Town of Ludlow & Village of Ludlow, Vermont: Local Hazard Mitigation Plan

Adopted by the Town: December 3, 2018

Adopted by the Village: December 4, 2018

Prepared by the Town of Ludlow and the Village of Ludlow and Southern Windsor County Regional Planning Commission

2018-2023

October 11, 2018

CERTIFICATE OF ADOPTION

Town of Ludlow, VT
Selectboard
A Resolution Adopting the
Town of Ludlow 2018-2023 All Hazard Mitigation Plan

WHEREAS, the Town of Ludlow has worked with the Southern Windsor County Regional Planning Commission to prepare an updated hazard mitigation plan for the town, to identify natural hazards, analyze past and potential future damages due to natural and man-made caused disasters, and identify strategies for mitigating future damages; and

WHEREAS, duly-noticed public meetings were held by the Ludlow Selectboard on 10/1/18 to present and receive public comment on the draft Plan; and

WHEREAS, the updated Town of Ludlow 2018-2023 Local Hazard Mitigation Plan demonstrates the community's commitment to implementing the mitigation strategies and authorizes responsible agencies to execute their actions; and

WHEREAS, the updated Town of Ludlow 2018-2023 Local Hazard Mitigation Plan was submitted to Vermont Emergency Management and the Federal Emergency Management Agency for review on October 18, 2018; and

NOW, THEREFORE BE IT RESOLVED that the Town of Ludlow Selectboard hereby adopts the 2018-2023 Ludlow Local Hazard Mitigation Plan for municipal use and implementation.

Duly adopted this 3rd day of December, 2018

Selectboard

Bruce Schmidt (PJC)
Bruce Schmidt, Chairman

Brett Sanderson
Brett Sanderson, Vice Chair

John Neal, Clerk

Logan Nicol

Heather Tucker

CERTIFICATE OF ADOPTION
Village of Ludlow, VT
Board of Trustees

A Resolution Adopting the
Village of Ludlow 2018-2023 Local Hazard Mitigation Plan

WHEREAS, the Village of Ludlow has worked with the Southern Windsor County Regional Planning Commission to prepare an updated hazard mitigation plan for the town, to identify natural hazards, analyze past and potential future damages due to natural and man-made caused disasters, and identify strategies for mitigating future damages; and

WHEREAS, duly-noticed public meetings were held by the Village of Ludlow Board of Trustees on 10/2/18 to present and receive public comment on the draft Plan; and

WHEREAS, the updated Village of Ludlow 2018-2023 Local Hazard Mitigation Plan demonstrates the community's commitment to implementing the mitigation strategies and authorizes responsible agencies to execute their actions; and

WHEREAS, the updated Village of Ludlow 2018-2023 Local Hazard Mitigation Plan was submitted to Vermont Emergency Management and the Federal Emergency Management Agency for review on October 18, 2018; and

NOW, THEREFORE BE IT RESOLVED that the Village of Ludlow Board Trustees hereby adopts the Local Hazard Mitigation Plan for municipal use and implementation.

Duly adopted this 4th day of December, 2018.

Village of Ludlow Board of Trustees:

Robert Gilmore, Chairman

David Rose, Vice Chair

Earl Washburn, Clerk

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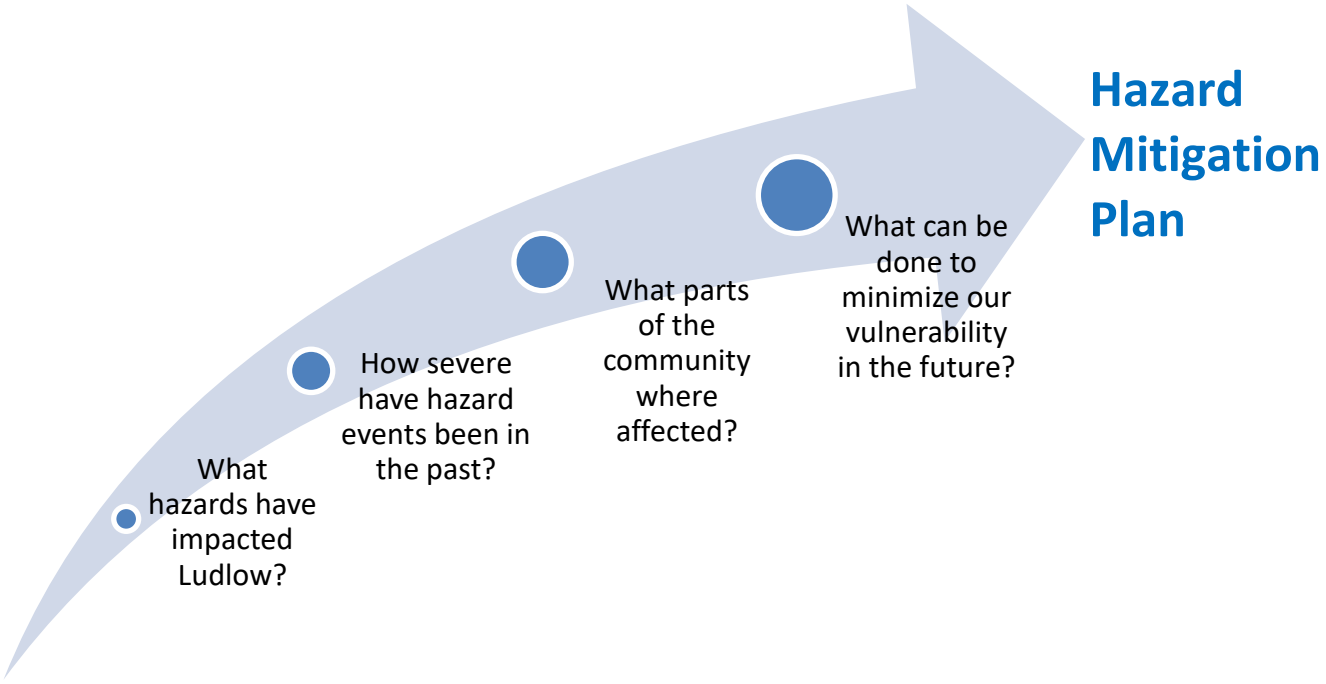
1. INTRODUCTION

The goal of this stand-alone Local Hazard Mitigation Plan is to help the community identify risks and provide local mitigation strategies that can be taken to make Ludlow and the Village of Ludlow more disaster resilient. Previously, the Town of Ludlow's Hazard Mitigation Plan was an annex to the Southern Windsor County Regional Planning Commission Multi-Jurisdictional Local Hazard Mitigation Plan. The updated plan is intended to serve as a 'stand-alone' plan for the Town of Ludlow and the Village of Ludlow and will focus on the hazards and mitigation programs best suited for the town.

What is Hazard Mitigation?

Hazard mitigation is an action taken to reduce or eliminate the long-term risk to human life and property from both natural and man-made hazards. The work done to minimize the impact of hazard events to life and property is called Hazard Mitigation Planning. This plan will focus on assessment of natural hazards and mitigating actions to increase the Town's resiliency to those hazards.



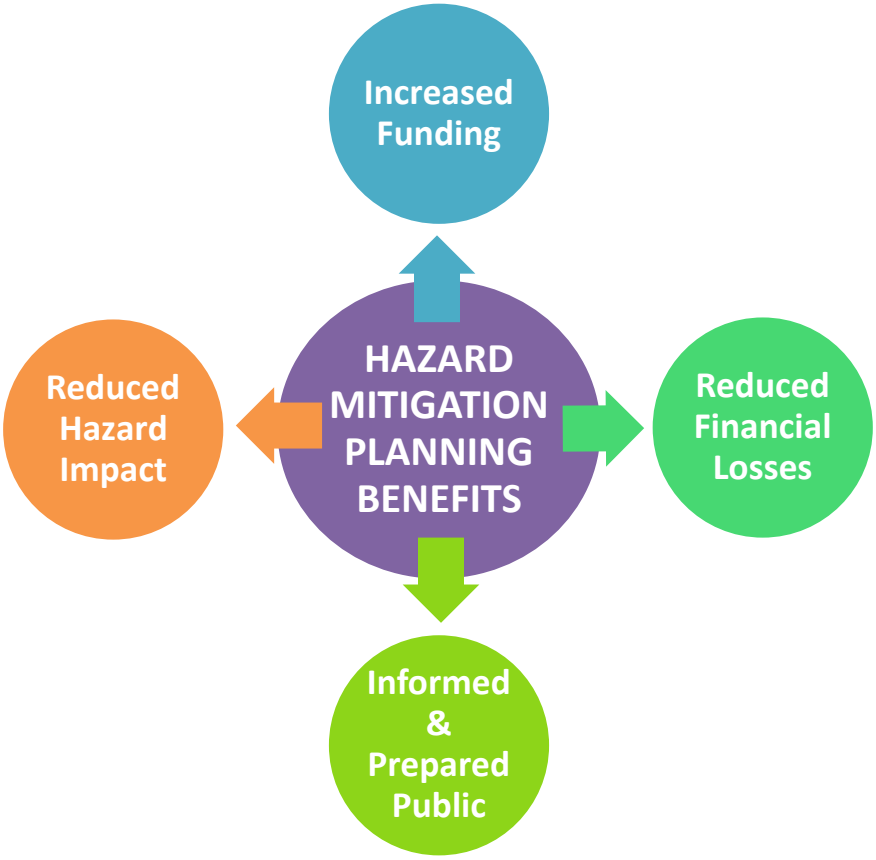
2. PURPOSE

The Federal Emergency Management Agency (FEMA), Vermont Emergency Management (VEM), and local towns have come to recognize that it is less costly to take action to minimize the impact of natural hazards than to repeatedly repair damage after a disaster has struck. Hazards cannot be eliminated, but it is possible to determine what the hazards are and which are more likely to occur and tend to have the greatest impact on a community. With some research and outreach, a local community can also determine the extent and impact of these hazards and which assets and areas are most at risk. A

culmination of these efforts is a working dynamic list of local strategies and actions that can be taken to reduce the impact of these hazards, both financial and physical, on the community.

It is less expensive to prevent disasters than to repeatedly repair damage after a disaster has struck.

This plan recognizes that communities have opportunities to identify mitigation strategies and measures during all of the other phases of emergency management; preparedness, response, and recovery.



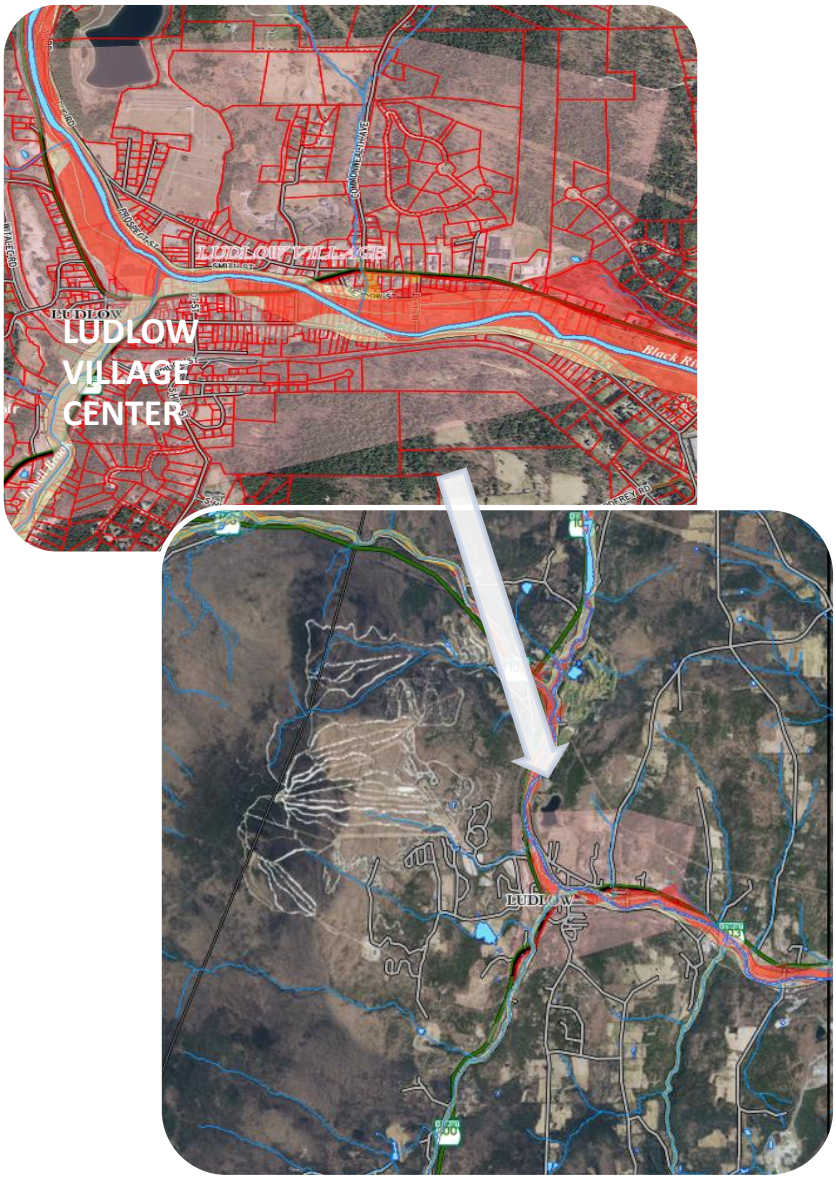
3. TOWN AND VILLAGE PROFILE[1]

Ludlow is located in the southwestern part of Windsor County, in southern Vermont, at the crossroads of VT Route 100 Scenic Byway and VT Route 103 (Calvin Coolidge Memorial Highway.) It is bounded on the north by Plymouth, on the east by Chester and Cavendish, on the south by Weston and Andover, and in the west by Mount Holly. The Black River runs through the center of Town.

