the Chicopee River Basin to significantly increase over the coming decades. As discussed earlier, at temperatures over 90°F, heat-related illnesses and mortality show a marked increase. Heat waves with multiple days over 90°F can be especially dangerous for vulnerable individuals. Warmer average temperatures and a longer growing season can also result in a longer pollen season, as well as an increase in vector-borne diseases and populations of invasive species and negative impacts on native plants and on pollinators that rely on plants flowering at particular times.

VULNERABILITY

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

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

DAM FAILURE

HAZARD DESCRIPTION

Dams and their associated impoundments provide many benefits to a community, such as water supply, recreation, hydroelectric power generation, and flood control. However, they also pose a potential risk to lives and property. Dam failure is not a common occurrence, but dams do represent a potentially disastrous hazard. When a dam fails, the potential energy of the stored water behind the 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's Office of Dam Safety (DCR ODS) is the agency responsible for regulating dams in the state (MGL Chapter 253, Section 44 and the implementing regulations 302 CMR 10.00). Regulated ("jurisdictional") 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

As summarized in Table 4-3 below, there are currently 11 dams within Ludlow, 4 of which are regulated by the Federal Energy Regulatory Commission (FERC) as hydroelectric dams, 2 of which are considered to be non-jurisdictional, and 5 of which are regulated by DCR ODS.

Table 4-3: Inventory of Known Dams in Ludlow

Dam Name	Hazard Level	Ownership	Regulatory Authority	Condition / Date Last Inspected	Date of Most Recent EAP
Ludlow Reservoir Dam	High	SWSC	DCR ODS	11/13/2019, Satisfactory	9/11/2019
Cherry Valley Dam	High	SWSC	DCR ODS	11/13/2019, Satisfactory	9/11/2019
Indian Orchard Dam	High	Central Rivers Power MA, LLC ⁹	FERC	CEII protected; inspected annually	CEII protected
Red Bridge Dam	High	Central Rivers Power MA, LLC ¹⁰	FERC	CEII protected; inspected annually	CEII protected
Putts Bridge	High	Consolidated Edison Energy	FERC	CEII protected; inspected annually	CEII protected
Harris Pond Dam	Significant	Town of Ludlow	DCR ODS	4/24/2017, Fair	1/13/2020
Collins Pond Dam	Low	Dichotomy Collins Hydro LLC ¹¹	FERC	CEII protected, inspected every 3 years	N/A
Alden Pond Dam	Low	Camp Alden Associated	DCR ODS	11/7/2020, Fair	N/A
Gauthier Pond Dam	Low	Edward and Nancy Gauthier	DCR ODS	11/21/2019, Poor	N/A
Ackerman Upper Pond Dam	Non-Jurisdictional	Raymond T. Haluch	N/A	No information	N/A
Nash Hill Reservoir Dam	Non-Jurisdictional	MWRA	N/A	No information	N/A

Source: DCR ODS, December 2021 except where noted

Dams and reservoirs licensed and subject to inspection by FERC are excluded from the provisions of the state regulations provided that all FERC-approved periodic inspection reports are provided to DCR ODS. Information about physical assets of the bulk power system are except from public release under the Freedom of Information Act under the Critical Electric Infrastructure Information (CEII) protection of the Department of Energy.

The location of occurrence for a dam failure is considered “medium,” with 10-50% of the Town affected.

⁹ <https://lowimpacthydro.org/lihi-certificate-112-indian-orchard-hydroelectric-project-massachusetts/>

¹⁰ <https://lowimpacthydro.org/lihi-certificate-96-red-bridge-hydroelectric-project-massachusetts/>

¹¹ <https://lowimpacthydro.org/lihi-certificate-88-collins-hydroelectric-project-massachusetts/>

EXTENT

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.

As of February 2017, all dams classified as a high hazard potential or a significant hazard potential are required to have an Emergency Action Plan (EAP) in place (DCR, 2019-a). This plan must be updated annually and submitted to the DCR Commissioner and MEMA. The plan should also be retained by the dam owner and the City or Town in which the dam is located. EAP development guidelines and a template were established by the Office of Dam Safety to ensure that all EAPs follow the proper format.

The SWSC participated in two of the three CRB workshops, and informed the Core Team that the EAPs for the Ludlow Reservoir and Cherry Valley Dams are currently in the process of being updated and combined, and the SWSC will coordinate with the Town's emergency management departments after approval by DCR ODS to conduct tabletop exercises to ensure successful implementation of emergency procedures. The only Town-owned dam that requires an EAP is Harris Pond Dam, which is inspected regularly and has an up-to-date EAP on file with DCR ODS.

PREVIOUS OCCURRENCES

According to Core Team members, there has been only one dam that has failed in Ludlow, the Collin's Pond Dam on the Chicopee 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.
- The area is within the 100-year floodplain.
- The dam has been rebuilt and is 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 SHMCAP, 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 Western United States, communities downstream of dams are already seeing 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. Due to projected increases in precipitation and severe storms from climate change, the probability of design failures of dams may increase as well.

Climate change may indirectly affect dam breaches for a variety of reasons. Dams are typically designed based on historic water flows and known hydrology. Climate change projections indicate that the frequency, intensity, and amount of precipitation will increase in New England. This anticipated increase in precipitation may push dams over capacity, placing additional stress on dam infrastructure. Therefore, continuing and enhancing dam monitoring will be crucial to maintaining safe dam conditions. There are several mechanisms in place to manage increased volume in water bodies, such as slowly releasing impounded water at scheduled intervals. It is advised that these controlled events are monitored closely as they can add additional stress on the dam infrastructure.

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 in Town, resulting in a total of \$466,714,842 worth of damage and approximately 4,088 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 locations and conditions of the dams in Town and the downstream resources that are vulnerable.

There are five 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

HAZARD DESCRIPTION

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. Direct impacts of drought include:

- Reduced crop, rangeland, and forest productivity
- Increased fire hazard
- Reduced water levels
- Increased livestock and wildlife mortality rates
- Damage to wildlife and fish habitat

Climate change is increasing the frequency and length of droughts, and although this impact is seen more significantly in the western US, it is impacting Massachusetts as well. Changes in precipitation patterns will result in longer periods of dry days in the summer and fall, as well as increased rainfall events that result in increased runoff and reduced infiltration of rainwater and replenishment of groundwater.

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 Core Team 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. Zone II wellhead protection areas for public water supplies are defined as an area of an aquifer that "contributes water to a well under the most severe pumping and recharge conditions that can be realistically anticipated (180 days of pumping at safe yield, with no recharge from precipitation)."¹² If these conditions extended beyond the thresholds that determine supply capacity the damage from a drought could be widespread due to depleted groundwater supplies.

The U.S. Drought Monitor also records information on historical drought occurrence. The U.S. Drought Monitor categorizes drought on a D0-D4 scale as shown below.

U.S. Drought Monitor		
Classification	Category	Description
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered

¹² <https://www.mass.gov/info-details/massgis-data-massdep-wellhead-protection-areas-zone-ii-zone-i-wpa#:~:text=As%20stated%20in%20310%20CMR,with%20no%20recharge%20from%20precipitation>

U.S. Drought Monitor		
Classification	Category	Description
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, <https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx>

PREVIOUS OCCURRENCES

In Massachusetts, six major droughts have occurred statewide since 1930, as well as seven less severe droughts.¹³ 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 into 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:

Annual Drought Classification Status in Massachusetts	
Year	Maximum Severity
2000	No drought
2001	D2 conditions in 21% of state
2002	D2 conditions in 99% of state
2003	No drought
2004	D0 conditions in 44% of state
2005	D1 conditions in 7% of state
2006	D0 conditions in 98% of state
2007	D1 conditions in 71% of state
2008	D0 conditions in 57% of state
2009	D0 conditions in 44% of state
2010	D1 conditions in 27% of state
2011	D0 conditions in 0.01% of state
2012	D2 conditions in 51% of state
2013	D1 conditions in 60%, D0 in 99.9% of state
2014	D1 conditions in 26%, D0 in 99.99% of state
2015	D1 conditions in 72%, D0 in 100 % of state
2016	D3 conditions in 52%, D2 in 90%, D1 in 98%, D0 in 100% of state
2017	D3 conditions in 9%, D2 in 69%, D1 in 98%, D0 in 99% of state
2018	D1 conditions in 36%, D0 in 85% of state
2019	D0 in 85% of state
2020	D3 conditions in 37%, D2 in 83%, D1 in 96%, D0 in 100% of state

Source: US Drought Monitor

¹³ US Geological Survey Water-Supply Paper 2375. "National Water Summary 1989 – Floods and Droughts: Massachusetts." Prepared by S. William Wandle, Jr., US Geological Survey.

Ludlow has had limited experience with severe drought conditions in the past, although this is changing as drought conditions related to climate change become more frequent. According to the Massachusetts SHMCAP, between 2001 and 2017, the Town experienced between 50 and 69 weeks of Severe Drought and 14 weeks of Extreme Drought, almost as many weeks as any other municipality in the State as classified by the U.S. Drought Monitor. Ludlow experienced extreme drought conditions again in 2020.

Figure 4.6: Weeks of Severe Drought in Massachusetts (2001-2017)

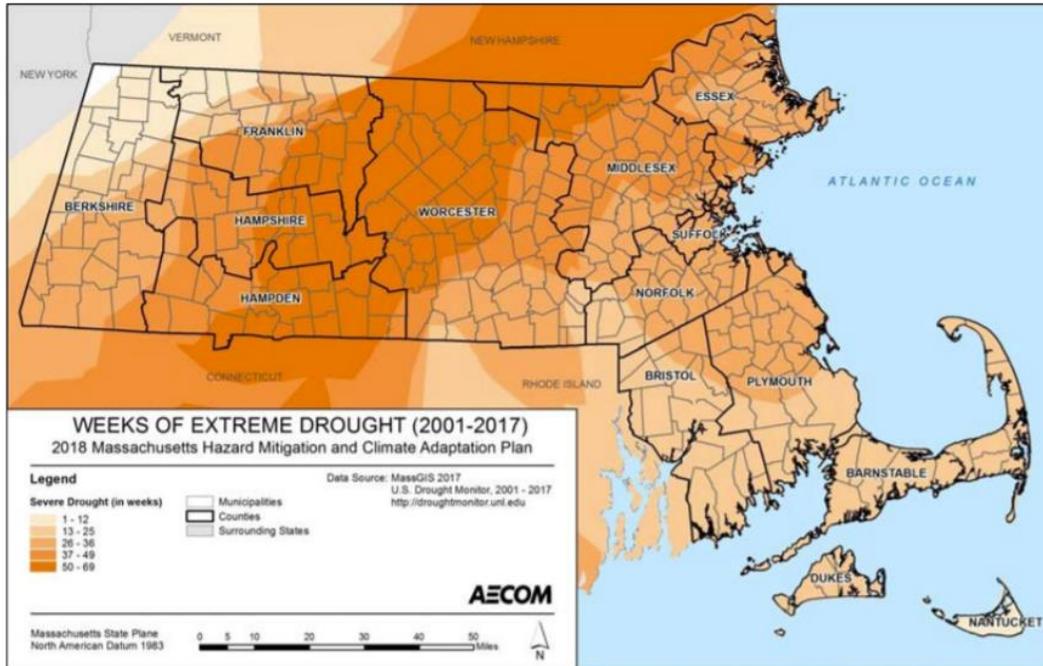
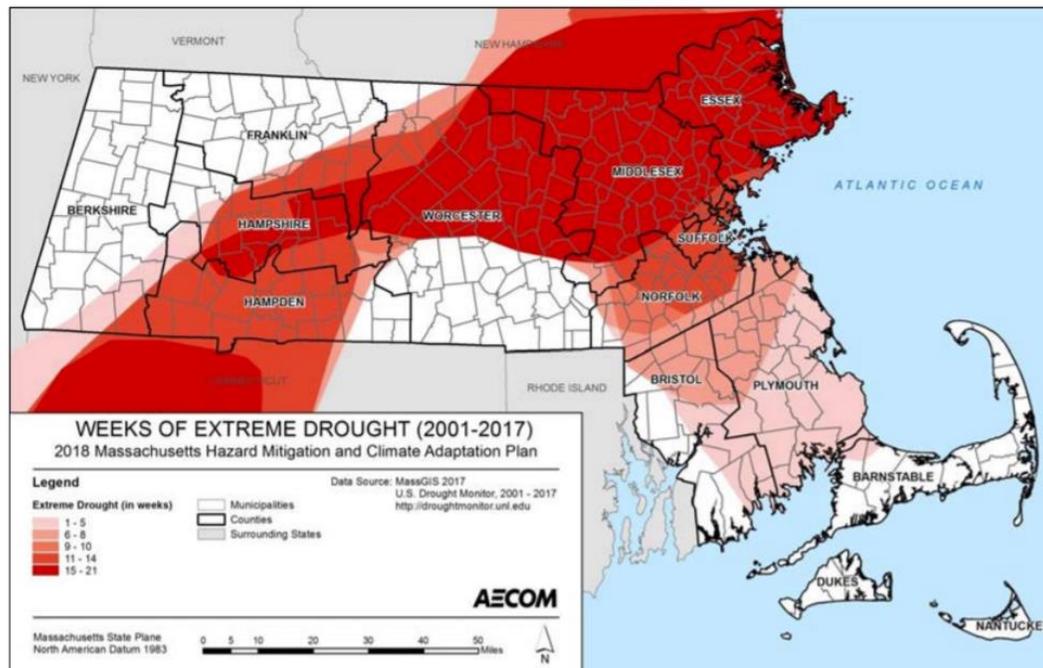


Figure 4.7: Weeks of Extreme Drought in Massachusetts (2001-2017)



Source: SHMCAP; US Drought Monitor, 2017

Ludlow has not been significantly impacted by these recent droughts, or by the drought in 2020. However, there have been a small number of cases of shallow wells running low during the drought several years ago, according to the Core Team. With about half of the Town relying on private wells for drinking water, occurrences such as this one are likely to increase in the future as the risk of drought increases due to climate change.

PROBABILITY OF FUTURE EVENTS

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. Due to climate change, projected higher average temperatures combined with the likelihood of increased consecutive days without precipitation in summer and fall, the probability of droughts will increase. In Ludlow the probability of a drought is “moderate,” between 10 percent and 40 percent in a single given year.

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, and/or 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 – moderate 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.¹⁴ 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.¹⁵

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.

¹⁴ Northeast States Emergency Consortium Web site: www.nesec.org/hazards/earthquakes.cfm.

¹⁵ Federal Emergency Management Agency Web site: www.fema.gov/hazards/earthquakes/quake.shtm.

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.

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.

Source: US Geological Survey

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.

Modified Mercalli Intensity Scale for Earthquake Intensity 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.

Largest Earthquakes in Region, 1924 – 2021		
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
Bliss Corner, MA	November 8, 2020	3.6

Source: Northeast States Emergency Consortium website, www.nesec.org/hazards/earthquakes.cfm

New England States Record of Historic Earthquakes		
State	Years of Record	Number Of Earthquakes
Connecticut	1668 - 2007	137
Maine	1766 - 2007	544
Massachusetts	1668 - 2007	355
New Hampshire	1638 - 2007	360
Rhode Island	1776 - 2007	38
Vermont	1843 - 2007	73
New York	1840 - 2007	755

Total Number of Earthquakes within the New England states between 1668 and 1989 is 2,262.

Source: Northeast States Emergency Consortium website, www.nesec.org/hazards/earthquakes.cfm

PROBABILITY OF FUTURE EVENTS

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

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

Based upon existing records, there is a “low” frequency of earthquakes in Ludlow, with between a 1 and 2 percent chance of an earthquake occurring in any given year.

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 is used.

An estimated 100 percent of damage would occur to 20 percent of structures, resulting in a total of \$466,714,842 worth of damage and 4,088 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 Core Team did not have the information necessary to determine which critical facilities would be most impacted by earthquakes. Eight of the Town’s evacuation 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 (Mass Pike) could have regional impacts on evacuation efforts.

CHAPTER 5: CAPABILITY ASSESSMENT AND EXISTING MITIGATION MEASURES

The Town of Ludlow is already undertaking measures to mitigate local hazards. Chapter 5 documents the Town’s current operations and discusses potential improvements. FEMA’s Local Mitigation Planning Handbook categorizes hazard mitigation measures into four types, as displayed in Table 5-1 below (FEMA, 2013). As this chapter will demonstrate, Ludlow uses many of these tools. The FEMA Mitigation Capabilities Assessment Worksheet is provided in Appendix E.

Table 5-1: FEMA’s Types of Mitigation Actions

Measure	Action	Examples
Local Plans and Regulations	These actions include government authorities, policies, or codes that influence the way land and buildings are developed and built.	<ul style="list-style-type: none"> • Comprehensive plans • Land use ordinances • Subdivision regulations • Development review • Building codes and enforcement • NFIP Community Rating System • Capital improvement programs • Open space preservation • Stormwater management regulations and master plans
Structure and Infrastructure Projects	These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards.	<ul style="list-style-type: none"> • Acquisitions and elevations of structures in flood prone areas • Utility undergrounding • Structural retrofits • Floodwalls and retaining walls • Detention and retention structures • Culverts • Safe rooms
Natural Systems Protection	These are actions that minimize damage and losses and preserve or restore the functions of natural systems.	<ul style="list-style-type: none"> • Sediment and erosion control • Stream corridor restoration • Forest management • Conservation easements • Wetland restoration and preservation
Education and Awareness Programs	These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential mitigation strategies. A greater understanding and awareness of hazards and risk among local officials, stakeholders, and the public is more likely to lead to direct actions.	<ul style="list-style-type: none"> • Radio or television spots • Websites with maps and information • Real estate disclosure for properties in the floodplain • Presentations to school groups or neighborhood organizations • Mailings to residents in hazard-prone areas. • Participation in the NWS’s StormReady community preparedness program • Participation in Firewise Communities through the National Fire Protection Association’s community preparedness program

There are numerous existing natural hazard mitigation measures already in place in Ludlow. These were identified through feedback from the Core Team, CRB Workshop participants, interviews with local experts, and additional research by the project team. For the analysis of the Town’s existing capabilities and mitigation measures, the Core Team 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

The hazard mitigation measures outlined below are organized by hazard type, including multi-hazards, floods, dam mitigation, wind, winter weather, drought, fire, extreme temperatures, and geologic hazards.

Table 5-2: Existing Multi-Hazard Mitigation Measures

Existing Multi-Hazard Mitigation Measures	Recommended Improvements
Ludlow Local Emergency Planning Committee – Under the Emergency Planning and Community Right to Know Act of 1986, communities are required to establish Emergency Planning Committees to develop a response plan for chemical emergencies. Ludlow has a Local Emergency Planning Committee led by the Fire Chief, Ryan Pease. In accordance with this legislation, the Town of Ludlow has identified locations where hazardous materials are stored, used, and transported.	Continue to update materials and provide resources for the community. Start a Certified Emergency Response Team (CERT)
Comprehensive Emergency Management (CEM) Plan – Every community in Massachusetts is required to have a Comprehensive Emergency Management Plan. This plan addresses mitigation, preparedness, response and recovery from a variety of natural and man-made emergencies. Included in this plan is important information regarding flooding, hurricanes, tornadoes, dam failures, earthquakes, and winter storms.	None at this time
List of Critical Facilities – The list of critical facilities was updated during this planning process.	None at this time
Mutual Aid Agreements – The Town is party to a number of mutual aid agreements, including statewide, Western Massachusetts Law Enforcement Council (WMLEC), Hampden County Fire Mutual Aid, and Local mutual aid with neighboring communities.	None at this time
Comprehensive Master Plan (2009) – The Town’s Master Plan, Envisioning 2030, addressed growth, development and land use, housing, natural resources, cultural and historic resources, open space, transportation and sustainability.	Effective but needs to be updated

Existing Multi-Hazard Mitigation Measures	Recommended Improvements
<p>Transportation Plan (Regional)- makes recommendations on zoning, new development, infrastructure, and economic development that could be commensurate with hazard mitigation such as:</p> <ul style="list-style-type: none"> • Ensuring citizens are educated on conservation • Increasing funds to purchase open space • Establish a permanent open space committee and increase inter-governmental and citizen coordination • Amend town by-laws and ensure strict compliance of zoning by-laws • Increasing coordination and buy-in between townspeople and government • Maintain water quality by prohibiting activities that affect erosion and pollution 	None at this time
<p>Open Space and Recreation Plan (OSRP) 2013 – The Town has a wealth of open space, conservation areas, and recreation spaces that reduce heat island effect and provide flood storage, among other climate resilient co-benefits. The OSRP aims to maintain, promote use, and increase the number of these spaces.</p>	Update the OSRP with climate resilience and hazard mitigation in mind.
<p>Zoning Bylaws – Zoning regulates the land use of new and redeveloped parcels. Zoning allows, regulates, or guides landscaping, the siting of small energy systems, environmental performance, and safety standards for various land use types. The Zoning Code includes a Floodplain Protection Overlay District which is further described in the following sections.</p>	None at this time.
<p>Subdivision Rules and Regulations – The enforcement of the subdivision control law in Ludlow mitigates hazards through provision of access and safety in case of fire, flood, or other emergencies, and for ensuring adequate provision for water, sewerage, drainage, underground utilities, fire, police, and other municipal equipment.</p>	None at this time
<p>Site Plan Review Requirements - Requirements:</p> <ul style="list-style-type: none"> • A plot of no less than 44,000 square feet of area and 200 feet of frontage • New structures or additions shall be no less than 40 feet from the property line • Side and rear yard of no less than 25 feet • No accessory buildings in front yards and designated permitted accessory uses • Guidelines for non-conforming uses • Designations for uses on special authorization by the Board of Appeals • Back land lot regulations (for single dwelling units with less than the required land) • Approval by the Planning Board 	None at this time
<p>Hazard Mitigation Plan – This is an update of the 2016 Plan. It identifies top hazards (floods, severe snow and thunderstorms, hurricanes, wildfires, earthquakes, dam failure, drought, and extreme temperatures) and critical as well as potential affected facilities. Includes an overview of existing and potential improvements to mitigation strategies</p>	None at this time
<p>Housing Needs Assessment and Production Plan (2018) – This plan identifies housing needs in Ludlow and recommends strategies to bring Ludlow closer</p>	None at this time

Existing Multi-Hazard Mitigation Measures	Recommended Improvements
to the state 10% housing affordability threshold as well as to meet the Town’s pressing housing needs.	
Rules and Regulations for Special Permits – Procedures and guidelines are set forth in the Zoning Ordinance. Special permits may be issued or approved by the zoning board of appeals.	None at this time.
Permits for Construction – Permits are required from the Building Department to ensure the building code and utility connections are properly made. Public Works requires permits to ensure safe excavation, sewer connections and other stormwater regulations are met. The Fire Department inspects certain aspects of all new construction for fire prevention safety.	None at this time
Buried Utilities – Buried utilities are required for new development to reduce power outages and damages to the grid.	None at this time, site conditions in many places in Town are not feasible for buried utilities
Multi-Department Review of Developments – Depending upon the type of development, extent of construction, and location, multiple departments, including the Planning Board, Building Department, Board of Health, Department of Public Works, Conservation Commission, the Fire Department, and Zoning Board of Appeals, may review site plans prior to approval.	None at this time
Massachusetts State Building Code – The Massachusetts State Building Code contains many detailed regulations regarding wind loads, earthquake resistant design, flood-proofing, and snow loads.	None at this time
CodeRED – The Town of Ludlow has the CodeRED system, which provides Town officials the ability to deliver messages to targeted areas or the entire Town quickly through a reverse calling system. Residents may update their CodeRED information on the Town website.	Expand outreach to increase the number of residents receiving alerts
Emergency Shelters – The Town has eight emergency shelters that are well distributed geographically, including one that can accommodate a MEMA trailer (Our Lady of Fatima Parish).	Increase coordination with Our Lady of Fatima Parish, consider alternative Emergency Shelter locations that are more accessible under a wider range of natural hazard events

Table 5-3: Existing Flood Mitigation Measures

Existing Flood Mitigation Measures	Recommended Improvements
FEMA FIRMS –FIRMs denote areas of the 100-year and 500-year floodplain, which is used for the NFIP and other regulatory controls. For example, the Building Inspector and the Ludlow Conservation Commission enforce a federal law requiring elevation above the 100-year flood level of new and substantially improved residential structures in the floodplain. These floodplains are also used in wetland protection and floodplain control regulation. Ludlow’s FIRMs were last updated in 2013.	Consider expanding wetland regulatory controls out from the 100-year to the 500-year floodplain to account for climate change and impacts of development in flood storage areas.