Ludlow is located on the eastern side of the Green Mountains and has Ludlow (Okemo) Mountain on its western border, whose summit rises about 2,400 feet above Main Street and 3,344 feet above sea level.

[1] Adapted from the Municipal Development Plan, 2017.

Since the 1970s, recreation and tourism have driven Ludlow's development, bolstered by the Town's proximity to Okemo Mountain Resort. Reliance on the existing market forces is likely to result in relatively high housing costs, and a trend toward a service economy to support tourism and seasonal homes. These trends suggest a prevalence of tourist-oriented local job opportunities that are heavily reliant upon good winter skiing conditions and a strong housing market. The construction and maintenance of seasonal housing has a strong impact on the local economy, but the second home market tends to increase the cost of housing beyond what is affordable at prevailing local wages. According to the 2016 American Community Survey, 2,348 of 3,277 total housing units in Ludlow, or 71.7%, are classified as "vacant". The preponderance of seasonal and rental housing also presents a distinct challenge for hazard mitigation planning. Vacant housing, and a potential lack of knowledge among tenants of the risks associated with fire and other hazards, can increase vulnerability to hazards for the Town and Village.



Historically, mixed, dense patterns of development have been concentrated in the Village and in other relatively flat, stable areas along stream corridors and in the Black River Valley. These uses are beginning to expand out from the core area south along VT Route 103 and at the base of Okemo Mountain Road, as well as along VT Route 100 north of VT Route 103. High concentrations of residential/seasonal use occur around Lakes Rescue and Pauline and on Ludlow (Okemo) Mountain.

Concentrations of seasonal residential development have and are occurring in the area surrounding the ski area (See **Appendix A: Map 1- Current Land Use**). This area is serviced by the village sewer. The concentration of development along the Black River and Lakes Rescue and Pauline makes both the Town and Village of Ludlow vulnerable to flooding, as the extensive damage sustained by Ludlow's road network during Tropical Storm Irene demonstrates (See **Appendix A: Map 9- Road Network Damage from Tropical Storm Irene**). Alternatively, development on Ludlow (Okemo) Mountain and in the area surrounding the ski area may be susceptible to landslides/slope failure and wildland fires.

Development over the previous plan period has not negatively impacted the community's vulnerability to the hazards addressed in this plan. Over the past five years, Ludlow has issued a total of 407 permits; 320 in the Town of Ludlow and 87 in the Village of Ludlow. Further discussion regarding floodplain development can be found in a discussion on Vulnerable Community Assets in the Flood and Fluvial Erosion Section 5.2c on page 37.

The 2010 U.S, Census Bureau indicated a population of 1,963 in Ludlow, a rate of -19.8% from the 2000 census. The population growth rate in Windsor County was -1.3% and 2.8% in Vermont as a whole over the same period.

As in the rest of Vermont, the climate in Ludlow is generally temperate with moderately cool summers and cold winters. Average annual precipitation is around 40 inches, and snowfall can be as much as 200 inches in a single winter. However, as is true throughout the state, the town is experiencing more extreme climate conditions. The weather is unpredictable, and large variations in temperature, precipitation, and other conditions may occur both within and between seasons.

Town and Village Relationship

This is almost entirely attributable to Okemo Ski Resort, which has increased the annual number of visitors to the mountain from approximately 95,000 in 1982/83 to more than 608,000 in 2008/09 – an increase well over 500%. Associated with this increase has been the development of nearly 800 on-mountain dwellings over the same period, in addition to the development of approximately 400 off-mountain seasonal dwellings. Ludlow's peak seasonal, day-time population is estimated by the municipality to be 15,000 to 18,000 people (more than 9.1 times the year-round population), including year-round residents, workers, skier visits, and lodgings. The peak population occurs on a number of winter weekends and vacation weeks over the course of a year and presents many planning challenges to the community

regarding how to manage impacts and meet the demand for facilities and services. In many instances, these challenges are best addressed through temporary mitigation measures.

The Town of Ludlow is uniquely divided with two governing bodies within the town. According the Town website, the Ludlow Village Board of Trustees "provides general supervision and control for the Village of Ludlow. This includes enacting ordinances, regulations and policies for the village. It oversees village property and personnel, prepares, presents and manages budget, oversees roads, including laying out, discontinuing and reclassifying roads and approves sewer hook-ups and waste water allocation." [2]

From the 2017, Ludlow Municipal Plan:[3]

"A municipal manager administers the affairs for the Town and Village of Ludlow. This position broadens the scope of community services and helps toward implementation of municipal goals and objectives. At the annual Town Meeting, members are elected to serve staggered terms on the five-member Board of Selectmen representing the legislative body. These Selectmen provide legislative direction for the Town.

The Village District is an incorporated area of the Town, independently directed by a three-member Board of Trustees. An annual meeting is held to transact business pertaining directly to the legislative affairs of the Village."

4. PLANNING PROCESS

The local planning process used to develop this hazard mitigation plan follows guidance by the Federal Emergency Management Agency (FEMA) and Vermont Emergency Management (VEM). Beginning in the fall of 2017, Southern Windsor County Regional Planning Commission (SWCRPC) staff reviewed the previously adopted 2014 Multi-Jurisdictional All Hazard Mitigation Plan for Ludlow to identify key areas for update. At that time the hazard mitigation plan was an annex to the 2012 Southern Windsor County Regional Planning Commission Multi-Jurisdictional All Hazard Mitigation Plan. The State of Vermont also recently adopted an updated Hazard Mitigation Plan in 2018 which was also consulted during this update.

In late fall of 2017, staff member and Community Development Specialist, Cindy Ingersoll, from the Southern Windsor County Regional Planning Commission, reached out to the Town of Ludlow Selectboard and Ludlow Village Board of Trustees for volunteers to spearhead the planning effort. The Town and Village share municipal staff and, therefore, are both represented on the Ludlow Hazard Mitigation Committee. The Town and Village also share municipal planning activities; however, zoning and flood hazard regulations and local ordinances are separate as indicated in **Table 2: Existing Ludlow Resources for Mitigating Hazards.**

[2] https://www.ludlow.vt.us/?SEC=1057636B-D7A3-4BA1-A366-DC1C36949007

[3] 2017 Town and Village of Ludlow Municipal Development Plan, 1.

A Hazard Mitigation Committee was formed and tasked with updating the plan and overseeing the public process.

Committee members, listed below, include representation from a cross-section of town departments and commissions.

- Frank Heald, Municipal Manager (2013-April, 2018)
- Scott Murphy, Municipal Manager (April, 2018- Present)
- Pam Cruickshank, Office Manager
- Ron Bixby, EMD
- Brett Sanderson, Selectboard Clerk
- Rosemary Goings, Director of Planning and Zoning
- Ron Tarbell, Highway Foreman
- Chuck Craig, Wastewater Treatment Chief Operator
- Jeffrey Billings, Police Chief
- Carl Matteson, Ambulance Coordinator
- Cindy Ingersoll, SWCRPC Staff

The Hazard Mitigation Committee members participated throughout the planning process either by scheduled group meetings or via committee email correspondence and conference calls as outlined in **Appendix C** and detailed in **Section 4.1**.

4.1. Plan Update Process

The Town of Ludlow and the Village of Ludlow, in partnership with the Southern Windsor County Regional Planning Commission, established a process for completion of this Local Hazard Mitigation Plan update. The update process activities and timeline are depicted in the **2018-2023 Ludlow Hazard Mitigation Plan Process Flow Chart** in **Appendix C.** The meeting dates, invitees and tasks performed are identified in the flow chart.

Beginning in December 2017, and throughout the process, SWCRPC staff made substantial re-writes to reflect input from meeting discussions with new emphasis on some hazards, and new data and hazard profile information from local, regional and state sources and new reports. Throughout the process and with the discussion of each hazard, members were encouraged to identify vulnerable areas and community assets and suggest potential mitigating actions or strategies to reduce the community's risk to each hazard.

A number of plans, studies, reports, technical information and web data sources were consulted during the preparation of this plan.

These sources provided data on hazard extent and historical trends, new hazard mitigation ideas, and potential improvements to current resources. A partial listing of these sources includes the following documents:

- Southern Windsor County Regional Planning Commission Multi-Jurisdictional All-Hazard Mitigation Plan with Ludlow, VT Annex. Adopted October 15, 2012.
- State of Vermont 2018 Hazard Mitigation Plan.
- Town of Ludlow Zoning By-Laws and Flood Hazard Regulations. Adopted June 6, 2016.
- Village of Ludlow Zoning By-Laws and Flood Hazard Regulations. Amended March 6, 2018.
- 2017 Town and Village of Ludlow Municipal Plan. Adopted December 4, 2017 (Town), January 2, 2018 (Village).
- Draft Flood Resilience Chapter, Ludlow Municipal Plan, Draft as of April 14, 2015.
- Ludlow Local Emergency Operations Plan (LEOP). Updated in 2017.
- 2017 Town and Village of Ludlow Road Erosion Inventory and Report.
- Black River Corridor Plan, June 2011.
- Vermont Agency of Natural Resources – VT Flood Ready Maps
- 2017 Town of Ludlow Annual Report
- 2017 Village of Ludlow Annual Report

This plan is an extensive update to the previous multi-jurisdictional plan and includes a number of revisions and improvements. The following partial list of revisions:

- General updates to Town profile and town maps.
- Inclusion of an easy-to-read Process Flow Chart to depict the planning process.
- Reorganization/restructuring of the plan contents to better reflect required FEMA elements.
- Reevaluation of hazards with a new methodology for scoring to more accurately determine priority of hazards for the planning period.
- Update of hazard data using new data sources and more local data.
- More comprehensive assessment of vulnerable community assets.
- Use of sub-sections under each hazard profiled for discussion of ‘Extent and Historical Trend’ and ‘Vulnerable Community Assets’.
- Addition of Hazard Mitigation Goals and correlation of mitigation strategies to plan goals.
- More specificity in identifying mitigation strategies and actions.
- Review and integration of new relevant reports and documents.
- Formalization of the Plan Monitoring Process to maintain focus on plan goals and to encourage progress, annual reporting, recording of local hazard events, identification of new vulnerable assets, and public outreach over the plan period.

4.2. Public Process

The Town began the process with a preliminary meeting in October, 2017 that was attended by Frank Heald, Pam Cruickshank, Ron Bixby, and Cindy Ingersoll. SWCRPC staff gave an overview of the process with a discussion on the purpose of hazard mitigation planning, the planning process and timeline for completing the update, and the importance of community outreach and public involvement. Hazard Mitigation Committee members and meeting schedule were determined at that time and a public outreach procedure was discussed. Procedures were also discussed for warning and inviting the public to planning meetings, informing local Boards and Commissions, and making draft plans available for questions and comments.

The process proceeded with the tasks as depicted in the 2018-2023 Ludlow Hazard Mitigation Plan Process Flow Chart in Appendix C.

The meeting dates and tasks performed at each meeting are identified in the flow chart. The local community of Ludlow was invited to the scheduled planning meetings, where identified in Appendix C. Meetings were noticed and meeting agendas posted per designated locations and procedures in the Town Charter: on the Town Website, at the Town Office.

Highlights of the Public Process:

- The Hazard Mitigation Committee held five publicly noticed meetings during the drafting of the plan. Throughout this process no one from the public attended these noticed meetings.
- A draft plan was completed and circulated to Hazard Mitigation Committee members for review and comment and edits were made. SWCRPC staff also discussed the draft with the new Town Manager and incorporated input from those discussions.
- The revised draft was then put out for public review and comment on September 24, 2018. The Public Review Process included:
    - An electronic copy posted on the Town website and circulated to the Board of Selectmen, Planning Commission, and Ludlow Village Trustees requesting comments from the local boards and community.
    - An electronic copy posted on the SWCRPC website requesting comments from regional partners.
    - A hard copy made available at the Ludlow Town Hall Office.
    - An electronic distribution was made to adjacent towns (Cavendish, Chester, Plymouth, Shrewsbury, Mount Holly, Andover, Reading) was made via email by SWCRPC to respective Town Clerks with a request to post on their websites and provide a copy to their Planning Commission and Selectboard members.
      All distributions included the following:

      "The Town of Ludlow and Village of Ludlow are seeking comment on its 2018-2023 Local Hazard Mitigation Plan final draft. The purpose of this

planning effort is to improve Ludlow's resiliency to natural hazards through hazard assessment, recognition of vulnerable assets, and identification of mitigating actions and strategies to reduce the impact of these hazards on the community. The neighboring town communities are also invited to attend the Ludlow Selectboard meeting of October 1st, 2018 at 7:00 PM for a review of the draft plan. The meeting will be at Town Hall, 37 Depot Street, Ludlow, VT. Please feel free to forward any questions or comments to Cindy Ingersoll, Community Development Specialist, at cingersoll@swcrpc.org or (802) 674-9201 by October 10th, 2018. We welcome all input."

- The revised draft plan was presented at a publicly noticed meeting of the Ludlow Board of Selectman on October 1, 2018. All Ludlow Planning Commission members and Ludlow Village Trustees were extended individual email invitations. No comments were received.

Subsequently, the plan will complete the Vermont State Hazard Mitigation Officer review for referral to FEMA for Approval Pending Adoption (APA). Following APA, the Town and Village may then adopt the Local Hazard Mitigation Plan and forward a copy of the adoption resolution for FEMA to complete the plan approval and adoption process. Following VT State and FEMA review, the final adopted Local Hazard Mitigation Plan will also be posted on the SWCRPC website and available at the Ludlow Town Offices and on their website.

4.3. Review of Previous Hazard Mitigation Plan

Table 1 below lists the mitigation and preparedness projects and actions from the previous *2014 Multi-Jurisdictional Local Hazard Mitigation Plan for Ludlow*. Mitigation actions, listed in order of priority set at that time, are shown here with an additional column to indicate the status of each as determined by the Hazard Mitigation Committee. As can be seen, most of these actions have been completed. Other actions have been revaluated and/or incorporated into this plan update and included in **Table 14: 2018-2023 Mitigation/ Preparedness Strategies and Actions** at the end of this document. Others were deemed to be ineffective or not necessary and have been dropped.

TABLE 1: Status of Previous Plan Mitigation Actions

MITIGATION ACTION	TYPE*	HAZARD ADDRESSED	STATUS
Trim identified trees along powerlines in coordination with electric providers	M	Severe Weather, Severe Winter Weather	Completed and on-going

Maintain Compliance with All NFIP requirements	M	Flood	Reviewed Annually & On-going
Retrofit existing drainage system to allow for greater water passage at Commonwealth Intersection.	M	Flood	Grant funding applied for $2.5MM, progressing
Provide 'Be Firewise Around Your Home' information to property owners	M	Structure Fire, Wildfire	Completed for condo and seasonal renter associations. Expansion of program carried over to this plan update.
Install wood roads on Mt. Ascutney to create firebreaks in coordination with VT Forest Parks & Recreation	M	Wildfire, (possibly structure fires)	Under private management of Okemo Mountain Resort
Complete property acquisitions along Route 103 (Emery's) for repetitive structure flooding	M	Flood	Buy-outs are progressing
Install redundant power supply at Ludlow Community Center/Town American Red Cross Shelter	M	Severe Winter Weather, Severe Weather, Flood	Looking for grant opportunity. Carried over to this plan update.
Upgrade Walker Bridge	M	Transportation Incident	Completed
Install left turn lane at Entrance to Jackson Gore	M	Transportation Incident	Completed
Encourage new development on Okemo Mtn. to create setbacks to forest canopy	M	Structure Fire	On-going in conjunction with Okemo Mtn. Resort, south-face may still be an issue. Carried over to this plan update.
Update fire pre-planning process and large business site visits	M	Structure Fire	Completed, and on-going 2-3 per year.
Revise current zoning regulations to require all new mobile homes be anchored	M	Flooding	Completed for flood hazard areas
Provide community outreach and literature on earthquake risk	M	Earthquake	Dropped, given low priority hazard and cost effectiveness
Implement a Ludlow water leak analysis program	M	Earthquake	Dropped, given low priority hazard and cost effectiveness

Study the vulnerability of wastewater facility and other municipal buildings to earthquakes	M	Earthquake	Study completed 2009 for man-made hazards and asset management plan for water system.
Discourage the installation of flat roofed structures	M	Severe Winter Weather	Established for permitting process and On-going
Create a database of contact information for vulnerable populations for use during emergency events	P	All Hazards	Not Done. Carried over to this plan update.
Develop winter weather travel preparedness information	M	Severe Winter Weather	Not Done, can work with Okemo Chamber of Commerce to develop under this plan update.

*M- Mitigation, P- Preparedness

4.4. Review of Town Plan

The 2017 Ludlow Town Plan has made strides, compared to earlier plans, in supporting sustainable development, natural resource conservation, flood resiliency and hazard mitigation efforts, either directly or indirectly. However, the town plan can benefit from better integration and coordination of hazard mitigation planning goals, objectives and strategies in the town planning process. To help achieve this, integration of hazard mitigation in town planning has been identified as a high priority action item in **Table 14: 2018-2023 Mitigation/Preparedness Strategies and Actions.**

Hazard mitigation related policies and recommendations in the town plan are outlined in **Appendix D**. Some have been selected as action items for this plan update and can be found in **Table 14: 2018-2023 Mitigation/Preparedness Strategies and Actions**

4.5. Review of Existing Town Resources

Currently, Ludlow participates in the NFIP program and will continue to regulate floodplain use through the Town of Ludlow's Zoning By-Laws and Flood Hazard Regulations, adopted June 6, 2016 and the Village of Ludlow's Zoning By-Laws and Flood Hazard Regulations, adopted April 5, 2016. The town has adopted the FEMA floodplain maps, last amended by FEMA in 2007.

Continued enforcement of these regulations by the Ludlow Administrative Officer, for both the Town and Village, will maintain Ludlow's compliance with the NFIP. The Administrative Officer is charged with implementing these regulations and, in concert with the Development Review Board, advises residents on floodplain development. The Town of Ludlow and the Village of Ludlow regulate development separately based on their Zoning & Flood Hazard Regulations and participate separately in NFIP. All other Resources listed below in **Table 2** are shared between the Town and the Village.

The following town authorities, policies, programs, and resources which help to reduce the impact of hazards on the community were evaluated for opportunities for improving effectiveness.

These resources help to reduce the effects of hazards to existing buildings and new development, town and village infrastructure, and critical facilities by encouraging or regulating development location, building design, environmental conservation and best management practices to reduce flooding and erosion. The Committee analyzed these programs for their effectiveness and noted any potential for improvement and the capacity to implement these improvements.

TABLE 2: Existing Ludlow Resources for Mitigating Hazards

Resource*	Description	Effectiveness in Implementing HM Goals	Opportunities for Improving Effectiveness
Municipal Plan	Plan for coordinated town-wide planning for land use, municipal facilities, water, natural resources, energy, etc. and is updated every 8-years.	Completed update in 2017. Policies and recommendations are made for each planning sector.	Next revision could be strengthened to improve effectiveness in hazard mitigation planning.
Local Emergency Operations Plan	Comprehensive procedures for emergency response. Currently being revised in 2017.	Plan outlines procedures for call-outs, evacuations, etc. and is effective for Hazard Event Preparedness.	Plan is reviewed every year following town meeting; functionality of statewide template has improved; timeliness of call transmissions can use improvement.
School Emergency Response Plan	School procedures for emergency response utilizing a template provided by the state. Updated April 2017.	Provides a checklist for school administrators and first responders for use in an emergency situation; is effective for Hazard Event Preparedness.	Response procedures are well coordinated with hazard response planning; resource is effective with continued updates for new identified hazard.
LEPC 3 All Hazards Resource Guide	Outlines resources available to Ludlow in emergency situations.	Effective through providing data and resources to town first responders.	Town and Village would need to review to determine effectiveness.
Local Emergency Planning Committee 3	Volunteer organization involved in regional hazard mitigation efforts.	Effective and important contributor in the hazard mitigation	Greater participation from Ludlow at the regional level would be beneficial.

		process.	
Mutual Aid – Emergency Services	Agreement among border towns for coordinated emergency services is updated annually.	Effective in providing additional emergency support during atypical events requiring emergency services -fire, ambulance, etc.	Formal protocols are in place for these agreements. Effective with annual updates.
Mutual Aid – Public Works	Agreement for regional coordinated emergency highway maintenance services is updated annually.	Effective in providing additional highway support and resources during atypical events.	Formal protocols are in place for these agreements. Effective with annual updates.
State and Local Road Standards	Town complies with State design and construction standards for roads and drainage systems. Standards are in the process of being updated.	Effective with implementation. Current update will address road erosion and stormwater runoff from roads.	Continued implementation of road standards is critical to Effectiveness. Work with SWCRPC to actively pursue available funding opportunities to increase effectiveness.
Subdivision Regulations	Regulates the division of land, provides standards for site access and Utilities.	Effective through continued implementation.	Continued updates and enforcement are important for continued effectiveness. Possible update this planning period.
Ludlow Zoning and Flood Hazard Regulations	Regulates development in and out of hazard areas.	Effective through limiting development in known hazard locations.	Continued updates and enforcement are critical for continued effectiveness. River Corridor Bylaws may be considered.
The Village of Ludlow Zoning and Flood Hazard Regulations	Regulates development in and out of hazard areas.	Effective through limiting development in known hazard locations.	Continued updates and enforcement are critical for continued effectiveness. River Corridor Bylaws may be considered.
State Site Plan Review	State review of plans for development and issues recommendations.	Effective in limiting development in hazard areas. Rely on State updates for continued.	Continued use of this tool will help prevent additional hazards. Provides a base upon which the Town could build.

		effectiveness.	
National Flood Insurance Program (NFIP) for Town and for Village	Provides ability for residents to acquire flood insurance.	Effective if Ludlow remains compliant with the NFIP program.	Flood maps should be updated by ANR (last update 2007), town may pursue CRS rating.
Road Maintenance Programs	Inventory and assess bridge and culvert infrastructure.	Effective at tracking and planning infrastructure upgrades.	Work with SWCRPC to actively pursue available funding opportunities to increase effectiveness.
Road Erosion Inventory (These assessments will become Municipal Road General Permit (MRGP) Inventory Assessments for the Town and for the Village)	Road survey to assess condition of town roads and identifies vulnerabilities.	Identifies and prioritizes road erosion issues and recommended actions with cost estimates.	This report is most effective when considered for capital budgeting, infrastructure upgrades and planning. Additional funding is needed to implement recommendations.
Access permits	Regulates driveway access along town maintained roads	Effective in limiting the number of road cuts, thereby reducing the potential for traffic Incidents.	Continued enforcement of access permit regulations is important for maintaining effectiveness. Possible review over this plan period.
2015 Flood Resiliency Study for Ludlow	Study to inventory flood and erosion hazard area and evaluate related impacts.	Effective in identifying vulnerable areas in town and recommending mitigation ideas for residents.	Information should be disseminated to public to be more effective.
Southern Windsor County RPC (SWCRPC)	Regional organization working to further emergency management and hazard mitigation goals	Effective in assisting towns in the adoption of new/updated regulations and the revision of planning tools.	The RPC should focus on improving the planning process and investigate additional sources for historical hazard data. Annual overview of funding opportunities would increase effectiveness.