Existing Flood Mitigation Measures	Recommended Improvements
<p>Participation in the NFIP – Ludlow participates in the NFIP, a Federal program administered by FEMA enabling property owners in participating communities to purchase insurance as a protection against flood losses in exchange for State and community floodplain management regulations that reduce future flood damages. The NFIP offers flood insurance to communities that comply with the minimum standards for floodplain management.</p> <p>As of January 11, 2022, there were 13 policies in effect in Ludlow for a total of \$3,013,400 in coverage and \$8,810 premium.¹⁰ Ludlow entered the NFIP on July 6, 1974, their current NFIP map is dated July 16, 2013.¹¹ Ludlow has had a total of six claims as of January 11, 2022 for total payments of \$14,991.88.¹² As of January of 2022, there have been no repetitive loss properties in Ludlow. The Town complies with the NFIP by enforcing floodplain regulations, maintaining up-to-date floodplain maps, and providing information to property owners and builders regarding floodplains and building requirements.</p> <p>NFIP uses a Community Rating System (CRS) to award communities that go beyond the minimum standards with lower flood insurance premiums for property owners. The incentives are awarded upon a credit system for various activities. Points are awarded to communities that prepare, adopt, implement, and update a comprehensive flood hazard mitigation plan using a standard planning process. As of December 2020, Ludlow is not currently participating in the CRS Program (CRS, 2020).</p>	<p>Continue participation in the NFIP to enable property owners to purchase insurance protection against flood losses. Increase outreach to property owners with the floodplain.</p> <p>Consider participation in the CRS, including participation in a regional effort. A regional effort would require partnering with local towns and the PVPC 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. 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.</p>
<p>Stormwater System Maintenance– The Department of Public Works regularly clears debris from its catch basins, storm drains, and culverts across the Town. Catch basins that regularly have more debris and manage more stormwater (like at the bottom of hills) are prioritized. The Department of Public Works also inspects culvert annually and conducted maintenance and upgrades as needed.</p>	<p>Continue regular and as-needed system maintenance; consider increasing inspections and clean-outs of catch basins known to have flooding issues due to leaf clogging</p>
<p>Stormwater Project Priority List- Prioritized list of culvert replacements, repairs, and other stormwater management needs.</p>	<p>Continue to update and implement highest priority recommendations for repair and replacement.</p>
<p>Floodplain Protection Overlay District (FPOD) – The Town’s FPOD is defined by the 100-year floodplain as designated by FEMA. The Floodplain Overlay District regulates certain activities within a flood zone enhancing federal/state laws. The Floodplain Overlay District is enforced by the Building Inspector (municipal staff) and regulated by Zoning Board of Appeals.</p>	<p>Consider increasing the FPOD to the 500-year floodplain to accommodate the anticipated impacts of climate change.</p>
<p>Subdivision Rules and Regulations - Subdivision plan requires delineating natural waterways and floodways. The subdivision regulations must comply with zoning protections for natural features. Subdivision drainage must be designed to withstand peak discharge rates from storms. New utilities must be buried. Design Standards for stormwater management systems - requiring easements, retention ponds, and other flood control infrastructure.</p>	<p>None at this time</p>

Existing Flood Mitigation Measures	Recommended Improvements
<p>Massachusetts Stormwater Management Standards and Handbook – Massachusetts administers stormwater standards through provisions of the Wetlands Protection regulations, 310 CMR 10.00 for wetland notices of intent and surface water discharge permits. The local Conservation Commission and Planning Board regulates this at the local level. The Massachusetts Stormwater Handbook provides guidance on how to meet the regulations and manage stormwater pollution.</p>	<p>The Massachusetts Stormwater Handbook is currently being updated by MassDEP.</p>
<p>Stormwater Management Plan (2019) – The plan addresses stormwater drainage and local flooding hazards. 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.</p>	<p>None at this time, update as needed annually based on changes in implementation and results of IDDE investigations</p>
<p>Flexible Development Ordinance – 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.</p>	<p>None at this time</p>
<p>Water Resources Protection District – The 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.</p>	<p>None at this time</p>
<p>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 operating condition at all times, and preservation of natural water storage areas.</p>	<p>None at this time</p>
<p>Open Space and Recreation Plan – Plan addresses flooding risk and need to limit development on soils with poor drainage and ban development in seasonal highwater areas. There is extended discussion on flood hazard areas and runoff, as well as steep slopes and the need to stop erosion and water pollution. Development is identified be one of the largest risks to hazards and conservation/open space efforts.</p>	<p>Many of the projects established in the OSRP are commensurate with hazard mitigation - it would be helpful to determine to what extent these tasks were completed or started.</p>
<p>Massachusetts Wetlands Protection Act and Local Wetlands Protection – The Commonwealth’s Wetlands Protection Act (Chapter 131, Section 40 MGL) regulates the protection of resource areas in and around wetlands, including land subject to flooding. This regulates development and activity within a 100-foot buffer around wetlands, and a 200-foot buffer around riverfront areas. The Wetlands Protection Act is locally enforced by the Conservation Commission.</p>	<p>Consider incorporating climate change into local wetlands protection.</p>

Existing Flood Mitigation Measures	Recommended Improvements
Flood Control System - Extensive system of concrete and earthen walls and related structures in areas adjacent to the Connecticut River.	None at this time

Table 5-4: Existing Hurricanes/Tornadoes/Strong Storms/High Winds Mitigation Measures

Existing Hurricane/Tornado/Strong Storm/High Wind Mitigation Measures	Recommended Improvements
Massachusetts State Building Code (Ninth Edition, 2018) – The Town enforces the Massachusetts State Building Code whose provisions are generally adequate to protect against most wind damage. The code’s provisions are the most cost-effective mitigation measure against tornadoes given the low probability of occurrence. If a tornado were to occur, damages would depend on the track of the tornado and would most likely be high due to the prevalence of older construction and the density of development.	None at this time
Comprehensive Emergency Management Plan - The CEMP 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.	None at this time
Zoning Regulations <ul style="list-style-type: none"> • Telecommunications facilities - No facility shall exceed 200 feet in height as measured from the mean finished grade at facility base. No tower exclusive of any attachments, shall be erected nearer to any property line than a distance exceeding the vertical height • Trailer/Mobile Homes Regulations - Mobile homes are an allowed use in all districts. • Subdivision Regulations (Utilities) - The Town requires all utilities for new subdivisions to be underground. 	None at this time
Tree Maintenance – The Department of Public Works conducts aggressive removal of hazard trees in the right of way as part of a multi-year project to increase sight line and sun exposure, and decrease power outages and the impacts of severe weather.	Continue hazard tree removal and maintenance.

Table 5-5: Existing Dam Failure Mitigation Measures

Existing Dam Failure Mitigation Measures	Recommended Improvements
DCR Dam Safety Regulations and Inspections (2017) – 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 only dam located within Ludlow that is owned and operated by the Town of Ludlow, Harris Pond Dam, is inspected as required.	Consider reaching out to private, non-hydroelectric dam owners regarding potential benefits of and resources to assist with dam removal
Permits Required for 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.	None at this time

Existing Dam Failure Mitigation Measures	Recommended Improvements
<p>Emergency Action Plans – DCR requires that all dams classified or reclassified as high hazard potential and significant hazard potential have an Emergency Action Plan. Harris Pond Dam has an up-to-date EAP on file with the DCR ODS.</p>	<p>Continue to update the Harris Pond Dam EAP annually. Coordinate with SWSC on desktop exercises to practice implementation of the combined Ludlow Reservoir Dam and Cherry Valley Dam EAP when completed .</p>
<p>Comprehensive Emergency Action Plan – The CEMP contains the following measures for dam failure:</p> <ul style="list-style-type: none"> • 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. • Local government agencies should familiarize themselves with technical data and other information pertinent to the dams which impact Ludlow, including 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. <p>Contaminate-laden waste (including dams that hold back pollution from traveling downstream).</p>	<p>None at this time</p>

Table 5-6: Existing Winter Hazards Mitigation Measures

Existing Town-Wide Mitigation for Winter-Related Hazards	Recommended Improvements
<p>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.</p>	<p>None at this time</p>
<p>Subdivision Regulations – Design Standards for Roads include street grade regulations (6 to 8 percent maximum); The Town requires all utilities for new subdivisions to be underground.</p>	<p>None at this time</p>
<p>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.</p>	<p>None at this time</p>
<p>Snow Plowing and De-icing Operations – The DPW provides standard snow plowing operations on main arterials, including salting. Certain roads in the Town are subject to ice build-up and require additional attention during cold weather, regardless of snowfall.</p>	<p>None at this time</p>
<p>Fuel Assistance – Available to renters and homeowners meeting income guidelines through the New England Farm Workers’ Council.</p>	<p>Expand programs to assist low-income households by providing fuel assistance.</p>

Table 5-7: Existing Drought Mitigation Measures

Existing Town-Wide Mitigation for Drought-Related Hazards	Recommended Improvements
Massachusetts Water Management Act - Regulates amount of water that can be used during a Water Emergency Declaration.	None at this time
Identification and reduction of water system leaks - The Department of Public Works routinely inspects and repairs water system leaks.	None at this time

Table 5-8: Existing Fire Mitigation Measures

Existing Town-Wide Mitigation for Fire-Related Hazards	Recommended Improvements
Open Burning Permits Required – The Town allows controlled open burning in accordance with state regulations from January 15 to May 1, between the hours of 10 a.m. and 4 pm. The Ludlow Fire Department requires a permit, which can be submitted online. 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. State police personnel provide information on safe burn practices.	None at this time
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.	None at this time
Public Education – The Fire Department has an ongoing educational program in the schools.	Continue public education efforts and update materials, as necessary
Fire Department Services – Ludlow Safety Complex, 574 Center Street	None at this time
Statewide Fire Mobilization Plan (Massachusetts Fire and EMS Mobilization Plan, 2018) – The state has a fire mobilization plan for brush fires. Ludlow is prepared to respond to small brushfires.	None at this time

Table 5-9: Existing Extreme Temperature Mitigation Measures

Existing Town-Wide Mitigation for Extreme Temperature-Related Hazards	Recommended Improvements
Heating and Cooling Shelter – The emergency shelters in Town have backup power and can be used as both heating and cooling shelters.	None at this time.

Table 5-10: Existing Earthquake Mitigation Measures

Existing Town-Wide Mitigation for Earthquakes	Recommended Improvements
<p>Massachusetts State Building Code – The State Building Code contains a section on designing for earthquake loads (780 CMR 1612.0). Section 1612.1 states that the purpose of these provisions is “to minimize the hazard to life to occupants of all buildings and non-building structures, to increase the expected performance of higher occupancy structures as compared to ordinary structures, and to improve the capability of essential facilities to function during and after an earthquake”. This section goes on to state that due to the complexity of seismic design, the criteria presented are the minimum considered to be “prudent and economically justified” for the protection of life safety.</p> <p>The code also states that absolute safety and prevention of damage, even in an earthquake event with a reasonable probability of occurrence, is not economically achievable for most buildings.</p>	None at this time

Existing Town-Wide Mitigation for Earthquakes	Recommended Improvements
<p>Section 1612.2.5 establishes seismic hazard exposure groups and assigns all buildings to one of these groups according to a Table 1612.2.5. Group II includes buildings which have a substantial public hazard due to occupancy or use and Group III are those buildings having essential facilities which are required for post-earthquake recovery, including fire, rescue and police stations, emergency rooms, power-generating facilities, and communications facilities.</p>	
<p>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.</p>	None at this time

CHAPTER 6: HAZARD MITIGATION AND CLIMATE ADAPTATION STRATEGIES

STATUS OF 2016 ACTION STRATEGIES

The Core Team reviewed the mitigation actions from the 2016 Hazard Mitigation Plan to determine which actions had been completed, and which to keep in the updated plan if not completed. Table 6-1 contains a summary of each of the mitigation actions from the 2016 plan, and indicates the status of each action and whether it will be moved forward into the 2022 update.

Table 6-1: Status of 2016 Mitigation Actions

Priority Rank	Mitigation Action	Responsible Dept/Board	Anticipated Timeline as of 2016 HMP	Mitigation Action Status as of February 2022	Keep Mitigation Action in 2022 Plan Update?
High #1	Replace Town emergency communication system	Town	March 2016 – April 2018	In progress	Keep
High #2	Replace Green Town Bridge	DPW	April 2016 – March 2021	Currently under repair, will be examined by State to see if replacement needed	Keep
High #3	Purchase a generator for the Town Hall	Town	April 2016 – March 2019	Not done	Keep
High #4	Replace or Retrofit (based on current study determination) West Street Bridge	Town / City of Springfield	March 2017 – March 2021	In progress	Keep
High #5	Upgrade generator at the DPW building	Town	April 2016 – March 2019	Not done	Keep
High #6	Purchase generators for each elementary school	Town	April 2018 – March 2021	Unknown	Keep
High #7	Develop and implement a tree trimming and maintenance program	DPW / Eversource	April 2016 – March 2021	Eversource has tree program and good communication with Town	Keep as ongoing
Medium	Establish and maintain emergency access to right of way and easement areas	Fire Department	May 2016 – April 2021	Ongoing	Yes
Medium	Clear sewer easement areas	DPW	May 2016 – April 2021	Ongoing	Yes
Medium	Replace Putts Bridge	Town / DPW	April 2018 – March 2021	Have done repairs	Remove
Medium	Replace the Piney Lane Culvert	DPW	March 2016 – April 2018	DOT undertaking design of replacement with bridge	Remove
Medium	Replace, repair or upgrade priority culverts on the Stormwater Management Project List	DPW	March 2016 – March 2021	Ongoing	Yes
Low	Bylaws, zone districts and subdivision regulations are reviewed on a quarterly basis to ensure hazard mitigation measures are up to date	Conservation Commission / DPW / Planning	March 2016 – March 2021	Not done	Yes
Low	Maintain Beaver Management Strategy	Board of Health / Conservation Commission	March 2016 – March 2021	Not a formal strategy, implement on a case-by-case basis	Remove

Priority Rank	Mitigation Action	Responsible Dept/Board	Anticipated Timeline as of 2016 HMP	Mitigation Action Status as of February 2022	Keep Mitigation Action in 2022 Plan Update?
Low	Participate in a regional effort to implement the Community Rating System	Board of Assessors / EMD / PVPC	March 2020-March 2021	Need to perform additional research	Yes, continue to perform research on feasibility
Low	Work with Eversource and communication companies to underground utilities on East Street and on Center Street	DPW	March 2017 - March 2021	Not done	Remove, cost-prohibitive, do require new subdivision utilities to be underground
Low	Implement an outreach and education program for homeowner associations regarding maintaining culverts and retention ponds on their property	Conservation Commission / DPW / Planning Board	March 2018-April 2021	Not done	Keep
Low	Educate home and business owners how to prepare and mitigate the hurricane and tornado risk	Fire Department	April 2018 – March 2021	Not done	Revise to be more broad for hazard risk management strategies, e.g. brochure on safe use of generators

IDENTIFICATION OF HAZARD MITIGATION AND CLIMATE ADAPTATION STRATEGIES

The Town developed a list of priority hazard mitigation and climate adaptation strategies through a multi-faceted approach. Strategies were discussed and developed upon review of the:

- Community profile, including the Town’s strengths and vulnerabilities
- Hazard and climate change risk assessment
- Existing mitigation measures and the capacity of the Town to respond to extreme events
- Updates from the previous HMP
- Input from stakeholders

Stakeholders were engaged through Core Team meetings, the CRB Workshop, expert interviews, and the Public Listening session. The full list of action items from the CRB Workshop are available in Appendix C and were integrated into the final list of action items vetted by the Core Team. Table 6.1 below represents the Town’s high and medium priority action items. Each of these action items was analyzed for its overall benefit, estimated cost, timeframe, and implementation responsibility, which informed prioritization. A description of each prioritization category is included below.

Mitigation Action and Description - A brief description of each mitigation measure identified in this plan.

Primary Responsibility/Oversight – Most mitigation measures will require a multi-department approach where several Town departments share responsibility. The designation of implementation responsibility in the table was assigned based on general knowledge of the responsibilities of each municipal department. The lead department for each action item is bolded. Some action items may require collaboration with State departments or private entities. Section 7 specifically addresses regional collaboration.

Priority – Designation of high, medium, or low priority was based on overall potential benefits. A High Priority action is very likely to have political and public support and necessary maintenance can occur following the project. A Medium Priority action may have political and public support and necessary maintenance had potential to occur following the project. A Low Priority action may not have political and public support for implementation or the necessary maintenance support following the project.

Estimated Cost – Approximate implementation costs are provided as an estimate for all mitigation measures. All cost data would need to be updated at the time of design and construction.

Potential Funding Source – Identification of sources of funding for each mitigation action, including grant programs, state or federal agencies, private organization, planning commission, town funding, or other source.

Time Frame for Completion – The time frames represented below are assigned based on the length of time necessary to complete the project. The timeframe is noted in years.

PRIORITIZATION METHODOLOGY

The Ludlow Core Team reviewed and prioritized a list of previously identified and new mitigation strategies using the following criteria:

- **Application to multiple hazards** – Strategies are given a higher priority if they assist in the mitigation of several natural hazards.
- **Time required for completion** – Projects that are faster to implement, either due to the nature of the permitting process or other regulatory procedures, or because of the time it takes to secure funding, are given higher priority.
- **Estimated benefit** – Strategies which would provide the highest degree of reduction in loss of property and life are given a higher priority. This estimate is based on the Hazard Identification and Analysis Chapter, particularly with regard to how much of each hazard’s impact would be mitigated.
- **Cost effectiveness** – in order to maximize the effect of mitigation efforts using limited funds, priority is given to low-cost strategies. For example, regular tree maintenance is a relatively low-cost operational strategy that can significantly reduce the length of time of power outages during a winter storm. Strategies that have identified potential funding streams, such as the Hazard Mitigation Grant Program, are also given higher priority.
- **Eligibility under the MVP Action Grant Program** – the MVP Action Grant program offers financial resources to municipalities that are seeking to advance priority climate adaptation actions to address climate change impacts resulting from extreme weather, sea level rise, inland and coastal flooding, severe heat, and other climate impacts. MVP Action Grants should incorporate the 9 Core Principles of the MVP program¹⁶, including utilizing climate change data for proactive solutions, employing nature-based solutions, increasing equitable outcomes for EJ and Climate Vulnerable Populations, and conducting robust community engagement.
- **Eligibility under FEMA Grant Programs** – FEMA’s 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 MEMA. Municipalities apply for grants to fund specific mitigation projects under MEMA requirements.

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

- **Low** – Strategies that would not have a significant benefit to property or people, address only one or two hazards, or would require funding and time resources that are impractical
- **Medium** – Strategies that would have some benefit to people and property and are somewhat cost effective at reducing damage to property and people

¹⁶ <https://www.mass.gov/doc/mvp-core-principles/download>

- **High** – Strategies that provide mitigation of several hazards and have a large benefit that warrants their cost and time to complete
- **Very High** – extremely beneficial projects that will greatly contribute to mitigation of multiple hazards and the protection of people and property. These projects are also given a numeric ranking within the category.

COST ESTIMATES

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

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

Cost estimates take into account the following resources:

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

PROJECT TIMELINE

Table 6-2 below is a completed list of mitigation strategies recommended by the Committee. The following action plan identifies Responsibility, Funding and a Timeframe for the mitigation projects recommended. The actions will begin as soon as the plan is approved and the community is eligible for funding, unless otherwise stated, and will be completed by the date as noted in the “Timeframe for Completion” column in Table 6-2 below.

Table 6-2: Mitigation Strategies to Increase Natural Hazard and Climate Change Resilience in Ludlow

Action Name	Description	Hazards Addressed	Primary Responsibility / Oversight	Priority	Estimated Cost	Potential Funding Source(s)	Timeframe <i>once funding becomes available</i>
Road/Stream Crossing Assessment and Implementation	Conduct an assessment of the condition of all road/stream crossings, develop report prioritizing locations for repair or replacement, and implement the recommendations of the report.	Flooding, Hurricanes/Tropical Storms, Winter Storms	DPW, ConCom	High	High	FEMA, MVP, DER Culvert Replacement Municipal Assistance, MassDOT Small Bridge	Assessment: 2024 Implementation: 2026
Putts Bridge Repairs	Coordinate with the City of Springfield on repairs to Putts Bridge.	Flooding, Dam Failure, Winter Storms, Hurricanes/Tropical Storms, Tornadoes	DPW	High	High	FEMA, MVP, MassDOT Small Bridge, MassWorks, Ch 90	2023
Critical Facility Identification and Prioritization	Continue to coordinate with Eversource on critical facility identification and prioritization plan for restoration of electrical service following an outage event.	Winter Storms, Hurricanes/Tropical Storms, Thunderstorms, Tornadoes	Fire Department, Police Department, HMP Committee	High	Low	Town funding	2022
Drainage Improvements	Design, permit, and install drainage improvements at known problem locations (Chapin Street and Electric Park).	Flooding, Hurricanes/Tropical Storms, Winter Storms	DPW, ConCom, Parks, Planning	High	High	FEMA, MVP, 319, Clean Water SRF Loan, MassWorks	2024
Pond Water Quality Report Implementation	Continue Pond Management Committee's work on pond water quality assessment and implement assessment report recommendations.	Flooding, Drought, Extreme Temperatures	Pond Management Committee, ConCom	High	Medium	MassDEP, 604B, 319	2025
Pioneer Valley Mosquito Control District	Implement mosquito control strategies, including evaluating joining the Pioneer Valley Mosquito Control District. Develop public education materials on mosquito habitats and control methods.	Flooding, Drought, Extreme Temperatures	Board of Health	High	Low	Town funding	2023

Action Name	Description	Hazards Addressed	Primary Responsibility / Oversight	Priority	Estimated Cost	Potential Funding Source(s)	Timeframe <i>once funding becomes available</i>
Town Green Infrastructure Plan and Implementation	Create a Town-wide Green Infrastructure plan - identify locations and types of green infrastructure suitable for installation, such as permeable pavement in Town parking lots, develop designs, and install with educational signage.	Flooding, Hurricanes/Tropical Storms, Extreme Temperatures	DPW, ConCom, Parks, Planning	High	High	FEMA, MVP, 319, Clean Water SRF Loan, MassWorks	2025
Emergency Event Communication Methods Survey	Conduct a survey of Town residents regarding the preferred method(s) for receiving communications from the Town for emergency communications and pre-event preparedness outreach.	All Hazards	HMP Committee, Town Administrator	High	Low	MVP, Town funding, volunteer time	2023
Liaisons for Outreach to Climate Vulnerable Populations	Identify and partner with community organizations and/or liaisons for outreach to climate vulnerable populations (e.g. low income populations, non-English speaking populations, elderly populations, and populations more likely to be at risk during and after a natural hazard).	All Hazards	Core Team, Town Planner, Town Administrator	High	Low	MVP, Town funding, volunteer time	2023
Critical Customers List	Continue coordination between Eversource and the Fire Department on critical customers list (customers prioritized for power restoration due to medical equipment needs). Post information on Town website on how to be added to critical customers list.	All Hazards	Fire Department, Board of Health, Council on Aging	High	Low	Town funding	2022
SWSC EAP Tabletop Exercises	Coordinate with SWSC to conduct tabletop exercises after the completion of the combined EAP for the Cherry Valley and Ludlow Reservoir Dams.	Dam Failure	SWSC, HMP Committee	Medium	Low	MEMA, FEMA	2023

Action Name	Description	Hazards Addressed	Primary Responsibility / Oversight	Priority	Estimated Cost	Potential Funding Source(s)	Timeframe <i>once funding becomes available</i>
Home Composter and Rain Barrel Discount Program	Offer reduced-cost home composters and rain barrels.	Flooding, Drought	DPW, ConCom, Town Planner	Medium	Low	Rain barrel manufacturers	2022
Identify New Emergency Operations Center	Conduct a feasibility study to identify a new Emergency Operations Center that will be accessible during various types of hazard events.	All Hazards	DPW, HMP Committee, Planning Board, Town Administrator	Medium	Medium	MEMA, FEMA	2024
Shade Tree Inventory	Conduct a shade tree inventory and develop a planting plan, including a Town tree and plant nursery to support future plantings.	Flooding, Extreme Temperatures	Tree Warden, DPW	Medium	Low	MVP, DCR Urban and Community Forestry Challenge Grant	2025
Update OSRP	Update the Town's Open Space and Recreation Plan, with an emphasis on climate resilience.	Flooding, Drought, Extreme Temperatures	Town Planner, ConCom, Open Space Committee	Medium	Medium	DLTA, EOEEA, Town Funds, MVP	2023
Public Education & Outreach – Natural Hazard Risk Mitigation Strategies	Develop and provide outreach and educational materials on natural hazard risks in Ludlow and strategies to prevent or mitigate impacts in multiple languages, both print materials and workshop-type events. Partner with the schools, library, and Senior Center for distribution of print materials and for holding events.	All Hazards	HMP Committee, Library, Town Planner	Medium	Low	MVP, MEMA	2024
Vulnerable Population Task Force	Put together a vulnerable population task force and implement a neighbor-to-neighbor check-in program.	All Hazards	Core Team, Town Administrator, Council on Aging	Medium	Low	Town funding, MVP, volunteer time	2023
Vulnerable Population Outreach During Emergencies	Continue coordination between Town departments, committees, and boards regarding vulnerable population outreach during natural hazard events.	All Hazards	Board of Health, Police Department, Fire Department, Council on Aging	Medium	Low	Town funding	2022

Action Name	Description	Hazards Addressed	Primary Responsibility / Oversight	Priority	Estimated Cost	Potential Funding Source(s)	Timeframe <i>once funding becomes available</i>
Public Education & Outreach – Water Quality	Develop and distribute public education materials for landowners on impacts to water quality from common homeowner practices, and strategies to prevent pollution (e.g., grass cutting management, fertilizer use, pet waste).	Extreme Temps., Drought	ConCom, DPW, Pond Management Committee	Medium	Low	Town funding, MassDEP, MVP	2025
Climate Resilient Master Plan	Create a Climate Resilient Master Plan to ensure that all Town plans and codes, such as the Subdivision Rules and Regulations, are planning for future conditions in the Town in a consistent manner.	All Hazards	Town Planner, Planning Board, Town Administrator	Medium	Medium	MVP, FEMA, DLTA	2026
Street Sweeping Prioritization Plan	Develop a prioritized plan and schedule for street sweeping based on known locations of street flooding associated with storm drains.	Flooding	DPW	Low	Low	Town funding (stormwater program)	2022
Eversource LNG ERP	Continue to coordinate with Eversource on the Town's role in the Emergency Response Plan for the Liquefied Natural Gas Plant.	All Hazards	Eversource, HMP Committee, Fire Department	Low	Low	Town funding, MEMA	2022
MWRA Water Line Condition	Communicate with the MWRA on the condition to the water line in Town.	Extreme Temps., Drought	MWRA, DPW	Low	Low	Town funding	2022
Public Education and Outreach – Invasive and Disease Vector Species Prevention	Implement public education programs on invasive, nuisance, and disease vector species, including workshops on invasive species identification and removal, tick risks and preventative measures, and how to avoid attracting nuisance species such as bears.	Extreme Temps.	ConCom, Core Team, Town Planner	Low	Low	MVP, Town funding	2027

Action Name	Description	Hazards Addressed	Primary Responsibility / Oversight	Priority	Estimated Cost	Potential Funding Source(s)	Timeframe <i>once funding becomes available</i>
Community Gardens	Identify additional locations for community gardens and revitalize the existing community garden.	Drought, Extreme Temperatures	Core Team, volunteers	Low	Low	MVP, MA Urban Agriculture Grant, Volunteer time	2026
Coordinate with Churches on Emergency Shelter Use	Work with Our Lady of Fatima, Christ the King, and St. Elizabeth churches on possible use as emergency shelters and role in natural hazard events.	All Hazards	Fire Department, Police Department, HMP Committee	Low	Low	MVP, Town funding, Volunteer time	2023

REGIONAL PARTNERSHIPS

Mitigating natural hazards is not strictly a local issue. The infrastructure systems that serve communities are often complex systems of storm drains, roadways, pump stations, dams, and other facilities owned and operated by a wide variety of state agencies, including MassDOT, MEMA, and DCR, as well as sometimes federal agencies. The planning, construction, operation, and maintenance of these facilities and structures are integral to the hazard mitigation and climate adaptation efforts of communities. The Town will strive to share and obtain vulnerability data in coordination with these agencies. These agencies also operate with the same budgetary and staffing constraints as communities. Like municipalities, they must make decisions about numerous competing priorities. In order to implement many of the mitigation measures identified by the Town, all parties will need to work together towards a mutually beneficial solution.

POTENTIAL FUNDING SOURCES

The identification of funding sources is the initial step in seeking funds and may vary depending on numerous factors. These factors include, but are not limited to, if a mitigation measure is conceptual or has been studied, evaluated, or designed. In most cases, the measure will require a combination of funding sources. The funding sources identified are not a guarantee that a specific project will be eligible for, or receive, funding. Upon adoption of this plan, the local representatives responsible for implementation should begin to explore potential funding sources in more detail.

Traditional funding sources within the Town of Ludlow, such as funding from the operating and capital budgets, may be able to cover some of the costs associated with the action items detailed in Table 6-2. State revolving funds and other no- or low-interest loans may also be of interest. There is a great variety of funding available for Massachusetts municipalities, both through the state and federal governments. A full list of funding opportunities can be found on the [Community Grant Finder webpage](#). The Community Grant finder provides a streamlined interface where municipalities can easily learn about grant opportunities. Specific funding options related to action items developed by Ludlow are listed in Table 6-3 below.

Table 6-3: Potential Funding Sources

Category	Agency/Grant	Description	Limitations & Stipulations
Community Development	MassWorks Infrastructure Program	Provides grants to communities to help them prepare for success and contribute to the long-term strength and sustainability of the Commonwealth.	None
Dam Repair and Removal	Dam and Seawall Program, EOEEA	Provides funding for repair or removal of dams	None
Dam Removal	Division of Ecological Restoration (DER)	Provides funding to remove dams and restore river processes.	Must provide a high enough ecological benefit
Drinking Water Supply Protection	Drinking Water Supply Protection (DWSP) Grant Program, MassDEP	Financial assistance for the purchase of land for protection of existing DEP-approved public drinking water supplies; protection of planned future public drinking water supplies; or groundwater recharge	For public water systems and municipal water departments

Category	Agency/Grant	Description	Limitations & Stipulations
Emergency Management and Planning	Flood Mitigation Assistance Grant Program (FMA)	Implement cost-effective measures that reduce or eliminate the long-term risk of flood damage.	For buildings and other structures insured under the NFIP
Emergency Management and Planning	Hazard Mitigation Grant Program (HMGP)	Provides funding after a disaster to significantly reduce or permanently eliminate future risk to lives and property from natural hazards.	None
Emergency Management and Planning	Building Resilient Infrastructure & Communities (BRIC)	Provides funds for hazard mitigation planning and the implementation of mitigation projects prior to a disaster event, with a focus on infrastructure projects and “community lifelines.” Replaced FEMA’s Pre-Disaster Mitigation (PDM) Program.	None
Emergency Management and Planning	MEMA Citizen Corps Program (CCP) Grant	Supports local Community Emergency Response Teams (CERT) and Volunteers in Police Service (VIPS) in preparing for all-hazards. Can be used for planning activities, equipment, training, and exercises.	None
Energy	Department of Energy Resources (DOER)	The DOER provides grant funding for clean energy-related programs.	None
Energy	Green Communities Designation and Grant Program	Provides a road map along with financial and technical support to municipalities that pledge to cut municipal energy and meet other criteria.	None
Environment	Community Forest Grant Program	Funding to establish community forests.	None
Environment, Flood Mitigation	Culvert Replacement Municipal Assistance Grant Program	Grant to replace undersized, perched, and/or degraded culverts located in an area of high ecological value.	Culvert replacements must meet Massachusetts Stream Crossing Standards to the maximum extent feasible.
Environment	US Forest Service Community Forest Grant Program	Funding to acquire private forest land threatened by conversion and establish community forests.	None
Environment	Conservation Assistance Grant Program	Provides funding for property appraisals, OSRPs, other land conservation planning.	Towns with 6,000 residents or fewer
Environment	604b Grant Program	Water quality assessment and management planning.	None
Environment	Land Use Planning Grants	Support effort to plan, regulate, and act to conserve and develop land consistent with the Massachusetts’ Sustainable Development Principles.	None
Environment	LAND Grant Program (Division of Conservation Services)	Helps cities and towns acquire land for conservation and passive recreation.	Municipality must have an approved OSRP

Category	Agency/Grant	Description	Limitations & Stipulations
Environment	Federal Land & Water Conservation Fund (DCS)	Funding for the acquisition, development, and renovation of parks, trails, and conservation areas.	Municipality must have an approved OSRP
Environment	MassTrails Program	Trail protection, construction, and stewardship projects.	None
Environment	MVP Program	Provides support to implement climate change resiliency priority projects.	None
Environment	Natural Resource Damages Program	Funding for restoration projects. Funding comes from settlements, so it is does not follow a set schedule.	None
Public Safety	Emergency Management Performance Grant (EMPG)	Reimbursable grant program to assist local emergency management departments to build and maintain an all-hazards emergency preparedness system.	Reimbursable
Public Safety	Public Assistance Program	The state reimburses governments and other applicants for disaster related costs.	75% reimbursable
Public Works & Transportation	Chapter 90 Program	Reimbursable grants on approved projects.	None
Public Works & Transportation	Community Transit Grant Program	Funding to meet the transportation and mobility needs of seniors and people with disabilities.	Depends on project type
Public Works & Transportation	Municipal Small Bridge Program	Funding for small bridge replacement, preservation, and rehab projects.	Bridges with spans between 10 ft and 20 ft
Transportation	Transportation Alternatives (TA)	Funding for smaller-scale transportation projects such as pedestrian and bicycle facilities, recreational trails, safe routes to school projects, community improvements such as historic preservation and vegetation management, and environmental mitigation related to stormwater and habitat connectivity.	None

CHAPTER 7: PLAN ADOPTION, IMPLEMENTATION, AND MAINTENANCE

PLAN ADOPTION

Upon completion of the draft 2022 Hazard Mitigation Plan Update, a public meeting was held by the Core Team to present the Plan and to request comments from Town officials and residents. Then a comment period was available for the public as well as Town officials to review the draft plan. The 2022 Hazard Mitigation Plan Update was then submitted to MEMA and FEMA for their review. Upon receiving conditional approval of the plan by FEMA, the plan was presented to the Town's Select Board on **DATE** 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 implementation of this plan will be the responsibility of the Core Team. Implementation will begin upon its formal adoption by the Ludlow Select Board and approval by MEMA and FEMA. The Core Team will be responsible for tracking the implementation of the plan over the 5-year period until the next HMP update, and will follow the plan maintenance plan described below. The Core Team will use Table 6-2 as a guide for taking action to mitigate hazards and vulnerabilities, and improve the Town's resilience. The time frame, responsible department, and funding mechanisms in Table 6.2 present an implementation plan for the Core Team. The Core Team will follow the implementation plan and be held accountable through the tracking mechanisms explained below. The 2022 MVP-HMP will also inform future planning and budgeting processes.

PLAN MAINTENANCE

FEMA's initial approval of this plan is valid for five years. During that time, the Town will continue to track progress, document hazards, and identify future mitigation efforts. This will be achieved through meetings and actions of the Core Team as well as continued public participation.

MEETINGS AND PUBLIC PARTICIPATION

Meetings: The Core Team, coordinated by the Town Planner, will meet once per year to monitor plan implementation. The composition of the Core Team may change slightly but will likely include representatives from the Fire Department, Department of Public Works, Council on Aging, Conservation Commission, and Pond Management Committee. These meetings will provide an opportunity for regular implementation updates and to identify capital planning needs related to hazard mitigation.

Continuing Public Participation: Public participation will be a critical component of the Plan maintenance process. The adopted plan will be posted on the Town's website with a mechanism for citizen feedback, such as an e-mail address, for questions and comments. The Town will encourage local participation whenever possible during the next five-year planning and implementation cycle.

The Core Team will also incorporate engagement into the implementation of the priority action items. All updates to the plan, including implementation progress, will be placed on the Town's MVP/HMP Committee website¹⁷. The Core Team will hold all meetings in accordance with Massachusetts open meeting law and the public is 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.

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. The OSRP is due to be updated in the near future; during the OSRP update process, the Town can use the work of the MVP-HMP plan update 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 and 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 SHMCAP* - This plan was used to insure that the Town's plan 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 MVP and HMP implementation process, the Core Team will review whether any of these plans are in the process of being updated. If so, the Core Team will remind people working on these plans, policies etc. of the 2022 HMP Update, and urge them to incorporate the plan into their efforts. The Core Team will also review current Town programs and policies to ensure that they are consistent with the mitigation strategies described in this plan. The HMP update will also be incorporated into updates of the Town's CEM Plan.

¹⁷ <https://www.ludlow.ma.us/html/mvp/index.htm>

Following this plan update, the Core Team will note 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 Planner will call meetings of all responsible parties to review plan progress on an annual basis in each of the following years: 2023, 2024, 2025, 2026, 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 2027.

The Town Planner 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 CEM 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.

APPENDICES

Appendix A: References and Resources

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Mitigation Funding Resources

404 Hazard Mitigation Grant Program (HMGP)	MA Emergency Management Agency
406 Public Assistance and Hazard Mitigation	MA 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 Work.....	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.

Appendix B: Acronyms and Abbreviations

Abbreviation	Definition
BFE	Base Flood Elevation
BRIC	Building Resilient Infrastructure and Communities
CAPE	Convective Available Potential Energy
CCP	Citizen Corps Program
CDC	Centers for Disease Control and Prevention
CEII	Critical Electric Infrastructure Information
CEM	Comprehensive Emergency Management
CERT	Certified Emergency Response Team
CFR	Code of Federal Regulations
CIS	Community Information System
CMR	Code of Massachusetts Regulations
CRB	Community Resilience Building
CRS	Community Rating System
DCR	Department of Conservation and Recreation
DCS	Division of Conservation Services
DER	Division of Ecological Restoration
DLTA	Direct Local Technical Assistance
DOER	Department of Energy Resources
DR	FEMA-declared Disaster
EAP	Emergency Action Plan
EJ	Environmental Justice
EM	FEMA-declared Emergency
EMPG	Emergency Management Performance Grant
EOC	Emergency Operations Center
EOEEA	Executive Office of Energy and Environmental Affairs
EOPSS	Executive Office of Public Safety and Security
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FIRM	Flood Insurance Rate Maps
FIS	Flood Insurance Study
FMA	Flood Mitigation Assistance
GHG	Greenhouse Gas
HMGP	Hazard Mitigation Grant Program
HMP	Hazard Mitigation Plan
LNG	Liquefied Natural Gas
MassDEP	Massachusetts Department of Environmental Protection
MassDOT	Massachusetts Department of Transportation

Abbreviation	Definition
MEMA	Massachusetts Emergency Management Agency
MGL	Massachusetts General Law
MMWEC	Massachusetts Municipal Wholesale Electric Company
MPH	Miles per Hour
MVP	Municipal Vulnerability Preparedness
MWRA	Massachusetts Water Resources Authority
NASA	National Aeronautics and Space Administration
NCEI	National Center for Environmental Information
NE CASC	Northeast Climate Adaptation Science Center
NECIA	Northeast Climate Impacts Assessment
NESIS	Northeast Snow Impact Scale
NFIP	National Flood Insurance Program
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
ODS	Office of Dam Safety
OSRP	Open Space and Recreation Plan
PDM	Pre-Disaster Mitigation
PVPC	Pioneer Valley Planning Commission
PVTA	Pioneer Valley Transit Authority
SFHA	Special Flood Hazard Area
SHMCAP	State Hazard Mitigation and Climate Adaptation Plan
SRF	State Revolving Fund
SWSC	Springfield Water and Sewer Commission
TA	Transportation Alternatives
VIPS	Volunteers in Police Service
WMA	Wildlife Management Area
WMLEC	Western Massachusetts Law Enforcement Council
WRHSAC	Western Region Homeland Security Advisory Council

Appendix C: Documentation of the Planning Process

Committee Meeting Agendas, Meeting Materials and Records of Attendance

Ludlow Municipal Vulnerability Preparedness & Hazard Mitigation Plan Update

Meeting #1 Agenda

On Zoom

December 17, 2021 – 11:00 AM

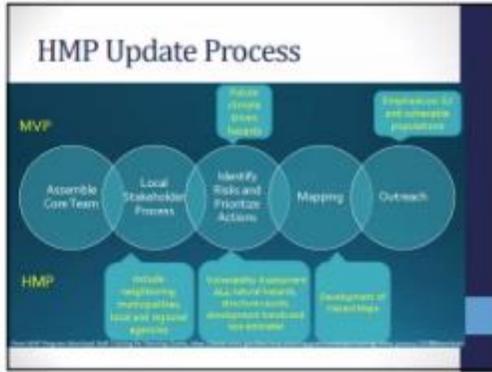
1. Introductions/Administrative
2. Project scope, MVP planning process, and HMP update process
 - a. Planning process and requirements
 - b. Project timeline
3. Brief discussion on Climate Change Impacts and Vulnerabilities
4. Affirm the goals of the MVP process in Ludlow
 - a. Why are we discussing climate vulnerability in Ludlow?
 - b. How will the community use the information and decisions constructed during the workshop?
5. PVPC Data Needs
 - a. Past plans, studies, or reports from the town?
 - b. Any specific hazard mapping needed?
6. Workshop logistics and stakeholder attendance
 - a. Review participant worksheet
 - b. Workshop schedule/date/location
7. Next steps
 - a. Core team meeting for workshop prep
 - b. Stakeholder engagement

Attendees:

- Emily Tully, PVPC
- Catherine Ratte, PVPC
- Andrew Smith, MVP Regional Coordinator
- Ellie Villano, Town Administrator
- Doug Stefancik, Town Planner
- Jim Goodreau, Assistant Town Engineer
- Andrea Crete, Health Agent
- Penny Lebel, Conservation Commission
- Jocelyn Zepke, Council on Aging
- Brian Shameklis, Sergeant, Ludlow Police



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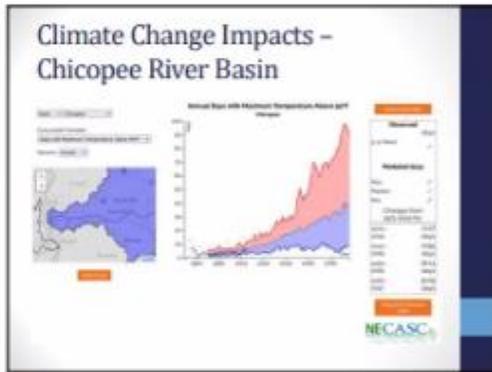
8

Climate Change Impacts on Natural Hazards

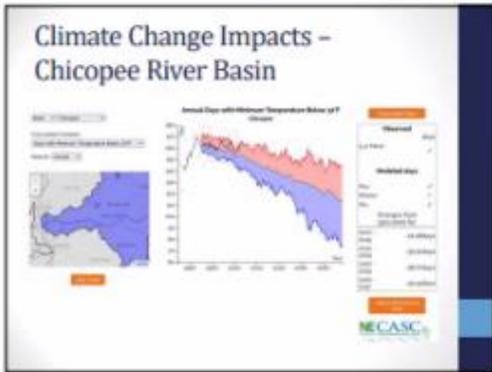
Climate Change Projections for Massachusetts

Category	Key Findings
Sea Level Rise	<ul style="list-style-type: none"> Sea level rise will increase by 1 to 6 feet by 2100. Sea level rise will increase by 1 to 6 feet by 2100. Sea level rise will increase by 1 to 6 feet by 2100.
Temperature Increase	<ul style="list-style-type: none"> Average annual temperature will increase by 2 to 6 degrees Fahrenheit. Summer will see an increase in the number of days with temperatures above 90 degrees Fahrenheit. Winter will see a decrease in the number of days with temperatures below 32 degrees Fahrenheit.
Extreme Weather	<ul style="list-style-type: none"> There will be an increase in the number of days with heavy rain. There will be an increase in the number of days with heavy snow. There will be an increase in the number of days with heavy ice.