* Resources are applicable to both the town and village except where noted.

5. HAZARD ASSESSMENT

The following assessment addresses Ludlow's vulnerability to all of the hazards identified by the Hazard Mitigation Committee during the hazard analysis. The probability of occurrence and impact to the town were used to assess the town's vulnerability to each hazard.

5.1. Hazard Identification and Impact Assessment

A hazard vulnerability assessment for Ludlow began with identifying all possible natural hazards.

The assessment considers the probability of occurrence, the anticipated amount of warning time, and potential impact, to the community of each hazard to determine the relative risk each poses.

To this overall hazard score was added an additional score to assess the 'Probability of Occurrence Over the Plan Cycle' in order to give more relative weight, and therefore priority, to those hazards that are more likely to occur. The total sum of the scores in these four categories reflects the Final Hazard Score. The results of this analysis are shown in **Table 3: Ludlow Hazard Identification and Analysis.** The ranking methodology used is detailed below.

A discussion of each of the hazards is given in the proceeding subsections under 5.2a through 5.2f. The Hazard Profile and Assessment in **Section 5** provided a basis for the selected implementation strategies and actions listed in **Table 14: 2018-2023 Mitigation/Preparedness Strategies and Actions.**

TABLE 3: Ludlow Hazard Identification and Analysis

Hazard	Probability of Occurrence	Warning Time	Potential Impact	Probability of Occurrence over Plan Cycle	Final Hazard Score
Score Range	**1 - 4**	**1 - 3**	**1 - 4**	**0 - 3**	**3 - 15**
Hurricanes/Tropical Storms[1]	2	1	3	1	7
Flood/Flash Flood/Fluvial Erosion	3	2	2	3	10
Severe Weather (Thunderstorm, Lightning, High Wind, Micro/Marco Bursts, Power Outage)*	4	3	2	3	12
Hail Storms	3	2	2	3	10
Landslide/Slope Failure	2	3	1	2	8
Severe Winter Weather (snow, blizzards, N'oreasters)**	4	1	1	3	9
Ice Storms**	4	1	3	3	11

Wildfire	1	3	2	0	6
Structure Fire	3	3	2	3	11
Brush Fire	4	3	2	3	12
Ice Jams	2	1	1	1	5
Extreme Temperatures Heat/Cold	3 / 2	1 / 1	2 / 2	3 / 3	9 / 8
Earthquake[2]	1	3	1	0	5
Tornado	1	3	2	0	6
Drought	1	1	3	0	5
Dam Failure	1	2	4	0	7

* 'Severe Weather' is defined to include two or more of the following hazards: Thunderstorm, Lightning, High Wind, Micro/Marco Bursts, Power Outage. Warning times can vary for these hazards. Hail storms will be profiled in conjunction with 'Severe Weather' as hail is a byproduct of severe thunderstorms.

** 'Severe Winter Weather' includes snow blizzards, and N'oresters. Ice storms will also be included in the profile of 'Severe Winter Weather'

** *Hazards that scored below '8' are not profiled in this plan as they are not likely to occur in Ludlow or are a way of life in Vermont and handled well by the Town. For these hazards the reader is referred the* ***State of Vermont Hazard Mitigation Plan*** *for more information.*

[1] *The Hurricanes/Tropical Storms Hazard Score is low as the region would not be expected to bear the brunt of hurricane sustained winds, but the secondary hazard of flooding scores high and is covered under 'Flood/Flash Flood/Fluvial Erosion'.*

[2] *The Earthquake score assumes that were an event to occur during the plan period, it would be minor or less than a 6 magnitude on the Richter Scale. Although this can be a significant hazard at magnitudes above 6, the likelihood of occurring in Ludlow over the plan period would be negligible based on the location distance from known epicenters and probability of occurrence data for New England, per the 2011 Southern Windsor County Regional Hazard Mitigation Plan (p27)*

Methodology Used for Hazard Analysis

Probability of Occurrence: Probability of local occurrence of hazard over time period below

1 = Unlikely	<1% probability of occurrence in the next 100 years (less than 1 occurrence in 100 years)
2 = Occasionally	1–10% probability of occurrence per year, or at least 1 chance in next 100 years (1 to 10 occurrences in 100 years)
3 = Likely	>10% but <100% probability per year (at least 1 chance in next 10 years)
4 = Highly Likely	100% probable in a year (an annual occurrence)

Probability of Occurrence over Plan Cycle: Probability of local occurrence of hazard over next 5 years.

0 = Unlikely
1 = Rarely
2 = Occasionally
3 = Likely

Warning Time: Amount of time generally given to alert people to hazard

1 = More than 24 hours
2 = 12-24 hours
3 = less than 12 hours
4 = None–Minimal

Potential Impact: Severity and extent of property damage, facilities disruption, impact on residents caused by hazard.

1 = Negligible - Isolated occurrences of minor property damage, minor disruption of critical facilities and infrastructure, and potential for minor injuries
2 = Minor - Isolated occurrences of moderate to severe property damage, brief disruption of critical facilities and infrastructure, and potential for injuries, few people in town are impacted
3 = Moderate - Severe property damage on a neighborhood scale, temporary shutdown of critical facilities, and/or injuries or fatalities, many people in town are impacted
4 = Major - Severe property damage on a town-wide or regional scale, shutdown of critical facilities, and/or multiple injuries or fatalities, most of the people in town are impacted

5.2. Hazard Profile and Vulnerability Assessment

This section includes a profile of each of the hazards most relevant to the Town of Ludlow and the Village of Ludlow. Each hazard is profiled under subsections 5.2a through 5.2f and includes:

1. a description of the hazard and its general impact on a community,
2. a discussion of historical local occurrences including trends and extent of the hazard based on available data, and
3. an assessment of the vulnerability of Ludlow's community assets to that hazard.

Ludlow is a small rural town and much of the town-specific data for these localized hazards does not exist. Previous occurrence hazard data specific to Ludlow has been provided where available. However, where no town-specific data exists, the most relevant available data or information has been provided, such as county, regional or state data, or data from a neighboring town. Ludlow, together with SWCRPC will strive to improve the recording and maintenance of local hazard data and have included this as part of the monitoring process for this plan.

The Hazard Committee had decided that only those hazards which scored an '8' or greater were considered for inclusion and are profiled in this plan.

For other hazards which scored a '7' or less, the HMC decided that these hazards be excluded as the likelihood of occurrence is very low with no account of recent local occurrence. For these hazards the reader is directed to the Vermont State Hazard Mitigation Plan (SHMP) for additional information.

Note that Ludlow determines the extent of impact of natural hazards by its effect on the community and its residents with regard to their safety and the availability of town services, as well as property and infrastructure damage. The safety of residents is considered in terms of both the potential level of risk, such as death due to local home fires, as well as the number of residents affected, as with damage to town infrastructure or loss of town services from a flood event. It should also be noted that the town considers secondary hazards in its assessment of the primary hazard.

For example, of the hazards assessed, those that were determined to be a "way of life" in rural Vermont, are typically considered less significant hazards, though they occur frequently such as snow or blizzard hazards. Small rural towns in Vermont, like Ludlow, are accustomed to dealing with this type of weather and the town and its residents are well prepared to handle it. However, the secondary hazards from severe winter weather, such as structural fires from indoor heating methods and power outages from downed power lines, would have a significant impact on the town and be reflected in the Severe Winter Weather score.

The following hazards scored an '8' or higher total impact score during the hazard analysis activity and are detailed in the Hazard Assessment and Hazard Mitigation Program sections of this plan.

Profiled Hazards:

SCORE	HAZARD
12	Severe Weather
12	Brush Fire
11	Ice Storms
11	Structure Fire
10	Flood/Flash Flood/Fluvial Erosion
10	Hail Storms
9	Severe Winter Weather
9/8	Extreme Temperatures Heat/Cold
8	Landslide/Slope Failure

The types of hazards having the greatest impact on a regional basis can be gleaned from **Table 4**, a listing of **FEMA Disaster Declarations for Windsor County** since 1990. It can be seen from this table that these are typically severe storms with heavy rains that cause flooding. Severe Winter Storms also occur;

however, harsh winters are a 'way-of-life' in Vermont and the Ludlow Town Highway Department is accustomed to operating in heavy snows and low temperatures. Other hazards such as flooding, wildfires, ice jams and landslides are more localized and characteristic of a town's topography, roadways, infrastructure, location of critical facilities, and land use.

TABLE 4: Federal Disaster Declarations for Windsor County VT

Federal Disaster Declarations: Windsor County 1990 – 2018(current)		
FEMA Disaster Number	**Date of Declaration**	**Description**
4356	January 2, 2018	Severe Storms and Flooding
4330	August 16, 2017	Severe Storms and Flooding
4207	February 3, 2015	Severe Winter Storm
4140	August 2, 2013	Severe Storms and Flooding
4120	June 13, 2013	Severe Storms and Flooding
4066	June 22, 2012	Severe Storm, Tornado, and Flooding
4043	November 8, 2011	Severe Storms And Flooding
4022	September 1, 2011	Tropical Storm Irene
4001	July 8, 2011	Severe Storms And Flooding
1995	June 15, 2011	Severe Storms And Flooding
1951	December 22, 2010	Severe Storm
1790	September 12, 2008	Severe Storms and Flooding
1784	August 15, 2008	Severe Storms, Tornado, and Flooding
1778	July 15, 2008	Severe Storms and Flooding
1715	August 3, 2007	Severe Storms and Flooding
1698	May 4, 2007	Severe Storms and Flooding
1559	September 23, 2004	Severe Storms and Flooding
1488	September 12, 2003	Severe Storms and Flooding
1428	July 12, 2002	Severe Storms and Flooding
1358	January 18, 2001	Severe Winter Storm
1336	July 27, 2000	Severe Storms And Flooding
1307	November 10, 1999	Tropical Storm Floyd
1228	June 30, 1998	Severe Storms and Flooding
1184	July 25, 1997	Excessive Rainfall, High Winds, Flooding
1124	June 27, 1996	Flooding
1101	February 13, 1996	Storms and Flooding
1063	August 16, 1995	Heavy Rain, Flooding
990	May 12, 1993	Flooding, Heavy Rain, Snowmelt
938	March 18, 1992	Flooding, Heavy Rain, Ice Jams
875	July 25, 1990	Flooding, Severe Storm

5.2a. Severe Weather

For the purposes of this Hazard Mitigation Plan, severe weather is defined as being two or more of the following hazards occurring together: thunderstorms, power failure, high wind, and lightning. Hail is also addressed here, even though the HMC scored it separately, because hail often accompanies thunderstorms.[4] Each hazard is described below. The Severe Weather hazard scored a '12' in the hazard analysis, making it one of the two highest scoring hazards for Ludlow due largely to its high probability of occurrence and short warning time.

Severe thunderstorms are a relatively common hazard in Vermont. Although typically short in duration, they are capable of producing damaging winds, heavy rain and flooding, dangerous lightning and large hail. Multicell cluster thunderstorms are likely to cause local flash flooding.

High Winds from a thunderstorm can gust up to 50 mph and cause property damage and disruption in electric and telecommunication utilities, transportation, and commercial businesses. Although difficult to predict, these storms also pose a high risk of injuries and loss of life. The downward draft from these storms can produce ***microbursts*** which are not uncommon in Vermont. These events can come with wind speeds in excess of 80 mph, and pose an additional threat to low flying aircraft, making it difficult for them to maintain altitude. Although less common in Vermont, super cell thunderstorms are the largest, longest lasting, and most devastating thunderstorms, which can produce tornadoes and widespread destruction of crops and property. Tropical storms, hurricanes, nor'easters, and winter storms can also cause high wind damage throughout the state.

The Beaufort Wind Scale shown below can be used to predict damage based upon wind speeds. The National Weather Service issues Wind Advisories when sustained winds of 31-39 miles per hour are reached for at least one hour or gust between 46-57 miles per hour and High Wind Warnings for winds of 58 mph or higher. Thunderstorm winds tend to affect areas of Vermont with significant tree stands as well as areas with exposed property and infrastructure and aboveground utilities. [5]

Beaufort Wind Scale		
Classification #	**Wind Speed**	**Land Conditions**
6	25 to 31 mph	Large branches in motion; whistling in telephone wires
7	32 to 38 mph	Whole trees in motion; inconvenience felt walking against wind
8 to 9	39 to 54 mph	Twigs break off trees; wind generally impedes progress
10 to 11	55 to 73 mph	Damage to chimneys and TV antennas; pushes over shallow rooted trees
12 to 13	74 to 112 mph	Peels surfaces off roofs; windows broken; mobile homes overturned; moving cars pushed off road
14 to 15	113 to 157 mph	Roofs torn off homes; cars lifted off ground

[4] 2018 State of Vermont Hazard Mitigation Plan
[5] 2018 State of Vermont Hazard Mitigation Plan

Lightning**,** the most unpredictable related hazard, can strike up to 50 miles away from a thunderstorm and carry up to 100 million volts of electricity reaching temperatures upward of 50,000°F. It is extremely hazardous to human life, and can also damage infrastructure, buildings and property, and can start forest fires. Lightning is the most unpredictable weather-related event. A combination of a severe lighting storm during a severe drought or dry spring conditions can ignite wildfires which can be devastating. Local data on historical occurrences or impacts of this hazard is not available.

Hail is a form of precipitation that falls as pellets of ice. The size of hail can typically range in size from pellet to golf ball size, though can be much larger during severe occurrences. Hail can be especially damaging to crops, structures and vehicles, and large hailstones can be deadly to livestock and people caught outside during an event.

Power Failure is a common secondary hazard caused by severe weather and has an annual frequency within Windsor County. Power outages can occur on a town-wide scale and are typically the result of power lines damaged by high winds or heavy snow or ice storms, but may also result from disruptions in the New England or national power grid as indicated by the widespread outages in 2003.

Dead or dying trees in proximity to power lines pose a particular threat for power failure, as these trees are often brought down by triggering events such as winter storms.

Potential loss estimates are difficult to predict for power failures as they are typically isolated in geographic area and short in duration. Therefore, power failures often have only minimal impact to people and property, however, longer duration events may result in the loss of perishable items and business losses. Power outages in winter months may result in the loss of home heating, ruptured water pipes, and the resulting structural damage. The loss of home heating may be a contributing factor to the increase in structure fires during the winter months. Local data on historical occurrences, extent of outage and associated costs are not available.

Extent and Historical Trend – Severe Weather

Thunderstorms and associated hazards can occur anywhere in Vermont at any time of the year; however, spring and summer are the most common times for severe thunderstorms. Ludlow largely exemplifies this trend; the two recorded thunderstorms that caused property damage in the Town occurred in summer and early fall. Since damaging thunderstorms have occurred roughly once every three years in Ludlow, it is very likely that one will occur during the 2018-2023 Plan cycle. The most recent severe thunderstorm in Ludlow occurred on July 4, 2017 producing high winds and large hail causing tree damage.

TABLE 5: Thunderstorm Damages in Ludlow, 1/1/2012 – 5/31/2018[6]

Estimated Property Damage	Crop Damage	Date of Storm	Fatalities
$10,000	0	9/11/2013	0
$5,000	0	7/17/2017	0

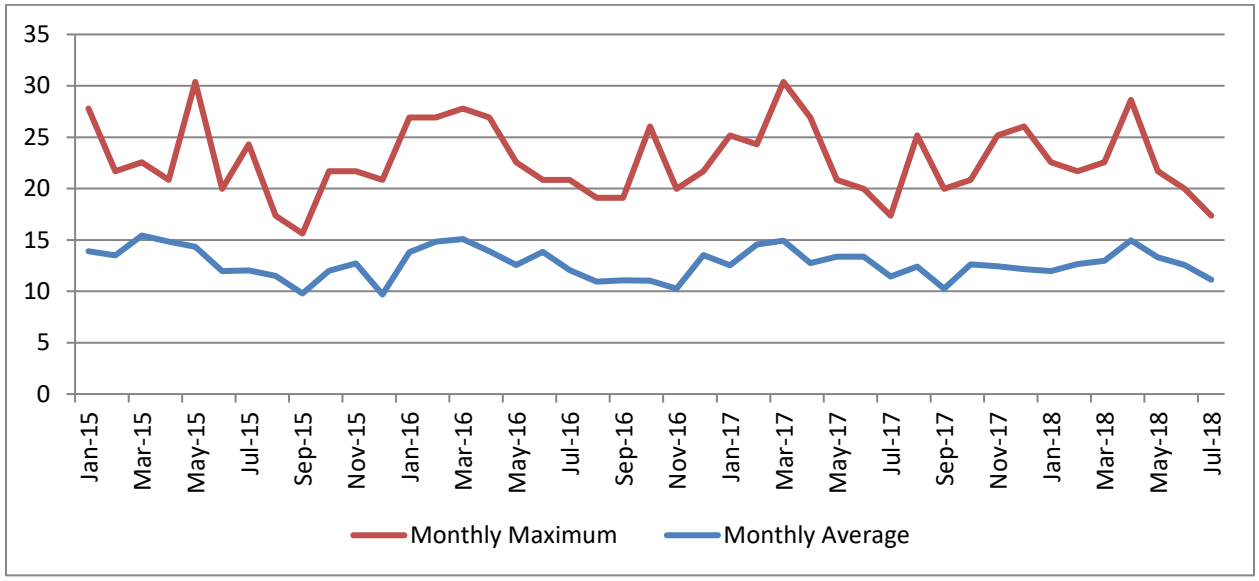
One example of a **high wind** event in Vermont was the Nor'easter of April 2007 that resulted in a federal disaster declaration: DR 1698. "High winds during this April storm resulted in many trees down and damage to some private homes and public infrastructure, primarily in southern Vermont." [7] **Table 6** below lists additional recorded high wind events in Windsor County from 2012-May, 2018. During this 6.5 year period, seven further damaging wind events were recorded. Assuming this trend continues, it is very likely that multiple damaging wind events will occur in Windsor County during the 2018-2023 Plan cycle. As a point of comparison, monthly average and maximum sustained wind speeds[8] from nearby Hartness Airport located in Springfield are presented in **Figure 1**.

TABLE 6: High Wind Event Damages in Windsor County, 1/1/2012 – 5/31/2018[9]

Estimated Property Damage	Crop Damage	Date of Storm	Fatalities	Wind Speed (kts.)
$5,000	0	1/18/2012	0	43
$20,000	0	10/29/2012	0	40
$10,000	0	1/20/2013	0	39
$15,000	0	10/7/2013	0	43
$25,000	0	2/29/2016	0	39
$20,000	0	5/5/2017	0	43
$50,000	0	10/30/2017	0	43

[6] NOAA, National Centers for Environmental Information
[7] 2018 State of Vermont Hazard Mitigation Plan
[8] The National Weather Service defines Sustained Wind Speed as: "Wind speed determined by averaging observed values over a two-minute period"
[9] NOAA, National Centers for Environmental Information

FIGURE 1: Hartness Airport Average and Maximum Sustained Wind Speeds (Kts.)[10]



Hail events are considered an infrequent occurrence in Vermont and generally accompany passing thunderstorms. They are much more frequent during the summer months than at any other time of year. Their extent is difficult to determine but tend to be highly localized and very short in duration, with hail size of < 1 inch in diameter. Regardless of its size, hail can damage property and crops and cause harm to those caught outside.[11] Since the event noted in the table below, an isolated event occurred in the Village in August 2018 producing large damaging hail.

TABLE 7: Hail Event Damages in Ludlow, 1/1/2012 – 5/31/2018[12]

Estimated Property Damage	Crop Damage	Date of Storm	Fatalities	Hail Size (in.)
$5,000	0	7/17/2017	0	1.00

Vulnerable Assets – Severe Weather

For the Severe Weather hazard category, all Ludlow residential areas are vulnerable to **power outages** from **high wind** events as those areas tend to be more wooded. Town assets are located in developed downtown areas with less trees and are not particularly vulnerable to this hazard. Based on the wind data from **Table 5**, the expected magnitude for future high wind events will fall between around 40 knots

[10]Historical wind speed data from NOAA: National Environmental Satellite, Data, and Information Service

[11] 2018 State of Vermont Hazard Mitigation Plan

[12] NOAA, National Centers for Environmental Information

(approximately 45 mph), or Beaufort scale number 8-9, and will likely result in downed trees, power lines, and small damage. However, the possibility does remain for larger high wind events such as the 1998 F3 tornado on the Enhanced Fujita Scale and localized microbursts. Clearing overhanging, leaning, and dying trees near power lines is part of annual town-wide maintenance to minimize impact from high winds.

5.2b. Wildland Fire/Brush Fire/Structure Fire

Fires, including brush fires and structure fires, were identified during the hazard analysis and vulnerability assessment as relatively high hazards to the Town of Ludlow with scores of 12 and 11, respectively. Based on scoring, brush fire is a hazard of primary concern to the community, while wildfire/forest fire scored considerably lower as it is expected to occur with much less frequency. Since data is unavailable that addresses brush and forest fire separately, the two will be addressed together here under "Wildland Fires".

Wildland Fires, which for discussion here include forest, brush, crop or grassland fires, are defined as *'An uncontrolled burning of woodlands, brush or grasslands."* [13] Wildland fires have the potential to damage structures and utilities as well as forest and croplands.

The State Hazard Mitigation Plan's analysis of wildfire threat states that *"Wildfire conditions in Vermont are typically at their worst either in spring when dead grass and fallen leaves from the previous year are dry and new leaves and grass have not come out yet, or in late summer and early fall when that year's growth is dry".* [14]

In addition to lack of precipitation, a particular town's vulnerability to large wildfires is directly related to the proportion and continuity of acreage that is forested, pasture and cropland. Although large wildfires are always a threat, particularly for rural communities with large tracts of forested and vegetative land, such as Ludlow, the Town's vulnerability is mostly dependent upon weather conditions, climate change, and continued outreach efforts to provide information on wildland fire prevention and enforcement of 'red flag' warnings to restrict controlled burning during dry season.

Structural fires were identified as having a high possible risk to the town, with a score of 11, due to their high probability of occurrence, short warning time, and potential for catastrophic loss. Structure fires are common throughout Vermont during the winter months as residents heat their homes with wood or wood pellet burning stoves. With little or no warning, these fires can affect a single residential structure or spread to other homes, businesses or apartment complexes and can result in loss of property and life. Fires can be caused by improperly disposing of ashes with live coals from wood stoves or by faulty electrical wiring and misuse of space heaters. The Vermont Fire Marshal Reports identify the leading causes of structure fires to be the result of heating and cooking incidents. The most significant common

[13] 2018 Vermont State Hazard Mitigation Plan
[14] 2018 Vermont State Hazard Mitigation Plan

factor in fire fatalities in Vermont continues to be the absence of a functioning smoke detector in the sleeping area of residential structures.

"*While the fire problem varies across the country, there are several common contributing factors such as poverty, climate, education, code enforcement, demographics and other factors that impact the statistics. Like the rest of the country, heating appliance and cooking fires in Vermont continue to be the leading causes of structure fires. The leading factor contributing to home heating fires was failure to clean creosote from solid-fueled heating equipment chimneys. The long cold Vermont winters put added stress on heating systems. Further-more, fluctuating fuel prices can force people to use alternative heating sources that may not be safe. An improperly installed and maintained heating appliance is dangerous and can result in carbon monoxide poisoning or be the source of a fire.*" [15]

According to the National Fire Protection Association, 25% of all structure fires are in residential construction. In Vermont, residential related fires accounted for 68% of total structure fires in 2017.[16]

Over the past 10 years, the top cause for residential fires has consistently been related to home heating.

Although the number of fire deaths has ticked higher in 2016 and 2017, compared to other states are[17]

- Age of Housing Structures - 33% of all homes were built before 1950.
- Extreme Winter Temperatures – Vermont is the 7th coldest state.
- Higher Risk Population -2nd oldest median age where the elderly is at higher risk. Over the last 4 years, 68% of Vermont's fire deaths have been seniors over the age of 60.
- Home Heating Methods - 1st for per capita use of wood for heating.