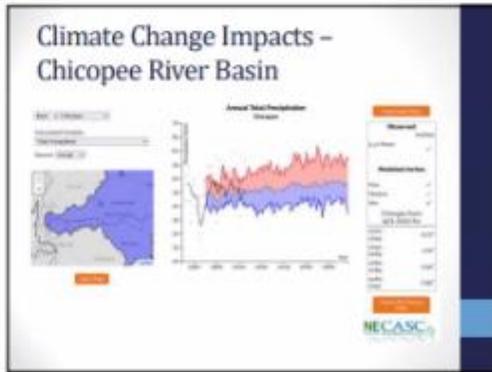
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Goals

- Why does Ludlow need to discuss current and future impacts of hazards?
- How will Ludlow use the information and decisions developed during the process?

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What Does Ludlow Get Out of This Process?

- Understanding of local strengths and vulnerabilities
- Eligibility to apply for funding to implement priority projects
 - MVP Action Grants
 - FEMA Hazard Mitigation Assistance Grants

Applicant	Project Title	Recommended Funding
Concord	Reforestation and Tree Resilience	\$150,000
Deerfield	Reducing Flooding Vulnerability in Deerfield	\$278,033
Northampton	Protecting Downstream: Northampton's Flood Control Levees	\$215,000
Worcester	Culvert Assessment and Green Infrastructure Survey	\$106,498
Wendham	Eagle Dam Removal	\$46,000

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Core Team Roles and Responsibilities

- Provide local information and expertise
- Identify and engage stakeholders
- Attend and participate in meetings, workshop(s), and public listening session(s)
- Review and provide input on draft plan chapters, hazard maps, and priority actions

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Workshop Schedule and Logistics

- In person or virtual
- One day (6-8 hours) or two half-days (4 hours each)
- If in person, suitable location
- Date(s) and time(s) – March/April timeframe



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Stakeholder Identification

- Who are the key decision makers in your community?
- Who is directly responsible for implementing decisions?
- Who has influence on decisions in your community?
- Which entities will be impacted by decisions?

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Data Needs

- Past plans, studies, or reports
- Any specific hazard mapping needed?



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Next Steps

- Send community photos to etully@pvpc.org
- Schedule next meeting
- Finalize list of participants
- Finalize workshop dates
- Finalize outreach and publicity plan
- Schedule stakeholder interviews

Ludlow MVP/HMP Core Team

Meeting #2 Agenda

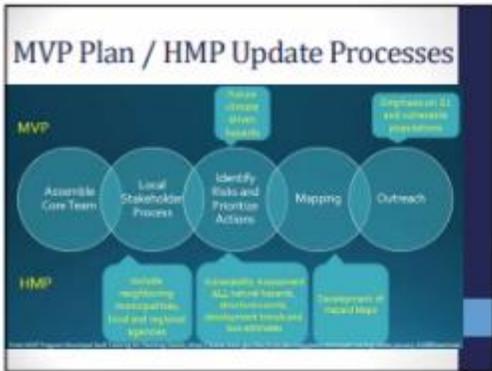
On Zoom

January 21, 11:00-12:30

1. Introductions/sign in
2. Review and update stakeholders, discuss outreach plan
3. Review past, present, and potential future natural hazards in Ludlow
 - a. Hazard identification and risk analysis table
 - b. Add or remove hazards, change risk level?
 - c. Decide on top 4 risks to focus on for workshop(s)
 - d. Update hazard locations and previous occurrences
4. Preliminary thoughts on Infrastructure, Societal, Environmental, and Economic features
5. Update any development in Town since 2016
6. Plan for CRB workshop(s)
 - a. Set date and time
 - b. Plan for invitation and outreach to invitees
 - c. Format and agenda for workshop
7. Review and update critical facilities (if time)
8. Next steps
9. Set date for first public meeting
10. Set next core group meeting date

Attendees:

- Emily Tully, PVPC
- Andrew Smith, MVP Regional Coordinator
- Ellie Villano, Town Administrator
- Doug Stefancik, Town Planner
- Jim Goodreau, Assistant Town Engineer
- Andrea Crete, Health Agent
- Penny Lebel, Conservation Commission
- Seth Falconer, Ludlow Fire
- Jocelyn Zepke, Council on Aging
- Brian Shameklis, Sergeant, Ludlow Police



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What is Hazard Mitigation?

Protection Prevention Response Recovery

Mitigation

Sustained action taken to reduce or eliminate long-term risk to human life and property from hazards.

FEMA

8

Types of Hazards (SHMCAP)

- Inland flooding
- Drought
- Hurricanes/Tropical Storms
- Severe Winter Storm/Nor'easter
- Other Severe Weather
- Average and Extreme Temperatures
- Invasive species
- Earthquakes
- Wildfire
- Tornadoes
- Landslide

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2016 HMP Top Hazards

Type of hazard	Location of occurrence	Probability of future events	Impact	Orderability (1 highest)
Sea Level Rise	Medium	Very Low	Limited	9
Drought	Large	Moderate	Limited	8
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
Wildfire/Windthrow/Urban Fire	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

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Infrastructure Assets

- Pole-based electrical and communication lines
- Town and state owned roads, evacuation routes
- Cul-de-sacs and dead end streets (single point of entry)
- Culverts
- Dams
- Sewer and drinking water lines and pumps

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Societal Assets

- Aging population
- Assisted living facilities
- Neighborhood organizations
- Pet populations
- Town communication system
- Non-English speaking populations
- Populations for whom transportation may be a challenge
- Emergency shelters
- Libraries
- Cultural or historic assets with special needs during hazards

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Environmental Assets

- Shade and street trees
- Waterbodies, watercourses, floodplains, and wetlands
- Open space and recreational resources
- Invasive species
- Unique or special natural features
- Drinking water aquifer

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Data Needs

- Comprehensive Emergency Management Plan?
- Recent FEMA grants/projects?
- Development since previous HMP?

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Next Steps

- Send community photos to etully@pvpc.org
- Review and update list of critical facilities
- Schedule next meeting – 1st public meeting?
- Implement stakeholder outreach plan
- Capability assessment – interviews?

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AGENDA

Town of Ludlow: Municipal Vulnerability Preparedness & Hazard Mitigation Plan Committee – Meeting #3 / Public Meeting #1

Meeting of February 17, 2022

Time: 10:00 AM.-11:30 AM

Ludlow Town Hall – Selectmen’s Conference Room *

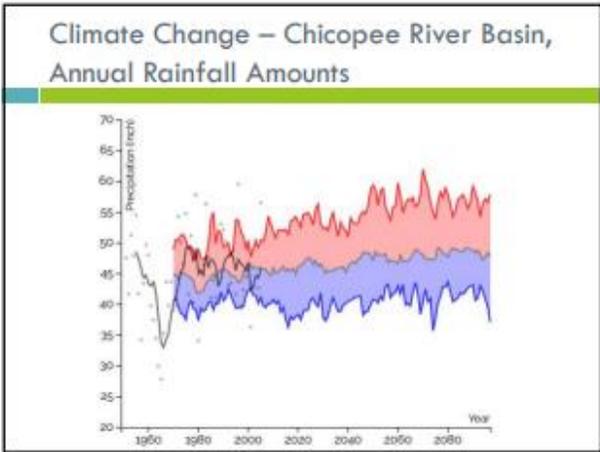
Appointments:

10:000 A.M.

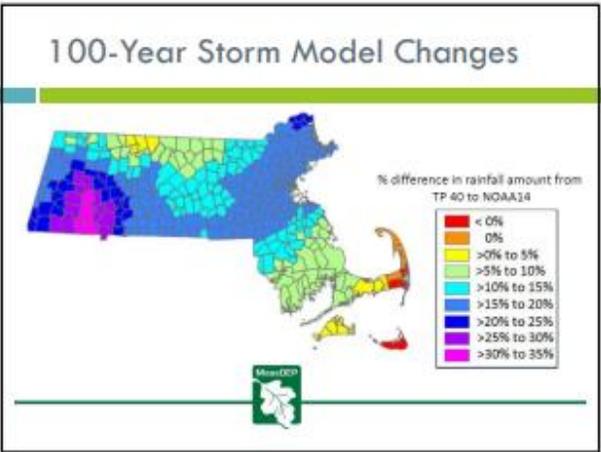
1. Overview of MVP/HMP planning processes, requirements, and timelines
2. Introduction to climate change and natural hazards
 - a. National, state-wide, and local trends
3. Natural hazards risk assessment for Ludlow
 - a. Past, present, and future hazards
 - b. Top 4 hazards
4. 2016 Hazard Mitigation Plan review and updates
 - a. Critical facilities
 - b. Capabilities assessment
 - c. Recommended mitigation measures
 - i. Current status
 - ii. Any updates or changes
 - iii. Which to carry forward into 2022 plan
 - iv. Prioritize mitigation actions
5. Next steps
 - a. Public engagement
 - i. Public survey on MVP page on Town website?
 - ii. Stakeholder outreach
 - b. Schedule workshop dates/times
 - c. Preliminary thoughts on infrastructure, environmental, societal assets

RECEIVED
TOWN CLERK'S OFFICE
2022 FEB - 8 A 10: 59
TOWN OF LUDLOW

***Please be advised that by Order of the Governor: [S 2475. An act relative to extending certain COVID-19 measures adopted during the state of emergency](#) –You may also access the meeting by Joining Zoom Meeting or by attending in person.**



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Natural Hazards in Ludlow

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

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- ### Critical Facilities
- ❑ **Critical Facilities:** Structures and institutions necessary for a community's response to and recovery from emergencies
 - ❑ **Essential Facilities**
 - ❑ **Transportation Systems**
 - ❑ **Lifeline Utility Systems**
 - ❑ **High Potential Loss Facilities**
 - ❑ **Hazardous Material Facilities**

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2016 HMP Review - Critical Facilities Category 1 – Emergency Response Services

- ❑ **Emergency Operations Center (EOC)**
 - ❑ Public Safety Complex
 - ❑ Highway Garage – Backup EOC
- ❑ **Emergency Electrical**
 - ❑ Power Facility – Mass Municipal Wholesale Electric Company (MMWEC, Moody St)
- ❑ Transfer Station
- ❑ Westover Air Base

2016 HMP Review - Critical Facilities Category 1 – Emergency Response Services

- ❑ **Emergency Shelters**
 - ❑ Baird Middle School
 - ❑ Health South
 - ❑ Ludlow Senior Center
 - ❑ Chapin Street School
 - ❑ East Street School
 - ❑ Town Hall
 - ❑ Veterans Park Elementary School
- ❑ **Dry Hydrants – Fire Ponds – Water Sources**
 - ❑ Springfield Reservoir
 - ❑ Leland Drive (cistern)
 - ❑ Jared Drive (cistern)
 - ❑ Parker Lane (cistern)

2016 HMP Review - Critical Facilities
Category 1 – Emergency Response Services

- Utilities
 - Bay State Gas LNG Plant
 - Buckeye Pipeline (Tank Farm Road)
 - Hydroelectric Dams
 - 1 Putts / Ludlow Bridge
 - 1 Miller Street
 - 1 Red Bridge
 - MMWEC (Westover Industrial Park)
 - Power Substation (Center Street)
- Communications
 - Cell Towers
 - Charter Communications Hub Site at Ludlow High School
 - Public Safety Complex



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2016 HMP Review - Critical Facilities
Category 1 – Emergency Response Services

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

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2016 HMP Review - Critical Facilities
Category 1 – Emergency Response Services

- Bridges on Primary Evacuation Routes
 - Collins Bridge / Miller Street
 - East Street – over Chicopee River
 - Fire Station Bridge
 - Holyoke Street – over Harris Pond
 - Mass Pike (I-90) – over Chicopee River
 - Putts / Ludlow Bridge
 - Red Bridge Road (Wilbraham) – over Chicopee River
 - West Street – over Chicopee River

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2016 HMP Review - Critical Facilities
Category 2 – Non Emergency Response Facilities

- Water Supply (50% of Town on private well water)
 - Nash Hill Covered Reservoir – MWRA (Fuller Street residents)
 - Springfield Water & Sewer Commission (SWSC)
 - Ludlow Reservoir (back-up water supply)
 - Wilbraham Water line (Miller Street residents)
- Problem Culverts
 - Bondsville Road
 - Center Street & Alden
 - Piney Lane
 - Pool Street
 - Randall Road (beavers)
 - West Street / Brook Street



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2016 HMP Review - Critical Facilities
Category 3 – Facilities/Populations to Protect

- Health South Rehabilitation Hospital
- Hampden County House of Correction
- Elderly Housing / Assisted Living
 - Keystone Commons
 - Chestnut Street Housing
 - Colonial Sunshine Manor
 - State/Meadow Street Housing for Elderly
 - Steven's Memorial Building
 - HAP Housing new facility at 188 Fuller Street
 - World Development Senior Housing building at Mill #10

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2016 HMP Review - Critical Facilities
Category 3 – Facilities/Populations to Protect

- Recreation Areas
 - Camp White
 - Children's Playground across from 47 Sewell Street
 - Facing Rock Wildlife Management Area
 - Ludlow Country Club
 - Memorial Park
 - Springfield Reservoir
 - West Street Park
 - Westover Golf Course
 - Whitney Park



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2016 HMP Review - Critical Facilities
Category 3 – Facilities/Populations to Protect

- Schools
 - Baird Middle School
 - Chapin Street Elementary School
 - Early Childhood Partnership & Integrated Preschool Program
 - East Street Elementary School
 - Ludlow Community Center / Randall Boys & Girls Club
 - Ludlow High School
 - St. John the Baptist School
 - Tiny Explorers Daycare
 - Veterans Park Elementary School

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2016 HMP Review - Critical Facilities
Category 3 – Facilities/Populations to Protect

- Churches
- Historic Buildings / Sites
 - 1st Meeting House
 - Clock Tower
 - Ludlow Center Historic District
 - Ludlow Village Historic District
- Mobile Home Parks
 - 229 Miller Street
 - 350 West Street



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2016 HMP Review – Mitigation Actions

Summary of 2016 HMP Mitigation Actions and Current Status					
Priority Rank	Mitigation Action	Responsible Dept/Board	Anticipated Timeline as of 2016 HMP	Mitigation Action Status as of February 2022	Keep Mitigation Action in 2022 Plan Update?
High	Replace Town emergency communication system	Town	March 2016 – April 2018		
High	Replace Green Town Bridge	DPW	April 2016 – March 2021		
High	Purchase a generator for the Town Hall	Town	April 2016 – March 2019		
High	Replace or Retrofit (based on current study determination) West Street Bridge	Town / City of Springfield	March 2017 – March 2021		
High	Upgrade generator at the DPW building	Town	April 2016 – March 2019		
High	Purchase generators for each elementary school	Town	April 2018 – March 2021		
High	Develop and implement a tree trimming and maintenance program	DPW / EverSource	April 2016 – March 2021		

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2016 HMP Review – Mitigation Actions

Summary of 2016 HMP Mitigation Actions and Current Status					
Priority Rank	Mitigation Action	Responsible Dept/Board	Anticipated Timeline as of 2016 HMP	Mitigation Action Status as of February 2022	Keep Mitigation Action in 2022 Plan Update?
Medium	Establish and maintain emergency access to right of way and easement areas	Fire Department	May 2016 – April 2021		
Medium	Clear sewer easement areas	DPW	May 2016 – April 2021		
Medium	Replace Pats Bridge	Town / DPW	April 2018 – March 2021		
Medium	Replace the Pacey Lane Culvert	DPW	March 2016 – April 2018		
Medium	Replace, repair or upgrade priority culverts on the Stormwater Management Project List	DPW	March 2016 – March 2021		

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2016 HMP Review – Mitigation Actions

Summary of 2016 HMP Mitigation Actions and Current Status					
Priority Rank	Mitigation Action	Responsible Dept/Board	Anticipated Timeline as of 2016 HMP	Mitigation Action Status as of February 2022	Keep Mitigation Action in 2022 Plan Update?
Low	Review bylaws, zone districts and subdivision regulations on a quarterly basis to ensure hazard mitigation measures are up to date	Conservation Commission / DPW	March 2016 – March 2021		
Low	Maintain Beaver Management Strategy	Board of Health / Conservation Commission	March 2016 – March 2021		
Low	Participate in a regional effort to implement the Community Rating System	Board of Assessors / EMD / DPW	March 2020-March 2021		
Low	Work with EverSource and communication companies to underground utilities on East Street and on Center Street	DPW	March 2017 - March 2021		

2016 HMP Review – Mitigation Actions

Summary of 2016 HMP Mitigation Actions and Current Status					
Priority Rank	Mitigation Action	Responsible Dept/Board	Anticipated Timeline as of 2016 HMP	Mitigation Action Status as of February 2022	Keep Mitigation Action in 2022 Plan Update?
Low	Implement an outreach and education program for homeowner associations regarding maintaining culverts and retention ponds on their property	Conservation Commission / DPW	March 2018-April 2021		
Low	Educate home and business owners how to prepare and mitigate the hurricane and tornado risk	Fire Department	April 2018 - March 2021		

Capabilities Assessment

Capability Assessment Worksheet

Jurisdiction: _____

Local mitigation capabilities are existing authorities, policies, programs, and resources that reduce hazard impacts or that could be used to implement hazard mitigation activities. Please complete the table and questions in the worksheet as completely as possible. Complete one worksheet for each jurisdiction.

Planning and Regulatory

Planning and regulatory capabilities are the plans, policies, codes, and ordinances that prevent and reduce the impacts of hazards. Please indicate which of the following your jurisdiction has in place.