Extent and Historical Trend - Structural Fire/Wildfire/Brush Fire

Both structure fires, brush fires and wildland fires have historically been reported in the annual *Vermont State Fire Marshal Report* which provides yearly fire statistics from reporting departments and by county. In the 2017 State Report, there were over 40,000 emergency incidents statewide, 2,500 of which were related to fire. A total of 10 civilian fatalities were reported as a result of a fire incident with 77% over the age of 40.[18]

[15] 2015 Vermont Fire Marshal Annual Report
[16] 2017 Vermont Fire Marshal Annual Report
[17] 2013-2015 Vermont Fire Marshal Annual Report
[18] 2017 Vermont Report of the State Fire Marshal

	2013	2014	2015	2016	2017	5 - year Total
Heating Equipment	0	0	2	3	0	5
Cooking	0	0	0	0	1	1
Smoking Materials	0	4	0	1	1	6
Open Flame	1	0	1	1	2	5
Explosion	0	0	1	0	0	1
Electrical	1	0	0	1	1	3
Undetermined	2	2	2	6	5	17
Homicide	0	0	1	0	0	1
Totals	4	6	7	12	10	33

Vermont Fire Death Causes by Type of Fire, 2017 Vermont Report of the State Fire Marshal

Year	Fire Departments Reporting	Fires Reported	Estimated Dollar Loss by Fire Departments	Insurance Companies Reporting/ Total	Fire Claims Reported	Reported Dollar Loss by Insurance Companies
2012	194	2,233	$ 17,840,192	860	839	44,510,095
2013	194	2,116	$ 26,485,951	615	878	50,911,724
2014	228	2,114	$ 30,412,139	615	1,130	50,589,356
2015	230	2,198	$ 25,112,224	606	939	45,574,673
2016	228	3,138	$16,919,906	**644**	**706**	**57,098,292**
2017	**172**	**2,458**	**$ 21,029,493**	Data not currently available		

According to the 2017 data compiled by the National Fire Incident Reporting System for Vermont as shown to the left[19], local fire departments reported a total of 2,458 incidences relating to structure fires with an estimated dollar loss of $21,029,493, or $8,555 per incident. The calculated annual average number of structure fires in Ludlow from 2007-2017, excluding 2015 and 2016,[20] is eight. Applying the $8,555 cost per incident to Ludlow then, the average annual loss due to structural fire is estimated to be $68,440.

Vermont's prime seasonal conditions for **wildland fires** are in the spring and fall. 'Despite the drought in 2016-2017, Vermont's 2017 Wildland Fire Program Annual Report notes that 2017 fire season was well below normal at 49 acres burned from 51 fires. The average between 2012 and 2016 was 109 fires and 317 acres per year, giving. These numbers were below normal and lowest since 2011.'[21] This was, in part, due to heavy winter snow melt and wetter and cooler spring months.

According to the State of Vermont Hazard Mitigation Plan, 'there has not been a major wildfire in Vermont in the last 50 years. Vermont has a reliable system of local fire suppression infrastructure coordinated at the state-level. Vermont's climate, vegetation type, and landscape discourage major wildfire.'[22] However,

[19] *NFIRS and Insurance Company Data, 2017 Vermont Report of the State Fire Marshal*

[20] Total number of structure fires for Ludlow was unavailable for these years, see below.
[21] 2018 Vermont State Hazard Mitigation Plan
[22] 2018 Vermont State Hazard Mitigation Plan

brush fires or burning debris are the major causes for wildland fires according to the Vermont Department of Forests, Parks and Recreation.

Table 8 below shows historical data for structure and wildland fires in Windsor County, where available, from the *Annual Report of the State Fire Marshal* and data from the Town of Ludlow as reported to the National Fire Incident Reporting System. As of 2016, the Fire Marshall Report no longer reports fire statistics by county nor does it breakdown fire by structure and wildland. The majority of these incidents are structure related fires.

TABLE 8: Fire Statistics for Windsor County and Town of Ludlow

YEAR	Windsor County[23]			Ludlow[24]		
	Structure Fire Responses	Wildland Fire Responses	Total	Fire-NFIRS Series 100	Structure Fire Responses	Wildland Fire Responses
2007	-	-	-	-	1	0
2008	-	-	-	-	9	3
2009	177	68	245	-	13	0
2010	181	70	251	-	9	0
2011	181	70	251	-	10	2
2012	201	101	302	-	9	2
2013	229	86	315	-	7	2
2014	-	-	-	-	10	3
2015	239	89	328	22	-	-
2016	-	-	-	20	-	-
2017	-	-	-	9	2[25]	2[26]
Annual Average	201	81	282	17	8	2

A special report from the *2015 Spring Fire Season Summary* published by the *Vermont Department of Forests, Parks, and Recreation* provides fire statistics shown below. The report indicates that the average number of acres burned per wildfire incident over a 10-year period (2005-2014) was 2.2 acres. Using this average to estimate the extent of potential wildland fire hazard for Ludlow would give an annual loss of about 4 acres. This can be compared with large fire activity in the spring of 2015 including a 26-acre forest fire in Andover, Windsor County, caused by a re-kindled brush fire; a 47-acre forest fire in Brattleboro, sparked by a downed powerline; and a 137-acre forest fired in Norwich, also caused by a downed

[23] Vermont Annual Report of the State Fire Marshal. As of 2016, this report no longer reports incidents by county.
[24] Vermont Annual Report of the State Fire Marshal
[25] 2017 Ludlow Town Report, Includes "Structure" and "Chimney" Fires
[26] 2017 Ludlow Town Report

powerline. These incidents occurred during a moderately dry spring for Windsor County when red flag warnings were issued by the National Weather Service.

Fire Statistics

	2015 Fire Statistics		10-Year Average 2005-2014	
Official reports – reports have been verified by warden or FPR				
	#Fires	#Acres	#Fires	#Acres
March	2	1	9	29
April	38	50	62	142
May	51	284	19	30
Year to date	91	335	90	201

2015 Spring Fire Season Summary/Vermont Dept. of Forests, Parks and Recreation.

Vulnerable Assets - Structural Fire/Wildfire/Brush Fire

An assessment of town structures vulnerable to structural fire would be based on age and proximate location to other high-risk structures. Community assets are not particularly vulnerable to wildfires as they are typically located in town centers and away from large tracts of forested and vegetative land. However, with expectations of more frequent drought conditions and increased wildfire risk, the town will plan to use available resources, like Firewise outreach programs, to educate community on how to minimize the risk of brush and wildfires and to issue dry weather alerts when the risk wildfire is high.

Higher death rates from fire statistically correlate to population factors including elderly population, adult smokers, poverty rates, and education.

The most significant common factor in fire fatalities in Vermont continues to be the absence of a functioning smoke detector in the sleeping area of residential structures.

In Vermont, structure fires can be caused by improperly disposing of ashes with live coals from wood stoves, lit cigarettes, failure to clean creosote from solid-fuel heating equipment chimneys, or faulty electrical wiring. The high proportion of seasonal occupations and rentals in Ludlow increases the likelihood of structure fires from improper operation and maintenance of solid-fuel heating systems due to lack of knowledge on the part of residents.

***Firewise*,** a community outreach program through the National Fire Protection Association provides guidance, resources, and training on protecting homes and property from wildfire hazards. The Firewise website (www.firewise.org) is an excellent resource for literature and community mitigation actions. The Vermont Annual Fire Marshal Report also offers informational resources for municipalities and property owners on fire safety.

Although structural and wildfire incidents in Ludlow can fluctuate from year to year, the probability of occurrence remains high with the projection of more extreme temperatures and continued periods of draught due to climate change. Ludlow residents remain particularly vulnerable to structural fires, which are more likely to cause physical harm and damage to homes, because many of the residents heat their homes using open flame options, such as wood or pellet burning stoves. The town also has a high vacation rental population during winter months with Okemo Mountain Resort. Most renters stay for brief periods and can be unfamiliar with potential fire risks. Enhanced efforts to inform residents and renters of safe home heating and installation of smoke detectors is the most effective way to help mitigate this threat.

The Town is concerned about patterns of development in the rural parts of town and within Okemo Mountain Resort. Residential developments continue to be constructed among large continuous blocks of forest, increasing the risk of large-scale damage from wildland fires. The Town wishes to educate developers about the dangers of this kind of development, and to suggest the implementation of practices such as fire breaks in order to lessen the risk.

5.2c. Flood/Flash Flood/Fluvial Erosion

Flooding, including **flash flooding** and overbank or **inundation flooding**, are significant natural hazard events for Windsor County and Ludlow.

The town is particularly susceptible to inundation flooding in lower lying areas of the Village and also to flash flooding in higher elevation areas.

There is also the risk of flash flooding causing dikes and dams to breach causing further damage downstream. These events are frequently caused by excessive rainfall over an extended period of time, heavy spring snow runoff, and ice jams.

"Flash flooding is characterized by intense, high velocity torrent of water that occurs in an existing river channel with little or no notice. Flash floods are very dangerous and destructive not only because of the force of the water, but also the hurling debris that is often swept up in flow." [27] This type of flooding threatens high-elevation drainage areas and typically occurs during summer when a large thunderstorm or a series of rain storms result in high volumes of rain over a short period of time, particularly on already saturated soils from a spring melt. Flash floods can also be triggered by a dam breach.

The damage from spring flooding events can vary greatly depending upon the amount of precipitation, snow cover, spring melt, soil saturation, existing erosion and topography. Infrastructure and structures within the narrow stream valleys receive drainage from the higher elevations and are often the most vulnerable to damage from flash flooding. Although flash floods are not frequent events, hazards posed can be significant as seen with the state-wide flooding from Tropical Storm Irene in the summer of 2011.

[27] INTERMAP http://www.intermap.com/risks-of-hazard-blog/three-common-types-of-flood-explained

Overbank flooding occurs in lower lying areas when water levels rise overflowing the banks of a river or stream. In hilly or mountainous areas this typically happens in valley areas when drainage from higher elevations flow to the lower reaches of a watershed carrying debris which can block culverts and the underpass of bridges.

The Federal Emergency Management Agency (FEMA) has designated flood zones, as defined below. The Special Flood Hazard Areas, which are comprised of the Floodway and Floodway Fringe, are particularly at risk for flooding.

Flood Zone Definitions	
Floodway	The channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height; also known as the regulatory floodway. As designated and determined by FEMA.
Floodway Fringe or Floodplain	The remaining portion of special flood hazard areas after exclusion of the floodway; also known as floodplain.
Fluvial Erosion	The erosion or scouring of riverbeds and banks during high flow conditions of a river. Fluvial erosion can be catastrophic when a flood event causes a rapid adjustment of the stream channel size and/or location.
Fluvial Erosion Hazard Zone	Includes the stream and adjacent lands necessary to accommodate the slope and plan form requirements of a geomorphically stable channel, and is subject to fluvial erosion as defined by the Vermont Agency of Natural Resources and delineated on the current Fluvial Erosion Hazard Zone Map.
Special Flood Hazard Area	The land in the flood plain within a community subject to a 1 percent or greater chance of flooding in any given year; also known as floodplain. As designated by FEMA.
River Corridor	The land area adjacent to a river that is required to accommodate the dimensions, slope, planform, and buffer of the naturally stable channel and that is necessary for the natural maintenance or natural restoration of a dynamic equilibrium condition and for minimization of fluvial erosion hazards, as delineated by the Agency of Natural Resources in accordance with river corridor protection procedures.

Fluvial Erosion, which often accompanies flood events, is the predominant form of flood damage in Vermont. Rivers are dynamic and move both water and sediment. As a result, river channels may move vertically or horizontally. High flows can cause sediment to become detached from a riverbed or riverbanks and can range from gradual bank erosion or massive slope failure to catastrophic changes in river channel location and dimension. The sediment and stone that is dislodged can expose roots of trees and vegetative buffers which become detached and carried downstream blocking culverts and bridges causing further flood damage.

Reasons for Vermont's vulnerability to this hazard are its topography, extreme climate, deep snows, destructive ice jams and intense rainstorms. Centers of commerce in villages and towns became concentrated along river banks, forests were cleared, and overtime, many rivers moved or channelized to accommodate this development rendering them unstable and prone to fluvial erosion. [28]

[28] Municipal Guide to Fluvial Erosion Hazard Mitigation, Vermont Agency of Natural Resources

Fluvial erosion can severely threaten mountain communities like Ludlow as most of rural town development lies in valley areas along rivers and streams, as is the case for Ludlow.

Areas within the river corridor are also considered areas of flood and erosion risk as rivers and streams seek equilibrium in accommodating the high flows causing major flood and erosion damage outside of special flood hazard areas. Vermont Agency of Natural Resources has mapped river corridors for these stream segments along with special flood hazard areas which are shown **in Appendix A, Map #3-Water Resources and Flood Resiliency** and can be found on-line.[29]

Ludlow Watershed Background

The vast majority of the Town of Ludlow, including all of Village, lies within the Black River watershed. A small portion of the southeast corner of the town is located in the upper Williams River watershed.

"The Black River watershed in southern Vermont drains approximately 204 square miles of land primarily within the towns of Plymouth, Ludlow, Cavendish, Weathersfield and Springfield. The Black River has seven major tributaries and flows into the Connecticut River. There are many different changes which are happening in the Black River watershed every day. Some, like bank erosion and gullying, take some time to occur with the changes slowly becoming apparent over years or decades. Other impacts of erosion and deposition on the river channel, like debris and ice jams, have more immediate impacts on the river channel and surrounding lands." [30]

The Black River Phase 1 and 2 Geomorphic Assessments were completed in 2007 and 2009, respectively, with the *Black River Corridor Management Plan* released in 2011. These watershed assessments and management plans focus primarily on hazard mitigation, local water quality and resource conservation. The overarching strategy is to protect the river corridor by giving the stream/river the space needed to find its own natural equilibrium which will minimize, in the long run, hazards related to flooding, flash flooding, fluvial erosion and ice jams. The Black River Corridor Management Plan has assessed the sensitivity of reaches along the Black River from Lake Rescue area, north of the Village, through the Village along Route 103 to the Town Wastewater Treatment facility. According to the plan, the higher the "sensitivity", the more likely that reach of river is expected to experience rapid adjustment in channel dimension and location during storm events.

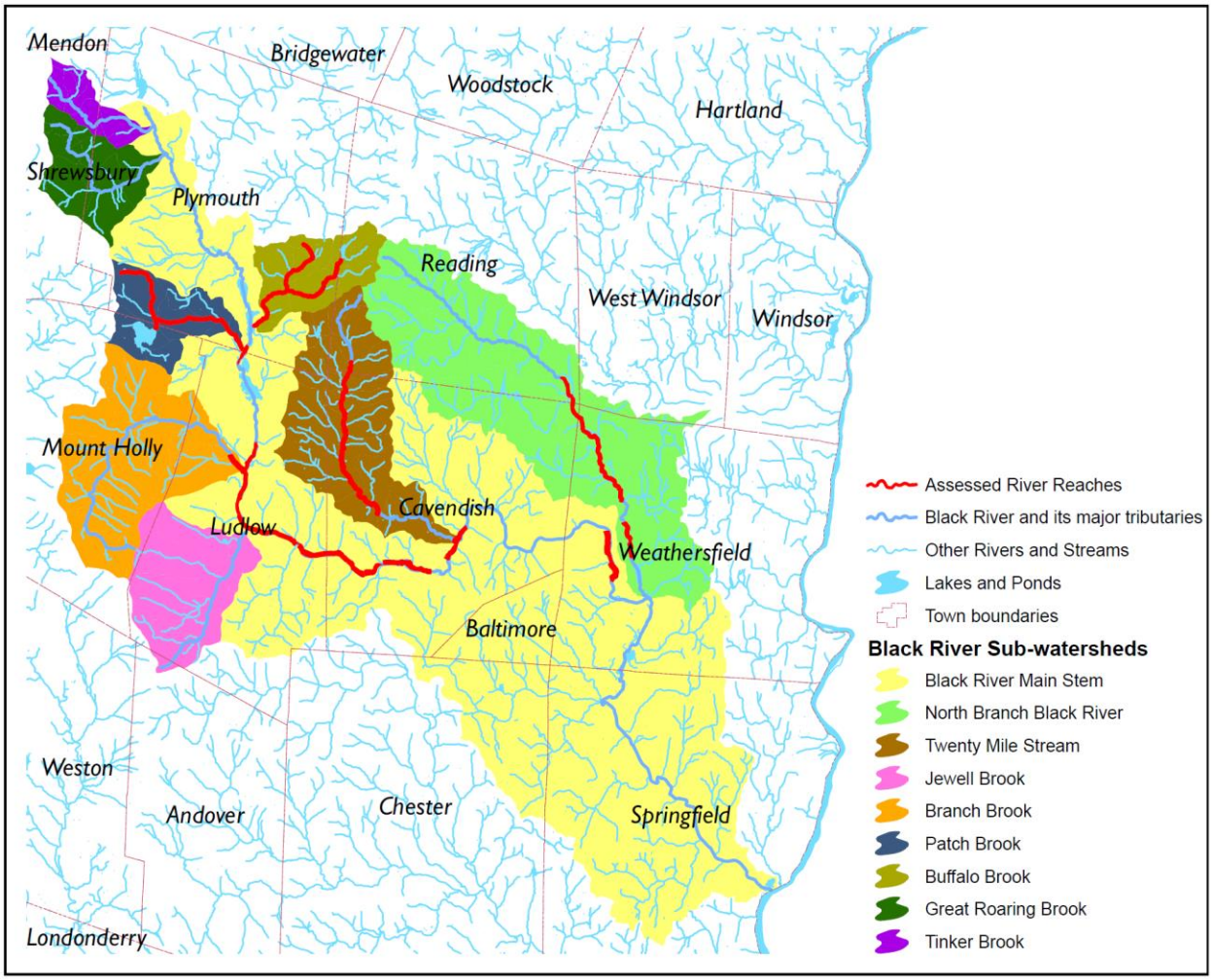
The sensitivity of the Black River main stem which runs through Ludlow has been assessed in these studies as High to Extreme,

[29] The ANR FLOOD READY link shows river corridors overlays and FEH zones, http://floodready.vermont.gov/assessment/vt_floodready_atlas.

[30] Black River Corridor Management Plan, June 2011

due a number of factors including bank armoring, loss of streambank vegetation, loss of wetland and floodplain access and increased stormwater flow from impervious surfaces in developed areas. A number of priority actions were recommended and are summarized in **Appendix F**.

FIGURE 2: Black River Watershed and Sub-watersheds



The most development can be found along the Black River Main Stem, a sub-watershed of the Black River shown in the map below taken from the river corridor plan.[31] Other Black River sub-watersheds within Ludlow include Jewel Brook, Branch Brook and a portion of the Twenty Mile Stream, all tributaries of the Black River.

[31] Black River Corridor Management Plan, June 2011.

Over the past five years, Ludlow has issued a total of 407 permits (320 in the Town of Ludlow and 87 in the Village of Ludlow), with 12 of those permits (10 in the Town of Ludlow and 2 in the Village of Ludlow) approved for development in the floodplain. It is surmised that this development has not increased the overall flood hazard risk to the Town or Village as the permitted structures in the floodplain were primarily accessory structures (i.e. decks) requiring approval by Vermont's Agency of Natural Resources based on FEMA regulation standards. In addition, recent updates to the Town and Village Zoning By-laws and Flood Hazard Regulations were modified to increase the stream setback along major tributaries, reducing Ludlow's potential vulnerability to flood and fluvial erosion.

Extent and Historical Trend – Flood & Fluvial Erosion

Table 4: **FEMA Disaster Declarations for Windsor County from 1990-2018** shows that of the 29 disaster declarations for Windsor County, 27 were related to flooding. One of the worst widespread flood disasters recorded in the State of Vermont that occurred in November, 1927, dropped nearly 10 inches of rain on frozen ground causing extensive damage statewide. Relatively recent widespread flooding occurred in June, 1973, when up to 6 inches of rain fell resulting in $64 million in damage. However, over the past several years, flooding has occurred in limited areas of the State from intense, scattered storm events and ground saturation from persistent and excessive rainfall.

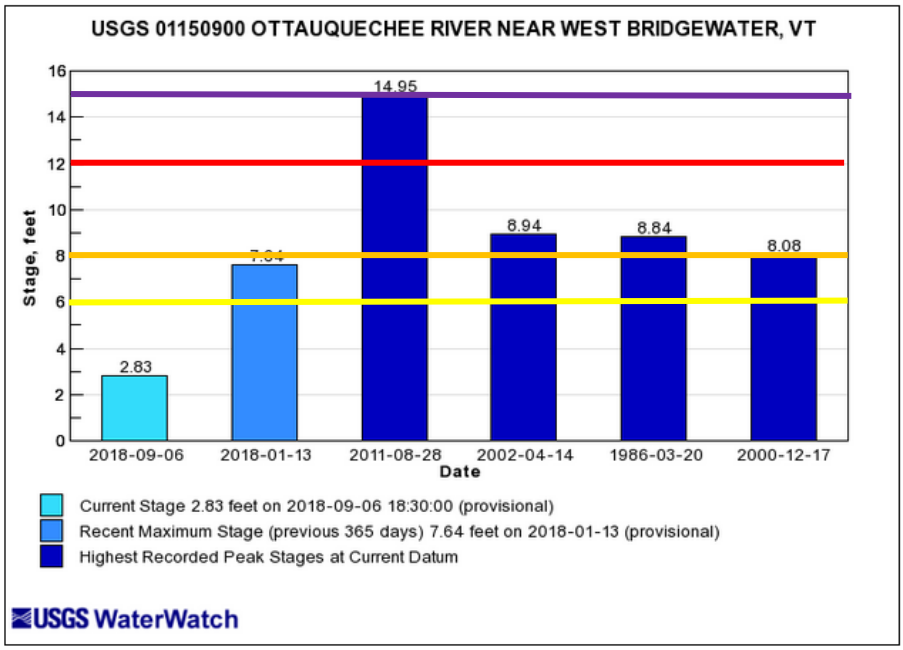
This characterized the pattern of flooding in 2011 when four regional disaster declarations were issued in Vermont due to flooding and fluvial erosion. The fourth was Tropical Storm Irene in late August when up to 11 inches of rain fell in some areas of the State. Tropical Storm Irene is also covered under the **"Tropical Storms/Hurricanes" (Section 5.2c)** hazard with additional discussion on the variation in rainfall amounts throughout the State with this storm.

On August 28 and 29 in 2011, Tropical Storm Irene dropped 3 to 5 inches of rainfall on much of Vermont, with some areas receiving more than 7 inches of rain. The heavier rainfall totals tended to fall in higher elevation areas, including Ludlow, which made the impacts of the event much worse in and around those steep headwater areas. Ludlow experienced significant, widespread damage from Tropical Storm Irene, as can be seen from **Appendix A, Map 5: Road Network Damage from Tropical Storm Irene**.

The USGS maintains a river gauge on the Ottauquechee River in West Bridgewater, site #01150900, located within Basin 10 north of the Town of Ludlow, which is the closest daily USGS monitored gauge location unimpeded by instream structures (See **Chart 1**). In the chart below USGS WaterWatch[32], which displays historic peak data on gauge height relative to National Weather Service Flood Stage levels, shows the gauge height approached Major Flood Stage during Tropical Storm Irene.