Plan	Yes/No Year	Does the plan address hazards?
		Does the plan identify projects to include in the mitigation strategy? (Can the plan be used to implement mitigation actions?)
Comprehensive Master Plan		
Capital Improvements Plan		
Economic Development Plan		

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Next Steps

- Public engagement
 - Public survey on MVP page on Town website?
 - Stakeholder outreach
- Schedule workshop dates / times, send invitations
- Preliminary thoughts on infrastructure, environmental, societal assets

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QUESTIONS / DISCUSSION

Emily Jully, Senior Planner, PVPC
ejully@pvpc.org / (802) 829-0341

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Core Team Meeting #3 / Public Meeting #1 Notes

Via Zoom and at Ludlow Board of Selectmen Meeting Room

2/17/2022, 11:00 AM – 12:30 PM

Attendees

- Emily Tully, PVPC
 - Doug Stefancik, Town Planner
 - Penny Lebel, Conservation Commission
 - Paulina Matusik, Public Health Coordinator
 - Andrea Crete, Health Department
 - Jim Goodreau, DPW
1. Overview of MVP/HMP planning processes, requirements, and timelines
 2. Introduction to climate change and natural hazards
 - a. National, state-wide, and local trends
 3. Natural hazards risk assessment for Ludlow
 - a. Past, present, and future hazards
 - Red Bridge Dam
 - More than 40 years ago, dam failure at Wilbraham bridge
 - Elderly communities vulnerable to high temperatures, could utilize Senior Center as cooling center
 - Increase dam failure rating in terms of vulnerability
 - Combine high winds with thunderstorms
 - Wildfire – wooded areas in residential areas
 - Decrease risk of extreme temperatures, Team does not think likely to impact Town to significant degree
 - b. Top 4 hazards
 4. 2016 Hazard Mitigation Plan review and updates
 - a. Critical facilities
 - Building communication towers Fire & Police
 - Lot of solar facilities built since 2016
 - Underground infrastructure
 - Ludlow CTV
 - Harris Brook Elementary School replaced Chapin St School
 - Old Lady of Fatima can bring in MEMA trailer
 - Remove Veterans Park Elementary School, add High School
 - Bridges are concern for use as evacuation routes would have to re-route
 - No major flooding problems on evacuation routes, but all at risk for tree limbs down during high wind storms except West Ave, which is parallel to the Mass Pike
 - Dealing with repairs on a couple of bridges right now:
 - Collins Bridge with Wilbraham – repairs

- Looking at West Street with West Springfield, not sure of scope
- Add cisterns on Sunset Ridge and Avalina Way
- Water services: SWSC, MWRA, South Hadley FD
- Have addressed Randall Rd beavers but possibility of return, leads to HCHC
- Not many generators in Town, power outages prevent usage of private well water pumps
- HAP Housing facility -> Wayfinders Housing, to be built next year
- World Development Senior Housing -> 55+ housing, Winn Development
- Colonial Sunshine Manor -> Wilson
- Health South -> Encompass
- Change all references from Springfield Reservoir to Ludlow Reservoir
- Add Electric Park and Gazebo Park to recreation areas

b. Review of 2016 HMP Mitigation Actions

- See table
- Email 2016 HMP to group

5. Next steps

a. Public engagement

b. Stakeholder outreach

c. Schedule workshop dates/times

- Possibility to have more, shorter workshops? Definitely prefer 2, 4 hr workshops to 1, 8 hr workshop, ET to email MVP program about options
- Mar – have one in AM, 2nd one in evening?
- Brochure invitation? Public Survey?

d. Preliminary thoughts on infrastructure, environmental, societal assets

Summary of 2016 HMP Mitigation Actions and Current Status					
Priority Rank	Mitigation Action	Responsible Dept/Board	Anticipated Timeline as of 2016 HMP	Mitigation Action Status as of February 2022	Keep Mitigation Action in 2022 Plan Update?
High #1	Replace Town emergency communication system	Town	March 2016 – April 2018	In progress	Keep
High #2	Replace Green Town Bridge	DPW	April 2016 – March 2021	Currently under repair, will be examined by State to see if replacement needed	
High #3	Purchase a generator for the Town Hall	Town	April 2016 – March 2019	Not done	Keep
High #4	Replace or Retrofit (based on current study determination) West Street Bridge.	Town / City of Springfield	March 2017 – March 2021	In progress	Keep
High #5	Upgrade generator at the DPW building	Town	April 2016 – March 2019	Not done	Keep
High #6	Purchase generators for each elementary school	Town	April 2018 – March 2021	Unknown	If not done, keep
High #7	Develop and implement a tree trimming and maintenance program	DPW / Eversource	April 2016 – March 2021	Eversource has tree program and good communication with Town	Keep as ongoing
Medium	Establish and maintain emergency access to right of way and easement areas	Fire Department	May 2016 – April 2021	Check with FD	
Medium	Clear sewer easement areas	DPW	May 2016 – April 2021	Ongoing	Keep
Medium	Replace Putts Bridge	Town / DPW	April 2018 – March 2021	Have done repairs	Remove
Medium	Replace the Piney Lane Culvert	DPW	March 2016 – April 2018	DOT undertaking design of replacement with bridge	Remove
Medium	Replace, repair or upgrade priority culverts on the Stormwater Management Project List	DPW	March 2016 – March 2021	Need to look into SWM Project List in more detail	
Low	Bylaws, zone districts and subdivision regulations are reviewed on a quarterly basis to ensure hazard mitigation measures are up to date	Conservation Commission / DPW / Planning	March 2016 – March 2021	Not done	Keep but maybe decrease frequency – floodplain and stormwater bylaw
Low	Maintain Beaver Management Strategy	Board of Health / Conservation Commission	March 2016 – March 2021	Not a formal strategy, implement on a case-by-case basis	Remove
Low	Participate in a regional effort to implement the Community Rating System	Board of Assessors / EMD / PVPC	March 2020-March 2021	Look into further	
Low	Work with Eversource and communication companies to underground utilities on East Street and on Center Street	DPW	March 2017 - March 2021	Not done	Remove, cost-prohibitive, do require new subdivision communications systems to be underground as part of Subdivision RRs
Low	Implement an outreach and education program for homeowner associations regarding maintaining culverts and retention ponds on their property	Conservation Commission / DPW / Planning Board	March 2018-April 2021	Not done	Keep
Low	Educate home and business owners how to prepare and mitigate the hurricane and tornado risk	Fire Department	April 2018 – March 2021	Not done	Revise to be more broad for hazard risk management strategies, e.g. brochure on safe use of generators

Community Resilience Building (CRB) Workshop Materials

List of CRB Workshop Invitees:

	Potential Participants	Local Stakeholder Name	Affiliation / Contact Information
Elected Officials (or equivalents)	Board of Selectmen		Selectmen@Ludlow.ma.us
	Town Administrator	Marc Strange	MVP/HMP Committee
	State Senator	Senator Eric Lesser	eric.lesser@masenate.gov
	State Representative	Representative Jacob Oliveira	Jacob.Oliveira@mahouse.gov
	US Senator	Senator Edward Markey	ma_casework@markey.senate.gov
	US Senator	Senator Elizabeth Warren	scheduling@warren.senate.gov
	US Representative	Congressman Richard Neal	https://neal.house.gov/forms/writeyourrep/
Business Leadership	Major Employer(s)	Randall's Farm Big Y	Karen Randall, kran@randallsfarm.net
	Chamber of Commerce/ Business Councils	East of the River 5 Town Chamber of Commerce (ERC 5)	https://business.erc5.com/contact
	Agriculture	Randall's Farm	Karen Randall, kran@randallsfarm.net
Academia	School Superintendent	Lisa Nemeth	l_nemeth@ludlowps.org
Muni Departments, Boards, Commissions	Conservation Commission	Penny Lebel	MVP/HMP Committee
	Council on Aging/ Senior Center	Jocelyn Zepke	MVP/HMP Committee
	Town Engineer / DPW	Jim Goodreau	MVP/HMP Committee
	Fire Department	Seth Falconer	MVP/HMP Committee
	Board of Health/ Public Health Department	Paulina Matusik	MVP/HMP Committee
	Tree Warden	Board of Public Works	
	Planning and Economic Development	Doug Stefancik	MVP/HMP Committee
	Recreation Department / Commission	Debbie Gates	Recreation@Ludlow.ma.us
	Building Department	Commissioner Justin Larivee	Building@Ludlow.ma.us
	Hubbard Memorial Library		Library@ludlow.ma.us
	Police Department	Brian Shameklis	MVP/HMP Committee
Sherriff's Dept (Hampden County Corrections)	Jeff McDonald, Hampden County Sherriff's Department	Jeffery.McDonald.HCSD@gmail.com	

	Potential Participants	Local Stakeholder Name	Affiliation / Contact Information
Other Community Stakeholders	Animal Shelters	Dog officer through Ludlow Police	
	Ambulance	Operated through Fire Department	
	Artists	Exit 7 Theater Company	exit7players@gmail.com
	Faith-based/Civic Organizations	Our Lady of Fatima St. Elizabeth Elks	https://ourladyoffatimaparish.org/contact-us
	Independent Nursing/ Hospice Centers	Keystone Commons Assisted Living / Nursing Facility Treatment Program at former hospital – Ganderma Center, treatment facility above Encompass Health Rehab Hospital	https://www.keystonesenior.com/senior-living/ma/ludlow/keystone-commons/vendor-contact-us
	Local/ Regional/ State Housing Authorities	Ludlow Housing Authority Mobile Home Rent Control Board	robin@ludlowhousing.com
	Major Employers	Hampden County Corrections MMWEC Town of Ludlow Construction companies	
	Neighborhood Associations/ Partnerships	Piney Lane Neighborhood Association – no longer active? Condo associations	
	Youth Groups	Ludlow Boys & Girls Club Boy Scout Troops – 1774 & 180	Boys & Girls Club: 413-583-2072
	Outdoor Recreation Groups	Ludlow Fish & Game Ludlow Country Club Westover Golf Course	staff@lfgclub.org https://www.ludlowcountryclub.com/contact Golf@Ludlow.ma.us
	Environmental Groups/ Committees	Chicopee 4 Rivers Elaine Hodgman, Pond Committee	Chicopeewatershed@gmail.com Elainehodgman@gmail.com

	Potential Participants	Local Stakeholder Name	Affiliation / Contact Information
	Water/ Power Utility	Aimee Henderson, Eversource Energy (LNG and Electric) Bob Weaver, Springfield Water & Sewer Commission	Aimee.Henderson@eversource.com Bob.weaver@waterandsewer.org
	Community	Celebrate Ludlow Committee	ludlowma250@gmail.com
Neighboring Communities	Chicopee	Glenn Joslyn, Emergency Management Director	gjoslyn@chicopeema.gov
	Springfield	Emergency Management Director District Chief Tyrone Denson	tdenson@springfieldcityhall.com
	Granby		
	Belchertown	Doug Albertson, Town Planner	planning@belchertown.org
	Palmer	William Bernat, Emergency Management Director	wbernat@palmermafd1.org
	Wilbraham	David Bourcier, LEPC	dbourcier@wilbraham-ma.gov

Workshop #1 Invitation Letter:



Town of Ludlow

Municipal Vulnerability Preparedness & Hazard Mitigation Plan Committee

The Town of Ludlow's Municipal Vulnerability Preparedness and Hazard Mitigation Plan Update Committee cordially invites you to join us at the first of a three-part **Community Resilience Building Workshop** series, from **9:30 AM – 12:30 PM** on **Wednesday, March 23rd**.^{*} This free, three-part Workshop series, which will take place in person at the **Ludlow Town Hall Board of Selectmen Conference Room, 3rd floor**, will help clarify and advance comprehensive community resilience planning and hazard mitigation efforts.

The Town of Ludlow is partnering with the Pioneer Valley Planning Commission to offer this timely three-part Workshop series, which will bring together community members like you to comprehensively identify and prioritize steps to reduce risk and improve resilience across the Town of Ludlow. The Workshops Objectives include:

- Understanding connections between natural hazards and local planning/mitigation efforts.
- Evaluating strengths and vulnerabilities of residents, infrastructure, and natural resources.
- Developing and prioritizing resilient actions for the municipality, local organizations, institutions, businesses, private citizens, neighborhoods, and community groups.
- Identifying immediate opportunities to advance actions that reduce the impact of hazards and increase resilience in the Town of Ludlow.

If you will not be able to attend but would still like to participate via a phone survey, or if you have any questions or concerns, please contact Emily Tully, Senior Planner at PVPC, at etully@pvpc.org, or Doug Stefancik, Ludlow Town Planner, at dstefancik@ludlow.ma.us or at (413)-583-5624 X1281.

For additional information, including a draft Town hazards map, MVP Committee members, and copies of previous presentations, please refer to the Town's MVP/HMP Committee website:

<http://www.ludlow.ma.us/html/mvp/index.htm>. For additional details on the Commonwealth of Massachusetts's MVP program, please go to: <https://resilientma.org/mvp/>.

You may also access the meeting by audio by calling 1-617-758-8793, attending via UberConference , or by attending in person



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Small Group Exercise – Report Out

- Designated reporter from each group will share assets and whether they are strengths and vulnerabilities to create a master list of all identified assets in Ludlow

25

Changing Risk of Top Natural Hazards

Hurricane / Tropical Storm	Changes in ocean circulation and temperatures are making hurricane season longer and harder to predict
Severe Winter Storm / Nor'easter	More winter precipitation is occurring as rainfall and freezing
Severe Thunderstorm / Wind / Tornado	Rainfall patterns are changing to fewer but more intense rainfall events
Flooding	Stream crossings and stormwater systems based on previous rainfall models may be undersized for future storm events

20

What Are Community Components?

- Infrastructure 
- Societal 
- Environmental 

23

Next Steps – Workshop #2

- Brainstorm mitigation actions and strategies
- Prioritize mitigation actions
- Mitigation actions can be turned into MVP Action Grant or FEMA HMA Grant applications!

26



21

Small Group Exercise

Break out into small groups to identify strengths and vulnerabilities in the Town of Ludlow

24

MVP Action Grant Project Types

- Vulnerability and Risk Assessment
- Community Outreach and Education
- Local Bylaws, Ordinances, Plans, and Other Management Measures Redesigns and Retrofits
- Nature-Based Flood Protection, Drought Mitigation, Water Quality, and Water Infiltration Techniques
- Nature-Based Infrastructure and Technology Solutions to Reduce Vulnerability to Extreme Heat and Poor Air Quality
- Nature-Based Solutions to Reduce Vulnerability to Other Climate Change Impacts
- Ecological Restoration and Habitat Management to Increase Resiliency
- Energy Resilience
- Chemical Safety
- Land Acquisition for Resilience
- Subsidized Low-Income Housing Resilience Strategies
- Mosquito Control Districts

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CRB Workshop #1 Sign-In Sheet

Town of Ludlow
Municipal Vulnerability Preparedness Workshop #1

March 23, 2022, 9:30 AM

Initial	Name	Affiliation	Email Address
	Bob Weaver	SWSC	bob.weaver@watershedcenter.org
	Penny Lebel	Conservation	conservation@ludlow.ma.us
	Doug Stefancik	Town Planner	dstefancik@ludlow.ma.us
	Amy Ollari	LCTV	amy@ludlowtv.org
	Jim Goodreau	DPW	jgoodreau@ludlow.ma.us
	Seth Falconer	Ludlow FIRE	firesafety@ludlow.ma.us
	Jack Oliveira	State Rep	jacko.oliveira@mahouse.gov
	Andrew Smith	EEA	andrew.b.smith@mass.gov
	MARC STANWICZ	TA/ BOS	MARC.STANWICZ@LUDLOW.MA.US
	JUSTIN LARVEE	^{Town of Ludlow} Bevily Commissioner	JLARVEE@LUDLOW.MA.US

Also in attendance:

- Emily Tully, PVPC
- Mimi Kaplan, PVPC
- Jacinta Williams, PVPC

CRB Workshop #2 Invitation Letter

Town of Ludlow

Municipal Vulnerability Preparedness & Hazard Mitigation Plan Committee



The Town of Ludlow's Municipal Vulnerability Preparedness and Hazard Mitigation Plan Update Committee cordially invites you to join us at the second of a three-part **Community Resilience Building Workshop** series, from **1:30 – 4:00 PM on Thursday, March 31st**. * This free, three-part Workshop series, which will take place in person at the **Ludlow Town Hall Board of Selectmen Conference Room, 3rd floor**, will help clarify and advance comprehensive community resilience planning and hazard mitigation efforts.

The Town of Ludlow is partnering with the Pioneer Valley Planning Commission to offer this timely three-part Workshop series, which will bring together community members like you to comprehensively identify and prioritize steps to reduce risk and improve resilience across the Town of Ludlow. The Workshops Objectives include:

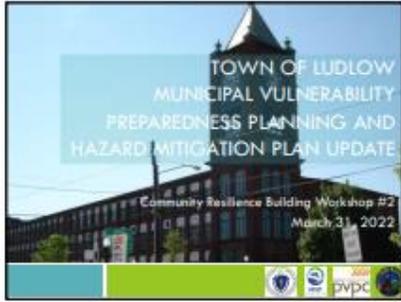
- Understanding connections between natural hazards and local planning/mitigation efforts.
- Evaluating strengths and vulnerabilities of residents, infrastructure, and natural resources.
- Developing and prioritizing resilient actions for the municipality, local organizations, institutions, businesses, private citizens, neighborhoods, and community groups.
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For additional information, including the presentation from the first Workshop, draft Town hazards map, MVP Committee members, and copies of previous Committee meeting presentations, please refer to the Town's MVP/HMP Committee website: <http://www.ludlow.ma.us/html/mvp/index.htm>. For additional details on the Commonwealth of Massachusetts's MVP program, please go to: <https://resilientma.org/mvp/>.

You may also access the meeting by audio by calling 1-617-758-8793, attending via UberConference, or by attending in person

CRB Workshop #2 Presentation



1

Today's Agenda

- Overview presentation on workshop goals, MVP program, natural hazards, Workshop #1 strengths & vulnerabilities
- Small group exercise to brainstorm mitigation actions
- Small group report-out, discussion of mitigation actions
- Workshop #3 schedule and agenda

4



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2

Why Are We Here?

- Help the Town of Ludlow improve preparedness for and resilience to natural hazard events
 - Understand community strengths and vulnerabilities
 - Plan for more frequent and intense weather events
 - Engage multiple stakeholders in the planning process
 - Identify short and long-term mitigation actions
 - Improve access to funding for mitigation and adaptation

SMART INVESTING MITIGATION SAVES

SPEND \$1 ON MITIGATION SAVES \$5 ON FUTURE DISASTER LOSSES

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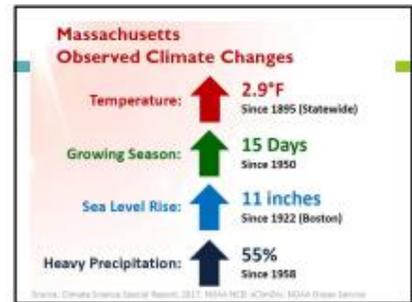
Thank You to Ludlow's MVP/HMP Core Team

- Ellie Villano
- Marc Strange
- Doug Stefancik
- Penny Label
- Andrea Crete
- Paulina Matunik
- Brian Shamelis
- Jim Goodreau
- Jacelyn Zepke
- Seth Falconer

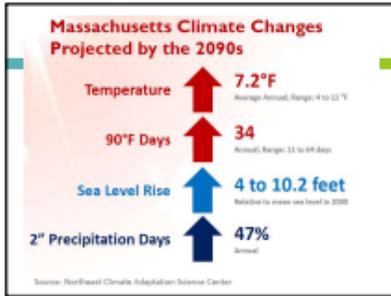
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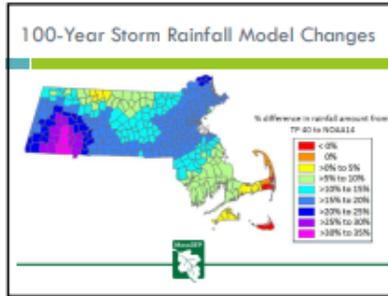
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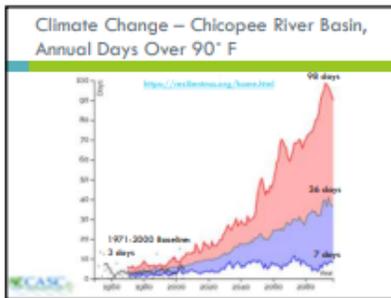
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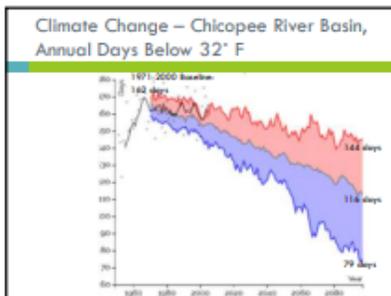
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Results from Workshop #1 – Infrastructural Assets

Feature	Location	Vulnerability or Strength
Dams – Town-owned	Harris Brook Dam, Colles Pond Dam	V – road dams in town high or significant hazard
Dams – privately-owned	Ludlow Reservoir Dam, Ludlow Manufacturing Association Dam	V / S – DWSG inspects and maintains regularly
Bridges and Culverts, underpasses	West St / Brook St, East St, Route 11 near Red Bridge, Center St under Mass Pike, Court Ave area around Electric Park, Broad Brook Canal Rd	V – underused SW system, aging and deteriorating culverts and bridges, underpass areas prone to flooding
Natural gas plant & pipelines	Plant SE corner near WBrabant Ave Pipeline along Mass Pike	V – Pipeline crosses through town, possible fire hazard 50% of town on natural gas
Gas stations, propane storage, jet fuel storage	Shell, Piko, Cornerland Farms, Mobil Dynamic storage near jet and golf course	V – Gas storage at some of the stations – tank, fire hazard; jet fuel storage close to dynamic storage and WBrabant water lines

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Results from Workshop #1 – Infrastructural Assets

Feature	Location	Vulnerability or Strength
Wastewater pump stations	3 pump stations – 1 in SE corner of Town, 1 downtown, 1 just over Chicago Ave	S / V
AWWSC	Mealy St – Stary Brook Energy Center	S / V
Drinking water	30% of town on private wells, rest of remainder on AWWSC, some Wilburton	S / V
Peak HE covered reservoir	Peak HE Rd, NWVA drinking water storage prior to distribution	S / V
Large scale solar facilities	Keller St area, proposed solar development near Mass Pike / East St	V – potential for erosion and runoff into waterbodies, may need additional zoning regs
Electric utility	Checked electrical distribution lines throughout town (renewable)	S / V – Resource has tree trimming program, good coordination with DPW
Transfer station	Route 21	

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Mitigation Actions – Nature-Based Solutions

Nature-Based Solutions are projects that:

- Address hazards like flooding, erosion, drought, and heat islands
- Restore, protect, or manage natural systems
- Mimic natural processes
- Are cost-effective, low maintenance, and have co-benefits for public health, safety, and quality of life

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Results from Workshop #1 – Societal Assets

Feature	Location	Vulnerability or Strength
United or non-English speaking populations	Primarily downtown Ludlow	S / V – likely to see population growth in the future
Ludlow Schools		S – outreach and communication, 10 languages
Senior and special needs housing / facilities	Senior Housing – Miller St, MB 10 Disabled, traumatic injury and high needs care – Northville Rd, Lynn St, Holyoke St Rehabilitation – Swanton Health	V – populations sensitive to high temperatures, low air quality transportation challenges
Churches and religious organizations	Downtown and surrounding areas	S – outreach and communication to immigrant and non-English speaking populations, emergency shelter
Neighboring communities	Chicopee, Granby, Belchertown, Wilburton, Springfield	Communication, mutual aid, and low formal cross-community relationships

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Mitigation Actions

Projects that are **NOT** MVP-competitive:

- Maintenance
- Diesel generators
- Tree removal
- Emergency preparedness
- Hard infrastructure without core MVP components/priorities

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Results from Workshop #1 – Environmental Assets

Feature	Location	Vulnerability or Strength
Ponds	Horland Pond, Palmer Pond, Wood Pond	S / V – located near Horland Pond are prone to flooding
Public open spaces and positive recreation areas	Trail along Ludlow Reservoir, Riverbank along Chicopee River, Western Recreation Area, Living Back Wildlife Management Area, small parks	Heavy use of areas, need more recreation areas, could enhance utilization of Chicopee River
Agriculture	Burdell's Farm, Community Garden behind Baitel Middle School	S – Right to Farm community; few of farmland over time
Ticks, invasive species, nuisance wildlife		V – population is increasing, public health risk
Shade trees		S / V – DPW maintains but does not replace
Wetlands	Throughout town	S / V – within CatCon, 25-R No Discharge Zone for wetlands

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MVP Action Grant Project Types

- Vulnerability and Risk Assessment
- Community Outreach and Education
- Local Bylaws, Ordinances, Plans, and Other Management Measures
- Redesign and Retrofits
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- Ecological Restoration and Habitat Management to Increase Resiliency
- Energy Resilience
- Chemical Safety
- Land Acquisition for Resilience
- Subsidized Low-Income Housing Resilience Strategies
- Mosquito Control Districts

24

Small Group Exercise

Break out into small groups to identify mitigation actions to enhance strengths and minimize vulnerabilities in the Town of Ludlow

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Small Group Exercise – Report Out

- Designated reporter from each group will share group's top recommendations for mitigation actions



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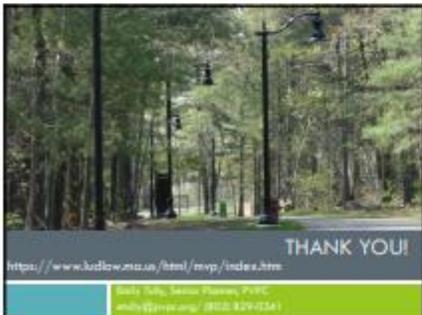
Next Steps – Workshop #3 Agenda

Review and finalize list of mitigation actions and strategies

Determine mitigation action priorities

Mitigation actions can be turned into MVP Action Grant or FEMA RMA Grant applications!

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CRB Workshop #2 Sign-In Sheet

Town of Ludlow
Municipal Vulnerability Preparedness Workshop #1 2
 March 23, 2022, 9:30 AM · March 30, 2022 1:30 PM

Initial	Name	Affiliation	Email Address
	Elaine Hodgman	resident	elaine elaine.hodgman@ad.com
	Paulina Matusik	Health Dept - Town of Ludlow	Paulina.matusik@ludlow.ma.us
	Aimee Henderson	Eversource Energy	aimie.henderson@eversource.com
	Seth Falconer	Ludlow Fire	firesafety@Ludlow.ma.us
	Penny Lebel	Conservation	Conservation@Ludlow.ma.us
	MARC SPANCIÉ	Town of Ludlow	MARC.SPANCIÉ@Ludlow.MA.US
	Doug Stefancik	Town of Ludlow	d.stefancik@ludlow.ma.us
	Bob Weaver	SWDC	bob.weaver@waterandsewer.org

Also in attendance:

- Emily Tully, PVPC
- Mimi Kaplan, PVPC
- Jacinta Williams, PVPC
- Jeff McDonald, Hampden County Sherriff's Department (by phone)
- Amy Ollari, Ludlow Community TV

Town of Ludlow

Municipal Vulnerability Preparedness & Hazard Mitigation Plan Committee



The Town of Ludlow's Municipal Vulnerability Preparedness and Hazard Mitigation Plan Update Committee cordially invites you to join us at the third and final workshop of a three-part **Community Resilience Building Workshop** series, from **2:00 – 4:00 PM on Thursday, April 7th**. * This free, three-part Workshop series, which will take place in person at the **Ludlow Town Hall Board of Selectmen Conference Room, 3rd floor**, will help clarify and advance comprehensive community resilience planning and hazard mitigation efforts.

The Town of Ludlow is partnering with the Pioneer Valley Planning Commission to offer this timely three-part Workshop series, which will bring together community members like you to comprehensively identify and prioritize steps to reduce risk and improve resilience across the Town of Ludlow. The Workshops Objectives include:

- Understanding connections between natural hazards and local planning/mitigation efforts.
- Evaluating strengths and vulnerabilities of residents, infrastructure, and natural resources.
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You may also access the meeting by audio by calling 1-617-758-8793, attending via UberConference, or by attending in person

CRB Workshop #3 Presentation



1

Today's Agenda

- Presentation: Overview of workshop goals, MVP program, climate change, and Ludlow natural hazards
- Group exercise: Review and finalize list of mitigation actions
- Group exercise: prioritize mitigation actions
- Wrap-up and next steps

4



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2

Why Are We Here?

- Help the Town of Ludlow improve preparedness for and resilience to natural hazard events
- Resilience = ability of a community to anticipate, cope with, and rebound stronger from events and trends related to climate change hazards

Resilient communities don't just recover—they continuously build capacity to reduce the impacts of future climate events.

5

Climate Change - Statewide

Massachusetts Climate	Observed Changes	Projected Changes by 2090
Temperature	↑ 2.9° F since 1895	↑ 7.2° F annual average
Growing Season	↑ 15 days since 1950	↑ 34 days annually
90° Days		↑ 4 to 10.2 ft above MSL
Sea Level Rise	↑ 11 in since 1922	↑ 47% annually
Heavy Precipitation	↑ 35% since 1958	

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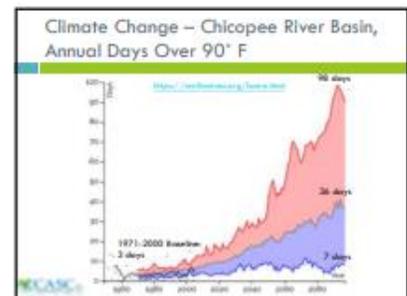
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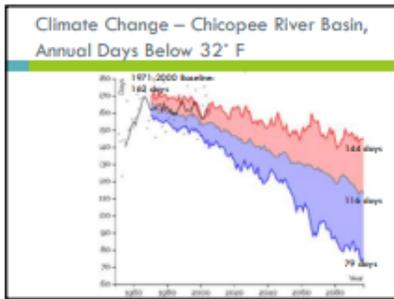
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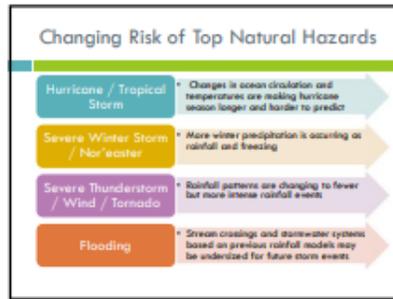
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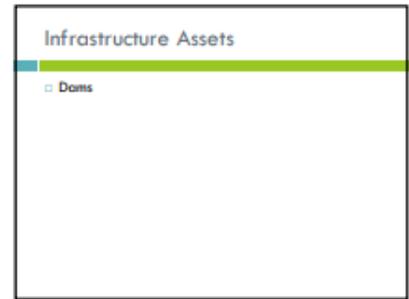
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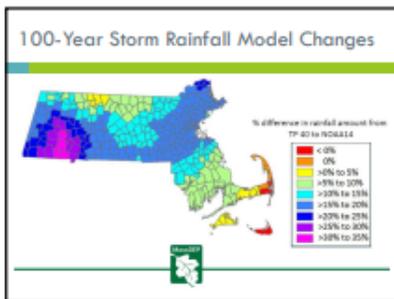
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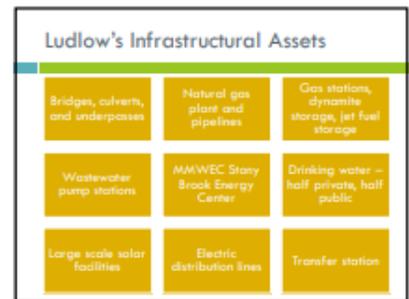
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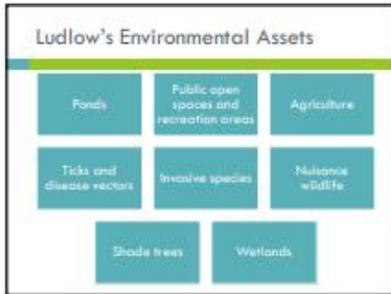
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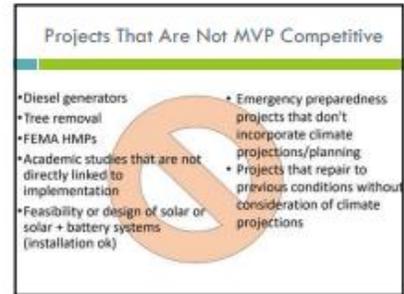
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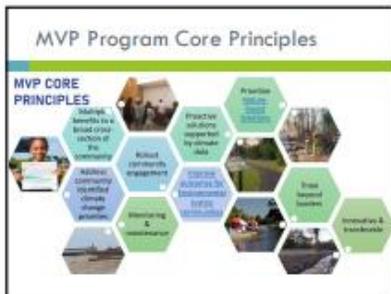


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Group Exercise: Finalize and Prioritize Mitigation Actions

- Review and finalize list of mitigation actions
- Determine priority and timeframe

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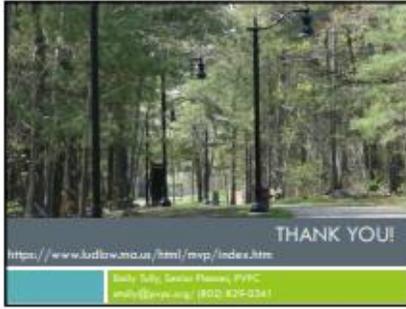
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CRB Workshop #3 Sign-In Sheet

Town of Ludlow
Municipal Vulnerability Preparedness Workshop #3
 April 7, 2022, 2:00 PM

Initial	Name	Affiliation	Email Address
	Flaine Hodgman	resident	ebinehodgman@aol.com
	Doug Stefancik	Town of Ludlow	dstefancik@ludlow.ma.us
	Henry Lebel	Conservation	conservation@ludlow.ma.us
	Seth Falconer	FIRE	firesafety@ludlow.ma.us
	JEFF McDONALD	HCSO	JEFFREY.McDONALD.HCSO@MAIL.RSJ

Also in attendance:

- Emily Tully, PVPC
- Jacinta Williams, PVPC
- Marc Strange, Ludlow Town Administrator
- Amy Ollari, Ludlow Community TV

CRB Workshop Matrix (also provided as an Excel file)

Community Resilience Building Risk Matrix www.CommunityResilienceBuilding.org							
Ludlow's Priority Assets					Mitigation Actions		
Features	Location	Ownership	V +/- S	Reason for V or S	Hurricane / Tropical Storm Severe Winter Storm / Nor'easter Severe Thunderstorm / Wind / Tornado Flooding	Priority High Medium Low	Time Short Long Ongoing
Infrastructural							
Dams - town owned	Harris Brook Dam, Collins Pond Dam, Alden Pond Dam	Town of Ludlow	V	Many dams in town, most are high or significant hazard, need to be maintained and inspected every 5 years. Collins Pond Dam is old, not in best condition.	Inventory and assess condition of all town-owned dams and options for repair/removal. Conduct feasibility study for possible options. Clarify ownership of all dams with Office of Dam Safety as well as status of inspections and EAPs.	Medium	L
Dams - State or Privately owned	Ludlow Reservoir Dam and Cherry Valley Dam (SWSC), Ludlow Manufacturing Association Dam	SWSC, Private	V/S	Ludlow reservoir used for fire suppression, not potable. SWSC performs regular inspections and maintenance, has EAPs at Fire Department.	After SWSC combines both EAPs into one, conduct tabletop exercises with town.	Medium	S
Bridges and culverts, underpasses	Old West Street/Brook Street (Weston Brook), East Street, Poole St near Red Bridge, Center St. under MassPike. Circuit Ave. Area around Electric Park. Broad Brook Canal Rd. Chapin Street floods by High School.	Town	V	Undersized stormwater systems. Some bridges and culverts are aging and in poor condition, need to be replaced. Underpass areas prone to flooding, manhole covers get blocked esp. by leaves in fall and other debris	Conduct an assessment of condition of all road/stream crossings. Schedule and plan for stormwater drain cleaning. Coordinate with Springfield on repair or replacement of Potts Bridge.	High	L/O
Transfer station	Route 21	Town/Waste Mgmt			Provide reduced cost home composters to residents	Medium	S
Road Flooding (not due to culvert issue)	Chapin Street (by High School)		V	Flooding during heavy rain in front of High School due to poor drainage	Design, permit and construct improved drainage, including possible GI.	High	L
Natural Gas Plant and Pipelines	Plant is near Wilbraham line, SE corner of town. Half of town on natural gas. Pipeline runs along MassPike and up to MMWEC	Eversource	V	Crosses through town, possible fire hazard. Some home are only 10 ft from pipeline in area near Haviland Pond	Eversource owns LNG plant and conducts annual site visits with ED, Ludlow and Wilbraham - continue these. Setting up a working group to put together emergency response plan. This will be an appendix to the operations plan.	Medium	S
Gas Stations and jet fuel storage	Gas stations along MassPike. Jet fuel storage near jail and Nash Hill Reservoir	Shell, Pride, Cumberland Farms, Mobil	V	Gasoline storage at some of the stations - Toxic material and fire hazard. Jet fuel storage close to dynamite storage-big fire risk. Also close to MWRA water lines - contamination risk			
Wastewater Pump Stations	3 pump stations - 1 in SE corner of town, 1 downtown, 1 just over Chicopee line	SWSC	S/V				
Mass Municipal Wholesale Electric Co.	Moody St, Stony Brook Energy Center	MMWEC	S/V				
Drinking Water	50% Town on private wells, most of remainder served by SWSC, small amount on Wilbraham Water (MWRA)	Private, SWSC, MWRA	S/V	MWRA Drinking water lines extend through town but service other communities. SWSC interconnection with MWRA on West Street. Private wells vulnerable during power outages.	Communicate with MWRA about condition of pipeline extending through town.	Low	S
Nash Hill Reservoir - covered	Nash Hill Rd	MWRA	S/V	Two covered reservoirs that store water from the Quabbin before distribution to western MA MWRA communities			
Solar Developments	Fuller Street area, proposed solar devpt near MassPike near East St	Private	V	Potential for erosion and runoff into waterbodies. Possible need for additional regulations, stricter zoning regs	Conduct regulatory review and possibly update to address stormwater, erosion, loss of open space, other concerns.	Low	S
Electric Utility	Overhead electrical distribution lines throughout Town	Eversource	S/V	Conducts tree trimming, coordinates with DPW	Continue to coordinate with Eversource on critical facility identification and outage plan prioritization.	High	O

Community Resilience Building Risk Matrix www.CommunityResilienceBuilding.org							
Ludlow's Priority Assets					Mitigation Actions		
Features	Location	Ownership	V +/- S	Reason for V or S	Hurricane / Tropical Storm	Priority	Time
					Severe Winter Storm / Nor'easter	High	Short
					Severe Thunderstorm / Wind / Tornado	Medium	Long
					Flooding	Low	Ongoing
Societal							
Limited or non-English speaking populations (Portuguese, Spanish, Turkish, Polish)	Primarily downtown Ludlow		S/V	This area will probably see more population growth in the near future - affordable housing and job opportunities	Identify and partner with community liaisons, organizations for outreach Utilize social media for messaging Provide education material on natural hazard risks and mitigation strategies in multiple languages, possibly coordinate with school and library.	High	S/O
Low income populations	Mostly Precinct 2 and 4, Joy Street.		V	Populations vulnerable to high temperatures, low air quality, transportation challenges	Provide outreach materials on natural hazard risks and mitigation strategies. Put a PSA in the Register. Possibly coordinate with library for print materials and events, and schools for curriculum and communication with families. Distribute a survey to all residents to assess how they access information and how they want to be contacted in natural hazard and emergency events.	High	S/O
Low and moderate income housing	Housing Authority- Wilsa Street and State Street Mobile home parks - West Street and Miller St. Stevens Memorial (Wayfinders)		V				
Senior and Special Needs Housing/Facilities	Senior Housing- Miller St., Mill 10 Disabled, Traumatic injury and high needs care - Nashville Rd. Lyons, Holyoke Streets Rehab - Encompass Health		V	Populations vulnerable to high temperatures, low air quality, transportation challenges	Continue to have public health nurse update list of vulnerable residents, and coordinate with Police/Fire/Senior Center. Eversource has critical customer list to prioritize during power outages - continue communication and coordination with FD. Implement a vulnerable population task force, neighbor to neighbor check-ins	Medium	O
Churches, other religious organizations, and social organizations (Boys and Girls Club, Portuguese Club)	Downtown and surrounding areas		S	Provide outreach and communication to immigrant and non-English speaking populations Our Lady of Fatima is an emergency shelter			
Hubbard Memorial Library	Center St	Town	S	Provide outreach and communication services			
Ludlow Public Schools	Ludlow High School, Baird Middle School, Harris Brook Elementary School,	Town	S	Schools can be used for outreach and communication, especially in different languages, have translation in 18 languages; serve as shelters			
Neighboring communities	Chicopee, Granby, Belchertown, Wilbraham, Springfield			Communication, mutual aid, less formal cross-Town relationships, especially between Chicopee and Ludlow			

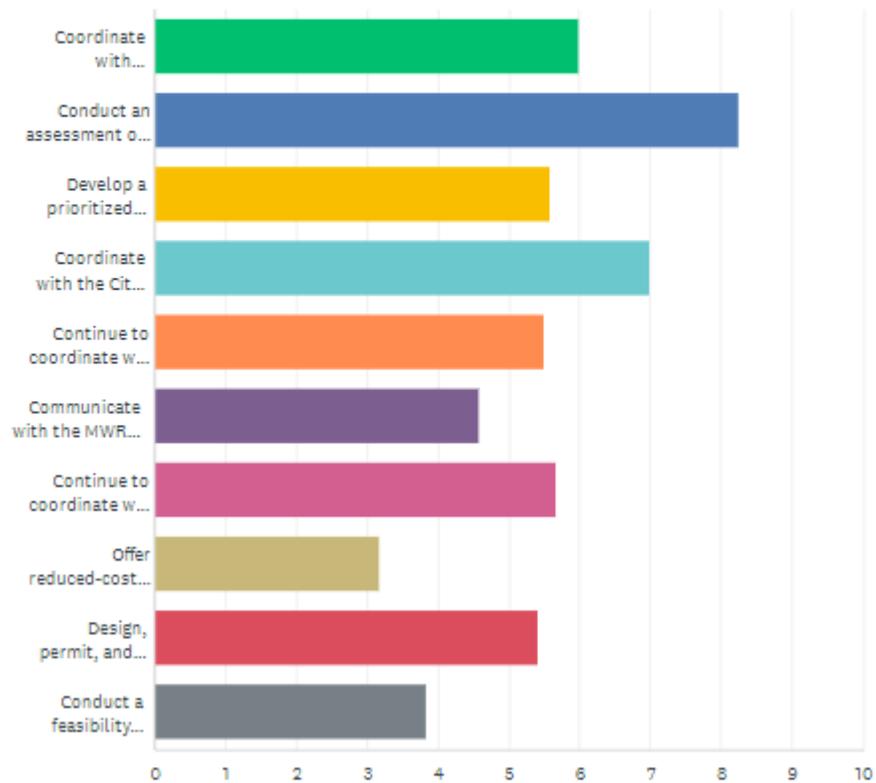
Community Resilience Building Risk Matrix www.CommunityResilienceBuilding.org								
Ludlow's Priority Assets					Mitigation Actions		Priority	Time
Features	Location	Ownership	V +/- S	Reason for V or S	Hurricane / Tropical Storm Severe Winter Storm / Nor'easter Severe Thunderstorm / Wind / Tornado Flooding	High Medium Low	Short Long Ongoing	
Environmental								
Ponds	Haviland Pond (spring fed), Pickerel Pond, Wood Pond	Town	S/V	Houses near Haviland Ponds are prone to flooding from underground seepage. Pond is open for fishing and swimming if there are lifeguards - closed last summer due to no lifeguards. Vulnerability of ponds near I90 to runoff and pollution.	Conduct assessment of ponds for water quality (algal blooms, nutrient levels, invasive species) and implement recommendations. Public education and outreach regarding impacts on water quality from fertilizers, pet waste, etc.)	High	S	
Public open spaces and passive recreation areas	Trail along Ludlow Res., Riverwalk along Chicopee River, Westover Rec Area, Facing Rock WMA	SWSC, Town, MassWildlife	S/V	Heavy use of areas, especially in recent years b/c of Covid. Need for additional trails, rec. areas. Enhance utilization of Chicopee river - could be used for crew, extend riverwalk	Update the town's Open Space and Recreation Plan, with an emphasis on climate resilience. Develop plans for better utilization of Town open space.	Medium	S	
Wetlands	Throughout Town		S/V	Active Concom; 25 ft no disturb zone for wetlands				
Agriculture	Randall's Farm, Community Garden behind Baird MS		S	Agricultural commission; Right to Farm community. Loss of farmland over time	Identify additional locations for community gardens, and revitalize the existing community garden. Look into setting up a town nursery and planting program for green spaces and potential new GI.	Low	L	
Shade trees			S/V	DPW maintains trees but does not replant	Conduct a shade tree inventory and develop a tree planting plan.	Medium	L	
Ticks, invasive species			V	Populations are increasing. Ticks pose a public health risk. Encourage predator populations - chickens, opossums	Develop educational material on invasive species and hold workshops on identification and eradication/control strategies. Provide education and outreach on ticks - diseases, avoiding exposure, treatment etc.	Medium	S	
Bears and other wildlife			S/V	Bears coming into people's yards	Education and outreach on bear behavior and reducing bear attractants	Medium	S	
Urban Green Spaces and Green Infrastructure			S	Reduce stormwater and flooding issues, reduce heat island effect, provide aesthetic and health co-benefits	Identify locations to implement green infrastructure. Some possible areas - Center St., across from Taco Bell, at High School. Design, permit and construct the GI projects (bioswales, raingardens, etc.)	High	L	

Survey Results

Ludlow MVP/HMP Top Priority Actions

Q1 Please rank the priority level of the following Infrastructure strategies:

Answered: 24 Skipped: 0



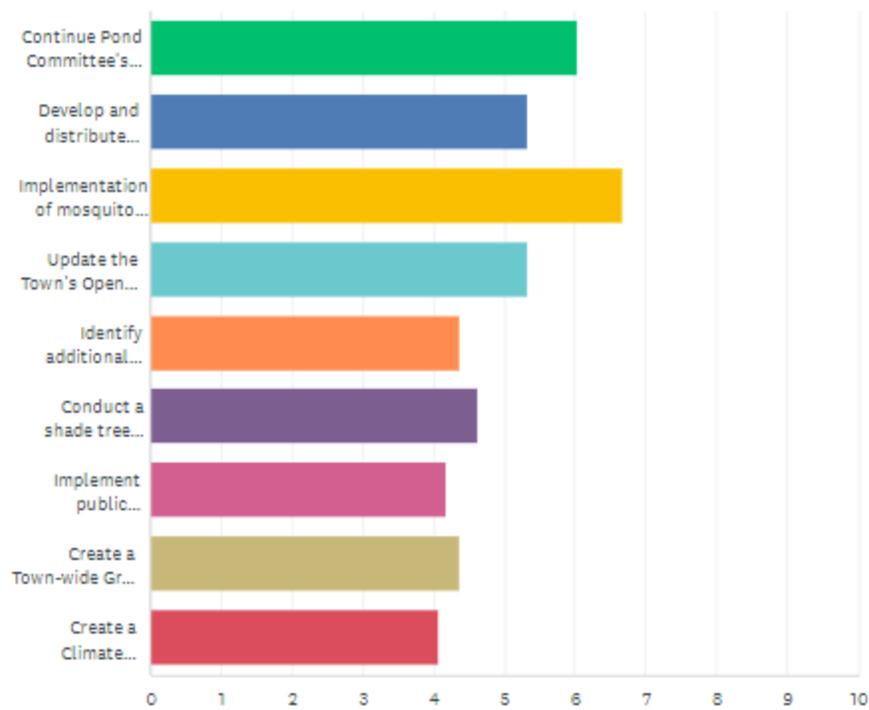
Ludlow MVP/HMP Top Priority Actions

	1	2	3	4	5	6	7	8	9	10	TOTAL
Coordinate with Springfield Water and Sewer Commission to conduct tabletop exercises (discussion-based sessions where staff and emergency responders discuss their roles during an emergency and their responses to a particular emergency situation) after the completion of the combined Emergency Action Plan for the Cherry Valley and Ludlow Reservoir Dams.	8.33% 2	16.67% 4	4.17% 1	16.67% 4	20.83% 5	0.00% 0	4.17% 1	16.67% 4	12.50% 3	0.00% 0	2
Conduct an assessment of the condition of all road/stream crossings, develop report prioritizing locations for repair or replacement, and implement the recommendations of the report.	41.67% 10	20.83% 5	8.33% 2	0.00% 0	16.67% 4	4.17% 1	8.33% 2	0.00% 0	0.00% 0	0.00% 0	2
Develop a prioritized plan and schedule for street sweeping based on known locations of street flooding associated with storm drains.	0.00% 0	12.50% 3	16.67% 4	12.50% 3	12.50% 3	8.33% 2	8.33% 2	20.83% 5	4.17% 1	4.17% 1	2
Coordinate with the City of Springfield on repairs to Putts Bridge.	16.67% 4	12.50% 3	25.00% 6	8.33% 2	8.33% 2	16.67% 4	4.17% 1	0.00% 0	4.17% 1	4.17% 1	2
Continue to coordinate with Eversource on the Town's role in the Emergency Response Plan for the Liquefied Natural Gas Plant.	0.00% 0	8.33% 2	16.67% 4	12.50% 3	12.50% 3	25.00% 6	8.33% 2	0.00% 0	4.17% 1	12.50% 3	2

Communicate with the MWRA on the condition to the water line in Town.	0.00% 0	0.00% 0	4.17% 1	8.33% 2	8.33% 2	33.33% 8	25.00% 6	12.50% 3	4.17% 1	4.17% 1	2
Continue to coordinate with Eversource on critical facility identification and prioritization plan for restoration of electrical service following an outage event.	12.50% 3	4.17% 1	16.67% 4	8.33% 2	8.33% 2	4.17% 1	16.67% 4	16.67% 4	12.50% 3	0.00% 0	2
Offer reduced-cost home composters and rain barrels.	4.17% 1	8.33% 2	0.00% 0	8.33% 2	0.00% 0	0.00% 0	12.50% 3	4.17% 1	16.67% 4	45.83% 11	2
Design, permit, and install drainage improvements at known problem locations (Chapin Street and Electric Park).	12.50% 3	12.50% 3	4.17% 1	16.67% 4	4.17% 1	4.17% 1	8.33% 2	12.50% 3	12.50% 3	12.50% 3	2
Conduct a feasibility study to identify a new Emergency Operations Center that will be accessible during various types of hazard events.	4.17% 1	4.17% 1	4.17% 1	8.33% 2	8.33% 2	4.17% 1	4.17% 1	16.67% 4	29.17% 7	16.67% 4	2

Q2 Please rank the priority levels of the following Environment strategies?

Answered: 24 Skipped: 0

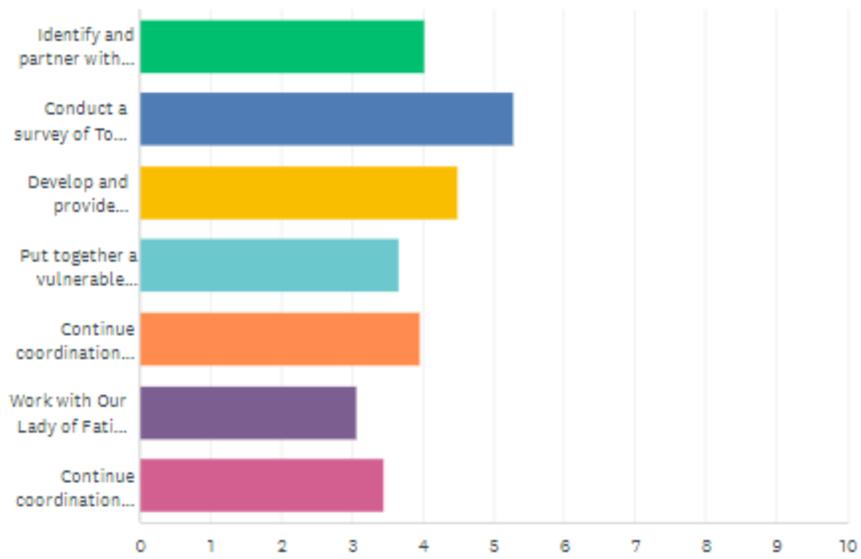


	1	2	3	4	5	6	7	8	9	TOTAL	SCORE
Continue Pond Committee's work on pond water quality assessment and implement assessment report recommendations.	33.33% 8	12.50% 3	8.33% 2	4.17% 1	8.33% 2	8.33% 2	8.33% 2	4.17% 1	12.50% 3	24	6
Develop and distribute public education materials for landowners on impacts to water quality from common homeowner practices, and strategies to prevent pollution (e.g., grass cutting management, fertilizer use, pet waste).	4.17% 1	20.83% 5	12.50% 3	8.33% 2	25.00% 6	4.17% 1	8.33% 2	8.33% 2	8.33% 2	24	5
Implementation of mosquito control strategies, including evaluation of joining the Pioneer Valley Mosquito Control District. Develop public education materials on mosquito habitats and control methods.	25.00% 6	29.17% 7	4.17% 1	8.33% 2	12.50% 3	12.50% 3	4.17% 1	0.00% 0	4.17% 1	24	6
Update the Town's Open Space and Recreation Plan, with an emphasis on climate resilience.	8.33% 2	8.33% 2	20.83% 5	20.83% 5	4.17% 1	8.33% 2	12.50% 3	12.50% 3	4.17% 1	24	5
Identify additional locations for community gardens and revitalize the existing community garden.	0.00% 0	8.33% 2	8.33% 2	12.50% 3	20.83% 5	20.83% 5	8.33% 2	4.17% 1	16.67% 4	24	4
Conduct a shade tree inventory and develop a planting plan, including a Town tree and plant nursery to support future plantings	8.33% 2	0.00% 0	16.67% 4	16.67% 4	8.33% 2	12.50% 3	12.50% 3	16.67% 4	8.33% 2	24	4

Implement public education programs on invasive, nuisance, and disease vector species, including workshops on invasive species identification and removal, tick risks and preventative measures, and how to avoid attracting nuisance species such as bears.	4.17% 1	4.17% 1	8.33% 2	12.50% 3	12.50% 3	8.33% 2	29.17% 7	8.33% 2	12.50% 3	24	4
Create a Town-wide Green Infrastructure plan - identify locations and types of green infrastructure suitable for installation, such as permeable pavement in Town parking lots, develop designs, and install with educational signage.	12.50% 3	0.00% 0	12.50% 3	8.33% 2	8.33% 2	12.50% 3	8.33% 2	33.33% 8	4.17% 1	24	4
Create a Climate Resilient Master Plan to ensure that all Town plans and codes, such as the Subdivision Rules and Regulations, are planning for future conditions in the Town in a consistent manner.	4.17% 1	16.67% 4	8.33% 2	8.33% 2	0.00% 0	12.50% 3	8.33% 2	12.50% 3	29.17% 7	24	4

Q3 Please rank the priority levels of the following Societal strategies.

Answered: 24 Skipped: 0



	1	2	3	4	5	6	7	TOTAL	SCORE
Identify and partner with community organizations and/or liaisons for outreach to climate vulnerable populations (e.g. low income populations, non-English speaking populations, elderly populations, and populations more likely to be at risk during and after a natural hazard)	16.67% 4	12.50% 3	16.67% 4	12.50% 3	12.50% 3	12.50% 3	16.67% 4	24	4.04
Conduct a survey of Town residents regarding the preferred method(s) for receiving communications from the Town regarding natural hazard events, both for emergency communications and pre-event preparedness outreach.	45.83% 11	16.67% 4	8.33% 2	4.17% 1	4.17% 1	16.67% 4	4.17% 1	24	5.29
Develop and provide outreach and educational materials on natural hazard risks in Ludlow and strategies to prevent or mitigate impacts in multiple languages, both print materials and workshop-type events. Partner with the schools, library, and Senior Center for distribution of print materials and for holding events.	8.33% 2	29.17% 7	29.17% 7	4.17% 1	8.33% 2	8.33% 2	12.50% 3	24	4.50
Put together a vulnerable population task force and implement a neighbor-to-neighbor check-in program.	8.33% 2	4.17% 1	12.50% 3	37.50% 9	12.50% 3	8.33% 2	16.67% 4	24	3.67
Continue coordination between the Public Health Nurse, Health Department Emergency Coordinator, Police Department, Fire Department, and Senior Center regarding vulnerable population outreach during natural hazard events.	8.33% 2	16.67% 4	16.67% 4	8.33% 2	25.00% 6	20.83% 5	4.17% 1	24	3.96
Work with Our Lady of Fatima, Christ the King, and St. Elizabeth churches on possible use as emergency shelters and role in natural hazard events.	0.00% 0	12.50% 3	12.50% 3	12.50% 3	20.83% 5	16.67% 4	25.00% 6	24	3.08
Continue coordination between Eversource and the Fire Department on critical customers list (customers prioritized for power restoration due to medical equipment needs). Post information on Town website on how to be added to the critical customers list.	12.50% 3	8.33% 2	4.17% 1	20.83% 5	16.67% 4	16.67% 4	20.83% 5	24	3.46

Public Meeting #2 – Meeting and Publicity/Outreach Materials



TUESDAY, JUNE 21, 6:30 PM
BOARD OF SELECTMEN
MEETING

LUDLOW
MUNICIPAL
VULNERABILITY
PREPAREDNESS (MVP)
AND HAZARD
MITIGATION PLAN
(HMP) UPDATE

*THE PUBLIC MEETING AND LISTENING SESSION
WILL INCLUDE A PRESENTATION ON THE
OUTCOMES OF THE RECENT MUNICIPAL
VULNERABILITY PREPAREDNESS WORKSHOPS*

**Remote attendance options available, please see the Town website for details*

Would you like to
learn about **CLIMATE**
CHANGE
VULNERABILITY and
share your
thoughts about
Ludlow can
become more
RESILIENT?

Ludlow has a grant to
prepare for natural
hazard and climate
change impacts,
build community
resilience, and
receive designation
as a Municipal
Vulnerability
Preparedness (MVP)
municipality.

Join us for a **PUBLIC**
LISTENING SESSION to
learn more and share
your thoughts.

We look forward to
seeing you!

LUDLOW TOWN HALL
Board of Selectmen
Conference Room
3rd Floor*
TUESDAY JUNE 21,
6:30 pm



Catalyst for Regional Progress

PVPC

Kimberly H. Robinson, MUP
Executive Director

MEDIA RELEASE / NOTICE

CONTACT: Emily Tully, Senior Planner at PVPC at etully@pvpc.org or (413) 285-1181
Doug Stefancik, Ludlow Town Planner, at dstefancik@ludlow.ma.us or (413)-583-5624

FOR IMMEDIATE RELEASE
6/9/2022

Town of Ludlow to Hold Public Listening Session for Municipal Vulnerability Preparedness/Hazard Mitigation Plan Update

Ludlow residents, businesses, and surrounding community residents and representatives are invited to learn about the Town of Ludlow Municipal Vulnerability Preparedness (MVP) and Hazard Mitigation Plan (HMP) and provide comments at a Public Listening Session on Tuesday, June 21, 2022 at 6:30 pm. The public meeting will be held as part of a regular Board of Selectmen meeting and will take place in-person at the Ludlow Town Hall Board of Selectmen Conference Room, 3rd floor. The meeting can also be viewed via the live Ludlow Community Television broadcast, attended by audio by calling in via 1-(617) 758-8793, or remotely via UberConference. Please see the Town's website for remote attendance instructions.

The meeting will include an overview of the Hazard Mitigation and MVP planning process, a summary of climate change impacts and natural hazards in Ludlow, a discussion of community strengths and vulnerabilities in Ludlow, and mitigation strategies proposed by the Core Team. Municipal officials and PVPC staff will be available to answer questions and hear input about the plan and proposed strategies. The meeting will provide an opportunity for the public to provide input and participate in the mitigation planning process. All members of the public, representatives from surrounding communities and other interested parties are welcome to attend the event.

This combined HMP/MVP plan is being completed by the Town with assistance from the PVPC, and is funded by the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA). Upon completion, the plan will be submitted to EOEEA and to the Massachusetts Emergency Management Agency (MEMA) and Federal Emergency Management Agency (FEMA) for review and approval. A FEMA-approved HMP makes the community eligible for federal and state mitigation grant funding. Upon completing the MVP Planning Grant, Ludlow will become designated as an MVP Community and will be eligible to apply for MVP Action Grants.

For additional information, including copies of previous presentations and workshop materials, please refer to the Town's MVP/HMP Committee website: <http://www.ludlow.ma.us/html/mvp/index.htm>.

NEWS

Ludlow public forum to be held on municipal vulnerability preparedness, hazard mitigation plan

by: [Kayleigh Thomas](#)

Posted: Jun 21, 2022 / 05:46 AM EDT

Updated: Jun 21, 2022 / 05:46 AM EDT

SHARE    

LUDLOW, Mass. (WWLP) – The Town will host a public listening session to get final input on its municipal vulnerability preparedness and hazard mitigation plan. The public meeting is scheduled to begin at 6:30 Tuesday at Ludlow Town Hall.

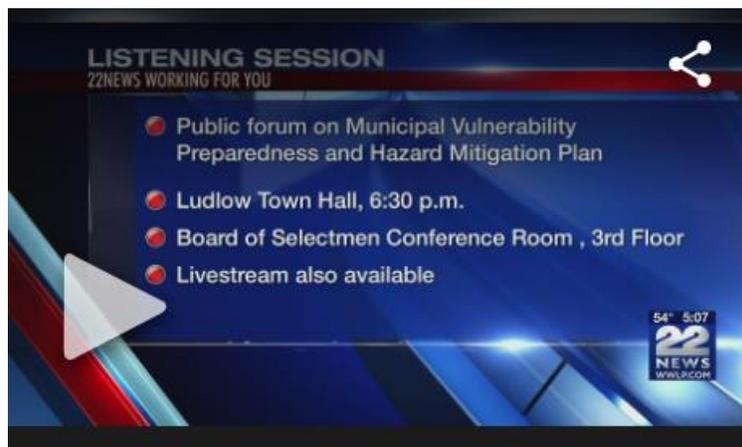
There will also be a livestream available on the town website and it will be broadcast on Ludlow Community Television.

| [Title IX celebration held at UConn for young girls](#) >

The meeting will include an overview of the plan and process, a summary of climate change impacts and natural hazards in town and discussion of community strength and mitigation strategies.

Once complete, the plan will be sent to MEMA and FEMA for approval. If approved, the plan can be funded through both state and federal grants.

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<https://www.wwlp.com/news/ludlow-public-forum-to-be-held-on-municipal-vulnerability-preparedness-hazard-mitigation-plan/>

Details

This is the official Facebook page for the Town of Ludlow, Massachusetts.

i Page Government Organization

📍 488 Chapin Street, Ludlow, MA, United States, Massachusetts

📞 (413) 583-5600

🌐 ludlow.ma.us

🕒 open now ▾

★ Rating 3.5 (18 reviews) **i**

Photos

[See all photos](#)



Town of Ludlow

June 10th 🌐



**TUESDAY, JUNE 21, 6:30 PM
BOARD OF SELECTMEN
MEETING**

**LUDLOW
MUNICIPAL
VULNERABILITY
PREPAREDNESS (MVP)
AND HAZARD
MITIGATION PLAN
(HMP) UPDATE**

*THE PUBLIC MEETING AND LISTENING SESSION
WILL INCLUDE A PRESENTATION ON THE
OUTCOMES OF THE RECENT MUNICIPAL
VULNERABILITY PREPAREDNESS WORKSHOPS*

**Remote attendance options available. please see the Town website for details.*

*Would you like to
learn about CLIMATE
CHANGE
VULNERABILITY and
share your
thoughts about
Ludlow can
become more
RESILIENT?*

*Ludlow has a grant to
prepare for natural
hazard and climate
change impacts,
build community
resilience, and
receive designation
as a Municipal
Vulnerability
Preparedness (MVP)
municipality.*

*Join us for a PUBLIC
LISTENING SESSION to
learn more and share
your thoughts.*

*We look forward to
seeing you!*

LUDLOW TOWN HALL
Board of Selectmen
Conference Room
3rd Floor*
**TUESDAY JUNE 21,
6:30 pm**

👍 3

👍 I like it

💬 Comment

➦ Share

Public Listening Session Agenda

Town of Ludlow

*Municipal Vulnerability Preparedness & Hazard
Mitigation Plan Committee*



AGENDA

***Town of Ludlow: Municipal Vulnerability Preparedness Program and Hazard
Mitigation Plan Update – Public Listening Session***

June 21, 2022

Time: 6:30 p.m.

Ludlow Town Hall – Selectmen’s Conference Room *

Appointments:

6:30 P.M.

1. Overview of Ludlow’s MVP Planning and HMP Update Process
2. Climate Change and Natural Hazards – Trends, Impacts, and Risks
3. Community-Identified Vulnerabilities and Strengths in Ludlow
4. Top Strategies for Improving Resilience in Ludlow
5. Next Steps and Q&A

****You may also access the meeting by audio by calling 1-617-758-8793, attending via
UberConference, or by attending in person****

Public Listening Session Presentation Slides

**LUDLOW
MUNICIPAL VULNERABILITY
PREPAREDNESS (MVP) AND
HAZARD MITIGATION PLAN (HMP)
UPDATE**

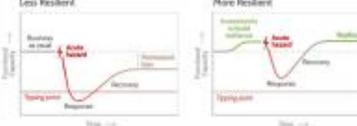
PUBLIC LISTENING SESSION
JUNE 21, 2022



1

**WHY DID THE TOWN GO THROUGH THE
MVP PLANNING GRANT PROCESS?**

* Help the Town of Ludlow improve preparedness for and increase resilience to natural hazard events

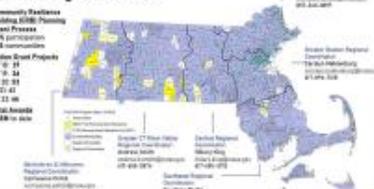


Resilient communities don't just recover—they continuously build capacity to reduce the impacts of future climate events

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WHAT IS THE MVP PROGRAM?

MVP Program Status



Community Resilience Grant (CRG) Planning Grant Process: 8% participation, 28 communities
Action Grant Projects: 17 of 24, 17 of 23, 17 of 22, 17 of 21, 17 of 20, 17 of 19, 17 of 18, 17 of 17, 17 of 16, 17 of 15, 17 of 14, 17 of 13, 17 of 12, 17 of 11, 17 of 10, 17 of 9, 17 of 8, 17 of 7, 17 of 6, 17 of 5, 17 of 4, 17 of 3, 17 of 2, 17 of 1

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AGENDA

- Overview of Ludlow's MVP/HMP Planning Process
- Climate Change and Natural Hazards Overview
- Community-Identified Vulnerabilities and Strengths
- Priority Strategies to Improve/Increase Resilience
- Next Steps and Comment/Question Period

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**WHY DID THE TOWN GO THROUGH THE
HMP UPDATE PROCESS?**

* Hazard mitigation = Any sustained action taken to reduce or eliminate long-term risk to people and property from natural hazards



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WHAT IS THE MVP PROCESS?



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THANK YOU TO THE CORE TEAM

- Marc Strange, Town Administrator
- Doug Stefancik, Town Planner
- Penny Sabel, Conservation Commission
- Fayline Malachuk, Health Agent
- Debra Shortell, Police Department
- Sarah Falconer, Fire Department
- Jim Goodreau, Department of Public Works



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**WHY DID THE TOWN COMBINE THE MVP
AND HMP PROCESSES?**

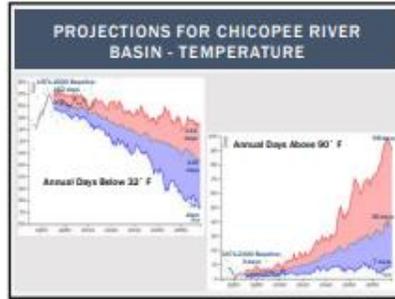


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**WHAT IS THE TIMELINE OF THE MVP
PLAN / HMP UPDATE PROCESS?**

CLIMATE CHANGE IMPACTS OVERVIEW

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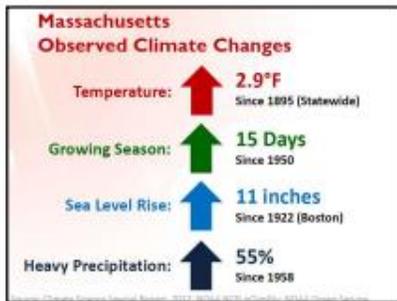


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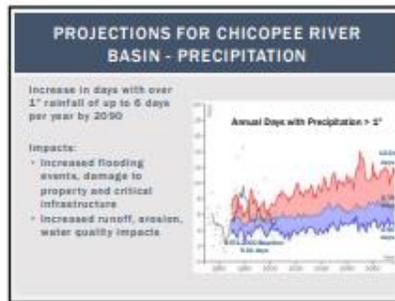
NATURAL HAZARD ASSESSMENT FOR LUDLOW

Type of Hazard	Intensity of Disturbance	Probability of Future Events	Impact	Vulnerability
Extreme Weather Storms (Hurricanes)	Large	High	Critical	1
Extreme Weather Storms (Winter Weather)	Large	Very High	Critical	1
Tornado/Blizzard	Large	Low	Catastrophic	1
Flood	Medium	Low	Limited	2
Wildfire/Flashfire/Urban Fire	Medium	Low	Limited	2
Extreme Temperature	Large	Very High	Limited	3
Strong	Large	Medium	Limited	3
Deep Snow	Medium	Very Low	Limited	4
Strong Storms/High Winds	Large	Very High	Limited	4
Earthquake	Large	Low	Critical	5

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VULNERABILITIES, STRENGTHS AND STRATEGIES FOR RESILIENCE IN LUDLOW

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LUDLOW'S INFRASTRUCTURAL ASSETS - STRENGTHS AND VULNERABILITIES

Bridges, culverts, and underpasses	Natural gas pipe and pipelines	Gas stations, dynamos, storage, jet fuel storage
Wastewater pump stations	MMWEC Steam Break Energy Center	Drinking water - half private, half public
Large scale solar facilities	Electric distribution lines	Transfer station

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LUDLOW'S SOCIETAL ASSETS - STRENGTHS AND VULNERABILITIES

Limited or non-English speaking populations	Ludlow Schools	Senior and special needs housing facilities
Churches and religious organizations	Neighboring communities	Mobile home parks
Low-income populations	Social organizations	

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TOP STRATEGIES TO IMPROVE ENVIRONMENTAL RESILIENCE



- Pond water quality assessment**
 - Continue Pond Connector's work, implement assessment report recommendations
- Mosquito control strategies**
 - Evaluate using Pioneer Valley Mosquito Control District
 - Develop public education materials as mosquito habitats and control methods
- Town-wide Green Infrastructure Plan**
 - Identify locations and types of green infrastructure suitable for installation on Town-owned property
 - Develop design
 - Install with educational signage

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NEXT STEPS

- Incorporate public comments into plan
- Submit plan to WEMA and EDEA by June 30 / review as needed
- Submit plan to FEMA
- Board of Selectmen adopts FEMA-approved plan
- Town becomes 501(c)(2)(b) and is eligible to apply for MVP Action Grants and FEMA FMA grants

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LUDLOW'S ENVIRONMENTAL ASSETS

Ponds	Public open spaces and recreation areas	Agriculture
Ticks and disease vectors	Invasive species	Nuisance wildlife
Shade trees	Wetlands	

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TOP STRATEGIES TO IMPROVE SOCIETAL RESILIENCE

- Town communication methods survey**
 - Survey on preferred methods for receiving communications from town both during emergency events and for programmatic outreach
- Climate-vulnerable population outreach**
 - Identify and partner with community leaders and/or organizations for outreach to populations most vulnerable to natural hazards
- Power outage critical customers list**
 - Continue to coordinate with Essexforce on list of customers prioritized for power restoration
 - Post information on town website on how to be added to the critical customers list



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THANK YOU!



Contact for any follow-up questions or comments:
 Emily Tully, Pioneer Valley Planning Commission
etully@pvpvc.org

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TOP STRATEGIES TO IMPROVE INFRASTRUCTURE RESILIENCE

- Road/stream crossings:**
 - Condition assessment report
 - Repairs to Putts Bridge
 - Drainage improvements at known problem locations
- Power outage restoration prioritization plan:**
 - Coordinate with Essexforce on identifying critical facilities for restoration of electrical service following an outage event



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PUBLIC COMMENT PERIOD

-  Draft plan and previous presentations are available for review at the MVP Committee's page: <https://www.ludlow.ma.us/html/mvp/index.htm>
-  Questions or Comments on the plan or process? Please reach out to me at etully@pvpvc.org or any member of the MVP/HMP Committee

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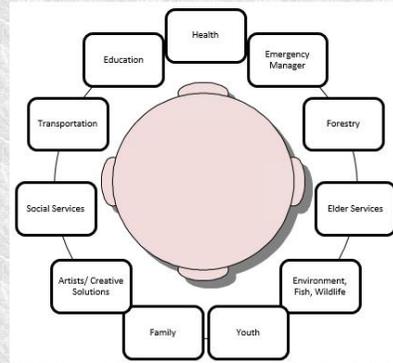
[Home](#)

- MVP Committee:
 - Doug Stefancik**
Town Planner
 - Ellie Villano**
Town Administrator
 - Andrea Crete**
Health Agent
 - Penny Lebel**
Conservation Commission
 - Jim Goodreau**
Town Engineer
 - Brian Shameklis**
Police Department
 - Jocelyn Zepke**
Council on Aging
 - Paulina Matusik**
Board of Health
 - Ryan Pease**
Fire Chief

- Address:
 - Vulnerability Preparedness Committee**
 - Ludlow Town Hall**
 - 488 Chapin Street**
 - Ludlow, MA 01056**
 - [Minutes & Agendas](#)

Vulnerability Preparedness & Hazard Mitigation Plan Committee

The Members of the MVP Committee Will Be Representatives of, and Vested in, a Resilient Future For Your Communities



MVP Top Priorities Survey
Deadline: May 6th, 2022

Misc Documentation

MVP Kickoff Meeting
Presentation

January 21, 2022 Meeting
Presentation

February 17, 2022 Meeting
Presentation

Community Resilience Building
Workshop Guide

March 23, 2022 Workshop
Slideshow

March 31, 2022 Workshop
Slideshow

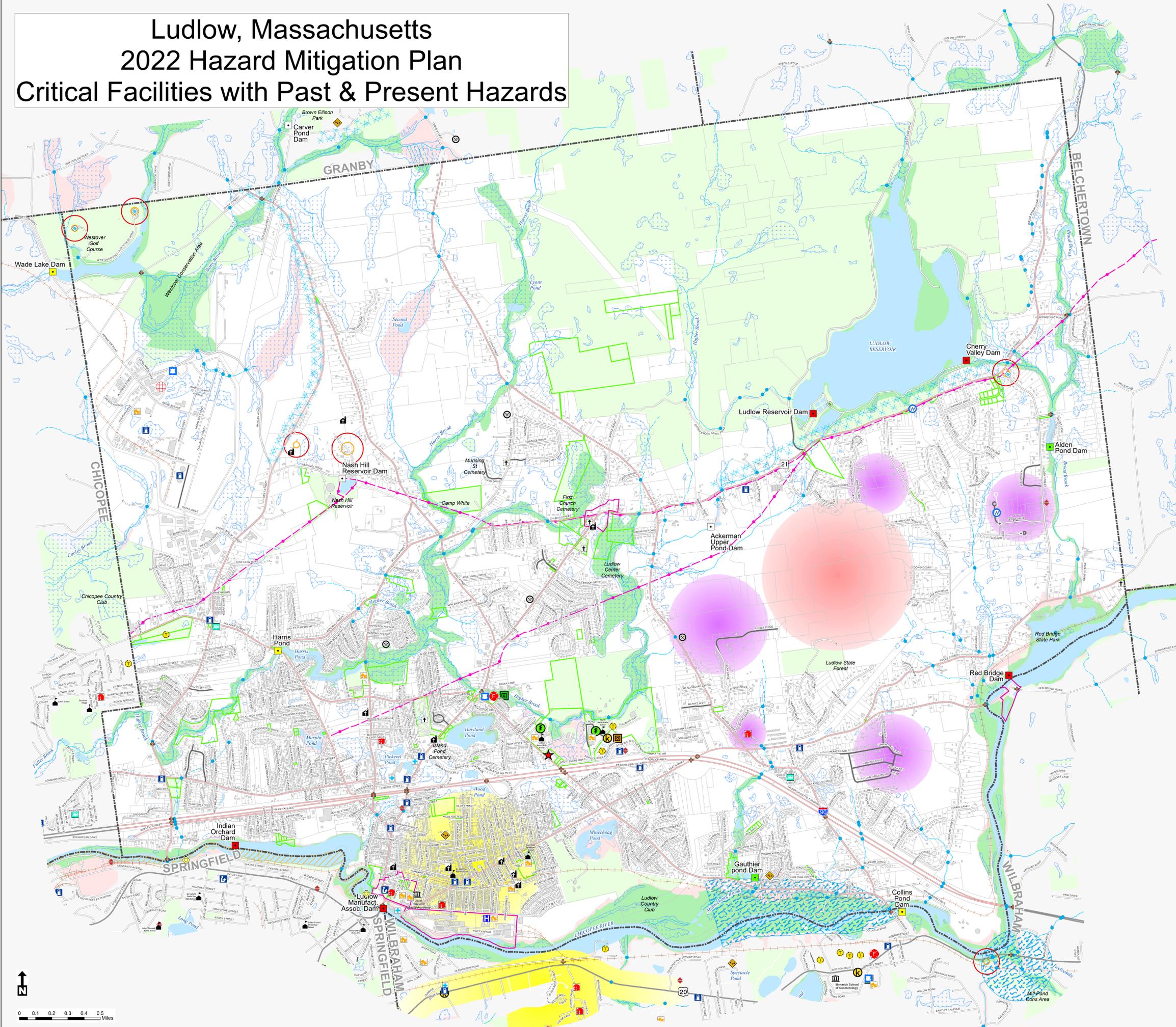
April 7, 2022 Workshop
Slideshow

**2022 Hazard Mitigation Plan -
Critical Facilities w/ Past & Present Hazards**

Hazard Mitigation Plan 2022 Update

Appendix D: Past and Potential Hazards/Critical Facilities Map

Ludlow, Massachusetts 2022 Hazard Mitigation Plan Critical Facilities with Past & Present Hazards



- Primary Emergency Operations Center
- Alternate Emergency Operations Center
- Shelter
- Police Station
- Fire Station
- Emergency Generator
- Helicopter Landing Zone
- Radio Communications
- Cell Tower
- Telephone Cross Box or Switching Station
- Hospital
- Pharmacies
- Power Plants
- Gasoline and Petroleum
- Dry Hydrants
- Town or City Hall
- DPW
- Transfer Station
- Library
- School
- College
- Churches
- Recreation Program
- Sand/Gravel Pit
- EPA Tier II Hazardous Materials
- Mobile Home Park
- Senior Housing
- Prisons
- Cemetery
- Culverts/Stream Crossings
- Bridge (Rail or Highway)
- Dam - High Hazard
- Dam - Significant Hazard
- Dam - Low Hazard
- Dam - N/A
- Rail Lines
- Aqueducts
- Evacuation Routes
- Municipal Properties
- Tax Parcel Boundaries
- Zone I Protection Area
- Interm Wellhead Protection Area
- Extensive Flooding
- Snow Drifts
- MicroBurst
- Wild Fire Area
- Future Development
- Concentrated Population
- FEMA Q3 Floodway
- 100 Year Flood Zone
- 500 Year Flood Zone
- Protected & Recreational Open Space
- Open Water usgs25K
- Stream usgs25K
- Intermittent Stream usgs25K
- Wetlands MADEP

Appendix E: Mitigation Capabilities Assessment Worksheet

Worksheet 4.1

Capability Assessment Worksheet

Jurisdiction: Ludlow

Local mitigation capabilities are existing authorities, policies, programs, and resources that reduce hazard impacts or that could be used to implement hazard mitigation activities. Please complete the tables and questions in the worksheet as completely as possible. Complete one worksheet for each jurisdiction.

Planning and Regulatory

Planning and regulatory capabilities are the plans, policies, codes, and ordinances that prevent and reduce the impacts of hazards. Please indicate which of the following your jurisdiction has in place.

Plans	Y/N Year	Does the plan address hazards?
		Does the plan identify projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?
Comprehensive/Master Plan	Y, 2009	The Master Plan addresses some hazards generally, such as floodplain development, future development density and locations, and drought.
Capital Improvements Plan	N	
Economic Development Plan	Y, 1995	The Economic Development Strategy of 1995 does not address hazards.
Local Emergency Operations Plan	Y, within CEM Plan (2021)	Mitigation strategies identified in the 2022 HMP update should be incorporated into the next CEM Plan update and operations plan.
Continuity of Operations Plan	N	
Transportation Plan	Y, within Master Plan and regional plan <i>Making It Happen: Opportunities and Strategies for Transit-Oriented Development in the Knowledge Corridor (PVPC)</i>	Regional plan makes recommendations on zoning, new development, infrastructure, and economic development that could be commensurate with hazard mitigation such as <ul style="list-style-type: none"> - Ensuring citizens are educated on conservation - Increasing funds to purchase open space - Establish a permanent open space committee and increase inter-governmental and citizen coordination - Amend town by-laws and ensure strict compliance of zoning by-laws - Increasing coordination and buy-in between townspeople and government - Maintain water quality by prohibiting activities that affect erosion and pollution
Stormwater Management Plan	Y, 2019	Stormwater drainage maintenance and design storm sizing are important mitigation concerns relative to preventing future flooding and identifying problem areas. The current MS4 General Permit is set to expire in 2022 but will be administratively continued, so the current SWMP can be used to implement mitigation actions.

Plans	Y/N Year	Does the plan address hazards? Does the plan identify projects to include in the mitigation strategy? Can the plan be used to implement mitigation actions?
Community Wildfire Protection Plan	N	Adhere to State Plans
Other special plans (e.g. brownfields, redevelopment, disaster recovery, coastal zone management, climate change adaptation)	Y, 2016 HMP and 2013 OSRP	Y, both the HMP (the update of which this is part of) and OSRP identify projects and can be used to implement mitigation actions, although the 2013 OSRP needs to be updated; it would be helpful to determine to what extent projects identified in the OSRP were completed

Building Code, Permitting, and Inspections	Y/N	Are codes adequately enforced?
Building Code	Y	Ludlow has adopted the Massachusetts State Building Code version , which promotes construction of buildings that can withstand hazards to a certain degree.
Building Code Effectiveness Grading Schedule (BCEGS) Score	N	
Fire Department ISO Rating	N	
Site plan review requirements	Y	

Land Use Planning & Ordinances	Y/N	Is the ordinance an effective measure for reducing hazard impacts? Is the ordinance adequately administered and enforced?
Zoning Ordinance	Y	Y, restrictions on building on steep grades and earth removal
Subdivision rules and regulations	Y	Y, Y
Floodplain Overlay District	Y	Y, Y
Natural hazard specific ordinance (stormwater, steep slope, wildfire)	Y	Stormwater bylaw – Y, Y
Flood insurance rate maps	Y	Y, Y
Acquisition of land use for open space and public recreation uses	Y	Y, Y
Other – Conservation Commission Bylaws	Y	Y, Y

How can these capabilities be expanded and improved to reduce risk?
<p>Could develop up-to-date Capital Improvement Plan that includes identification of road-stream crossings that need to be repaired or replaced and stormwater improvements that are needed as mitigation projects that fall under the purview of capital improvements</p> <p>Update SWMP as needed annually based on changes in implementation, results of IDDE investigations, improvements to known flooding areas, the anticipated upcoming MA Stormwater Handbook revisions, and the anticipated future updates to the MS4 General Permit; consider increasing inspections and clean-outs of catch basins known to have flooding issues due to leaf clogging</p> <p>Consider increased the FPOD to the 500-year floodplain to accommodate the anticipated impacts of climate change</p>

How can these capabilities be expanded and improved to reduce risk?

Determine status of 2013 OSRP tasks and relationship to mitigation actions identified in the 2022 HMP update, Update the OSRP with climate resilience and hazard mitigation in mind

Consider incorporating climate change into local wetlands protection bylaws and regulations, such as expanding jurisdiction to 500-year floodplain and requiring use of a rainfall model that incorporates climate change such as the Cornell Extreme Precipitation model

Start a Certified Emergency Response Team (CERT)

Update Master Plan, include climate change resiliency considerations

Consider participation in the NFIP Community Rating System (CRS), including participation in a regional CRS effort

Administrative & Technical

Identify whether your community has the following administrative and technical capabilities. These include staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions. For smaller jurisdictions without local staff resources, if there are public resources at the next higher level of government that provide technical assistance, indicate so in your comments.

Administration	Y/N	Describe capability Is coordination effective?
Planning Board	Y	Coordination is effective most of the time and is led by Town Planner
Mitigation Planning Committee	Y	Ludlow has a Local Emergency Planning Committee led by the Fire Chief, Ryan Pease
Maintenance programs to reduce risk (e.g. tree trimming, clearing drainage systems)	Y	Coordination with Eversource on tree trimming is effective Catch basin cleaning is performed annually and as-needed, street sweeping is performed twice a year as per the SWMP
Mutual aid agreements	Y	Police, Fire, and DPW in surrounding communities

Staff	Y/N FT/PT	Is staffing adequate to enforce regulations? Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective?
Chief Building Official	Y	Building Inspector is effective
Floodplain Administrator	N	
Emergency Manager	N	Fire Chief is lead coordinator of local Emergency Planning Committee
Community Planner	Y, FT	Full-time Town Planner led 2022 MVP/HMP update process
Civil Engineer	Y, FT	Assistant Town Engineer participates in multiple committees to ensure coordination
GIS Coordinator	N	Mainly rely on Tighe & Bond for GIS
Other – Town Administrator	Y, FT	Health Coordinator works with multiple agencies and Towns to coordinate public health response to emergency events Town Administrator helps ensure adequate communication and coordination between boards and committees

Technical	Y/N	Describe capability Has capability been used to assess/mitigate risk in the past?
Warning systems/services (Reverse 911, outdoor warning signals)	Y	The Town of Ludlow has the CodeRED system, which provides Town officials the ability to deliver messages to targeted areas or the entire Town quickly through a reverse calling system. Residents may update their CodeRED information on the Town website.
Hazard data and information	Y	National Weather Service, MEMA, Climate Change Clearinghouse for the Commonwealth, local police and fire departments
Grant writing	N	All departments assist with grant writing
Hazus analysis	N	2016 HMP utilized free Hazus analysis service provided by the Northeast States Emergency Consortium, which is no longer funded
Other		

How can these capabilities be expanded and improved to reduce risk?
Start a Certified Emergency Response Team (CERT)
Expand CodeRED outreach to increase the number of residents receiving alerts
Continue hazard tree removal and maintenance and maintain good working relationship with Eversource

Financial

Identify whether your jurisdiction has access to or is eligible to use the following funding resources for hazard mitigation.

Funding Resource	Access Eligibility Y/N	Has the funding resource been used in the past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital Improvements Project funding	Y	
Authority to levy taxes for specific purposes	Y	
Fees for water, sewer, gas or electric services	Y	Sewer fees collected, could not be used to fund mitigation actions
Impact fees for new development	Y	
Storm water utility fee	N	
Incur debt through general obligation bonds and/or special tax bonds	Y	Concerns over utilizing regarding % interest
Community development block grants	Y	Have not received to date
Other federal funding programs	Y	CARES Act, ARPA, EPA Brownfields, Department of Commerce grant for Riverside Road upgrades
State funding programs	Y	Ch 90 road funding – could be used for bridge repairs or culvert replacements; Massachusetts School Building Authority for Chapin Street School
Other		

How can these capabilities be expanded and improved to reduce risk?
<p>Work with neighboring towns to hire a regional grant writer</p> <p>Pursue additional funding for mitigation measures</p> <p>Update OSRP to be eligible for associated grant funding</p> <p>Pursue community compact grant funding opportunities.</p>

Education & Outreach

Identify education and outreach programs and methods already in place that could be used to implement mitigation activities and communicate hazard-related information.

Program/Organization	Y/N	Describe program/organization and how it relates to disaster resilience and mitigation
Local citizens groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	Y	Pond Management Committee is working to mitigate Non-point source and climate change-related impacts to local waterbodies Council on Aging and Board of Health are involved with ensuring awareness of ability to be added to Critical Customers List for residents on life-support systems
Ongoing public education or information program (e.g. responsible water use, fire safety, household preparedness, environmental education)	Y	Ongoing Fire Safety program (see below)
Natural disaster or safety related school programs	Y	Fire Safety programs in partnership with the School Department
StormReady certification	N	
Firewise Communities certification		
Public-private partnership initiatives addressing disaster-related issues	N	
Other		

How can these capabilities be expanded and improved to reduce risk?
<p>Pursue public-private partnerships to expand outreach – for example, should increase coordination with Our Lady of Fatima Parish and other churches for outreach to climate vulnerable populations and for use as shelters during emergency events</p> <p>Work cross-agency to develop public education and outreach materials</p> <p>Identify community liaisons for outreach to climate vulnerable populations, pursue StormReady community designation</p> <p>Consider reaching out to private, non-hydroelectric dam owners regarding potential benefits of and resources to assist with dam removal</p> <p>Perform a Town-wide survey on how residents prefer to receive emergency preparedness and hazard event information from Town (e.g., phone alerts, brochures, bill inserts, Ludlow Community TV)</p>