[32] http://waterwatch.usgs.gov accessed in May 2018, Toolkit, Flood-Tracking Chart

CHART 1: Historical Gage Heights for Ottaquechee River Near West Bridgewater, VT



Major Flood Stage:	15
Moderate Flood Stage:	12
Flood Stage:	8
Action Stage:	6

***Note** the gauge height approached 'Major Flood Stage' of 15 feet during Tropical Storm Irene. Prior to Tropical Storm Irene in 2011 and, since 2000, the next highest recorded peak stages were at 'Flood Stage' in the range of 8 to 9 feet in 2002 and most recently in January 2018 when gauge height hit 7.94 feet.*

> *"On August 28, 2011, 'Irene' wreaked havoc on Ludlow roads, residential properties and area businesses. The Water/Wastewater Treatment Facility and Little League Fields were also severely impacted. Nearly every road in Ludlow sustained significant damage, as did the East Lake/Route 100 Bridge, Mill Street Bridge, Pleasant Street Extension Bridge and large culverts on Trailside Road and East Lake Road." The total damage from the storm is currently estimated at $2.5 to $3 million…..The Village's insurance through the Vermont League of Cities & Towns will cover much of the damage sustained at the Water and Wastewater Treatment Facility."* [33]

The following summarizes Irene damages based on information from the municipal offices: [34]

- Town of Ludlow = $2,168,008.02
- Village of Ludlow = $360,000+
- Village of Ludlow Electric Light Department = $38,660+
- Seventeen (17) properties asked for tax relief due to the storm damage
- A total of eight (8) properties requested relief from their water and wastewater charges
- Two (2) restaurants were devastated by flood waters and had to completely rebuild

[33] *2011 Ludlow Annual Report*
[34] *2015 Flood Resiliency Study for Ludlow VT, 5/14/2015*

Figure 3: Inundation Flooding at Walker Bridge on Main Street in Ludlow following Tropical Storm Irene

Figure 3b: Inundation Flooding at Shaws Shopping Plaza in Ludlow following Tropical Storm Irene

The pictures above show the extent of inundation flooding that occurred in the Village following Tropical Storm Irene. Since 2011, Windsor County has experienced an additional five Federal Disaster Declarations due to flooding. According to the *2013 State of Vermont Hazard Mitigation Plan*, studies show that areas of the State can expect a greater frequency of flooding with an increase in extreme rainfall amounts.[35]

Erosion along rivers and streams is the predominant form of flood damage in Vermont. Ludlow is more likely to experience **fluvial erosion** along the Black River tributaries. The mainstem riverbanks have been straightened and armored to protect against erosion over the years. However, these practices have destabilized these river reaches making them more prone to dramatic avulsion. A notable historic avulsion a quarter-mile long occurred on the Black River in Cavendish during the 1927 flood when the river bypassed the Cavendish Gorge and eroded approximately 2 million tons of sediment down to bedrock leaving a channel 150 feet deep and 600 feet wide. [36]

The photo on the left is an example of the extent of fluvial erosion which occurred during Tropical Storm Irene resulting in extensive loss of property and home damage.

Figure 4: Erosion event in Ludlow

Vulnerable Assets – Flood & Fluvial Erosion

Flooding is one of the primary natural disasters in Vermont. According to information provided by the Agency of Natural Resources (ANR) at the 2014 Municipal Day and as stated in the Town Plan Flood Resiliency section, "flooding accounted for 5% of hazard events, but 67% of the hazard losses. . . that occurred statewide between 1960 and 2009. According to the Vermont Economic Resiliency Initiative website, 25% to 40% of businesses affected by a disaster never reopen." [37]

In 2015, the Town and Village of Ludlow completed a Flood Resiliency Study to inventory flood and erosion hazard areas and evaluate related impacts on the Town and Village areas. As can be seen in **Appendix A,**

[35] 2013 State of Vermont Hazard Mitigation Plan, p 4-9
[36] Black River Watershed Stream Geomorphic Assessment Phase I, September 2007
[37] 2017 Ludlow Town Plan, Flood Resiliency Section, pp. 112-120

Map 1: Current Land Use, most of Ludlow's town infrastructure and commerce are concentrated along the Black River main stem which runs through the center of the Village. Development in these areas is vulnerable to flood and erosion with risk of channelization during high flow events.

Visual map displays of the Town's most populous areas can be found in **Appendix E** using Vermont Flood Ready Atlas Maps.[38] Similar to the one below of the Village of Ludlow, these maps show structural assets located in flood hazard areas (highlighted in red) and river corridor areas (highlighted in yellow). Some portions of town are not currently mapped but may be at risk of flooding. The areas most vulnerable to fluvial erosion are those that were triggered by Tropical Storm Irene and exacerbated by subsequent storms.

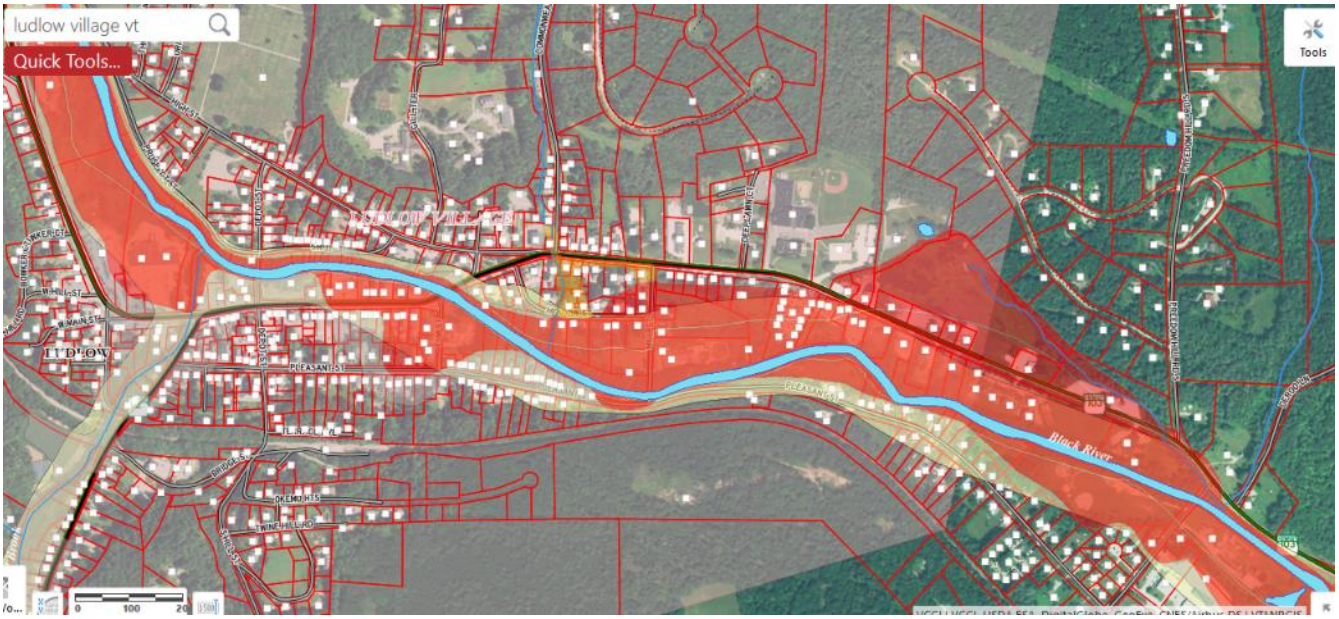


Table 9 and **Table 10** list the number and types of vulnerable structures that lie within Special Flood Hazard Zones and River Corridor.[39] In Ludlow, the floodway fringe, or "floodplain", includes the A and AE Zones as defined in the zoning bylaws.

[38] Flood Ready Vermont Atlas, http://floodready.vermont.gov/assessment/vt_floodready_atlas, 1/28/2018
[39] 2015 Flood Resilience Study for Ludlow, VT

TABLE 9: Summary of Buildings within Flood Hazard Zones

Flood Zone	Building Type	Village		Town		Total	
		# Units	%	# Units	%	# Units	%
Floodway	Accessory	2	9.5%	1	4.5%	3	7.0%
	Single-Family Dwelling	3	14.3%	6	27.3%	9	20.9%
	Multi-Family Dwelling	1	4.8%	6	27.3%	7	16.3%
	Mobile Homes	6	28.6%	2	9.1%	8	18.6%
	Camps		0.0%	1	4.5%	1	2.3%
	Commercial	8	38.1%	3	13.6%	11	25.6%
	Lodgings		0.0%	1	4.5%	1	2.3%
	Civic	1	4.8%	1	4.5%	2	4.7%
	Other		0.0%	1	4.5%	1	2.3%
	SUBTOTAL	*21*	*100.0%*	*22*	*100.0%*	*43*	*100.0%*
Floodway Fringe	Accessory	5	8.2%	5	5.6%	10	6.6%
	Single-Family Dwelling	23	37.7%	70	77.8%	93	61.6%
	Multi-Family Dwelling	3	4.9%	2	2.2%	5	3.3%
	Mobile Homes	9	14.8%	0	0.0%	9	6.0%
	Camps			7	7.8%	7	4.6%
	Commercial	14	23.0%	4	4.4%	18	11.9%
	Lodgings	1	1.6%	0	0.0%	1	0.7%
	Civic	6	9.8%	0	0.0%	6	4.0%
	Other			2	2.2%	2	1.3%
	SUBTOTAL	*61*	*100.0%*	*90*	*100.0%*	*151*	*100.0%*
SHFA TOTAL		**82**		**112**		**194**	
Local Flood Hazard Area (Stream Setback)	Accessory			2	50.0%	2	50.0%
	Single-Family Dwelling			2	50.0%	2	50.0%
	All Other Types					0	0.0%
	SUBTOTAL			*4*	*100.0%*	*4*	*100.0%*
TOTAL All FLOOD ZONES		**82**		**116**		**198**	

TABLE 10: Summary of Buildings within the River Corridor

Flood Zone	Building Type	Village		Town		Total	
		# Units	%	# Units	%	# Units	%
River Corridor	Accessory	10	6.5%	10	8.5%	20	7.3%
	Single-Family Dwelling	66	42.6%	84	71.2%	150	54.9%
	Multi-Family Dwelling	17	11.0%	6	5.1%	23	8.4%
	Mobile Homes	14	9.0%	5	4.2%	19	7.0%
	Camps	0	0.0%	3	2.5%	3	1.1%
	Commercial	37	23.9%	7	5.9%	44	16.1%
	Lodgings	2	1.3%	1	0.8%	3	1.1%
	Civic	5	3.2%	1	0.8%	6	2.2%
	Other	4	2.6%	1	0.8%	5	1.8%
	SUBTOTAL	*155*	*100.0%*	*118*	*100.0%*	*273*	*100.0%*

Local areas that lie within the floodway are most vulnerable to riverine flooding and include:

- Areas along the Black River between Mill St. and Pleasant St. Extension;
- In and around Fletcher Fields along the Black River; and
- Near the confluence of The Black River and Branch Brook.

Other areas are located within the Floodway Fringe or "Floodplain" and are vulnerable to flood and erosion include:

- Along the westerly portion of the Branch Brook and Buttermilk Falls Road,
- In the southern part of Town along the upper Williams River on portions of South Hill Road, Smokeshire Road, Lovejoy Road and Lovejoy Brook Road,
- An area generally along Main Street starting near the intersection with Commonwealth Avenue and extending to both Meadow Street and Mill Street,
- Soapstone Brook area east of the Village,
- Black River Mobile Home Park,
- Dug Road and bridge access
- Jewell Brook Bridge, historic Mill St. trestle bridge, Vail Bridge

Other vulnerable town assets include two critical facilities situated on the Black River mainstem within the Flood Hazard Area; the wastewater treatment facility (WWTF) located in the Village Center and the Ludlow Firehouse located upstream from the town center. Substantial damage was done to the WWTF during Tropical Storm Irene and, as recently as November 2017, a heavy rain event caused water to rise around the WWTF making exiting the plant difficult for employees. The Fire Station has also seen water rise up to the bay doors during high flows.

Roads, bridges and culverts are also vulnerable to flood and fluvial erosion damage as much of this infrastructure is located in mountain valleys and along rivers and streams. Vermont State has begun to focus its efforts on "hydrologically-connected" road segments as part of the new *Municipal Roads General Permit (MRGP) Standards*. These standards will help to increase flood resiliency and reduce the risk of road erosion.

The failure of bridges and culverts throughout southern Vermont during Tropical Storm Irene, was primarily due to their being undersized and constricting flow.

This resulted in debris jams, increased streambed scour, bank erosion both up and downstream of the crossing and slope failure at some locations. Blocked culverts compromised the structural integrity and safety of the road crossing and resulting in damage to adjacent properties. Factors contributing to debris jams include materials stored in the floodplain and unsecured structures (i.e. hay bales, propane tanks; small sheds; wood piles). **Appendix A, Map 7: Bridge and Culvert Inventory** shows the assessed condition of Ludlow's bridges and culverts. A number of main thorough fares, evacuation routes and other roadway segments also lie within flood zone.

Currently, Ludlow is a participatory, non-sanctioned member of the National Flood Insurance Program and regulates development in the floodplain through the enforcement of the regulations in the Town of Ludlow's and the Village of Ludlow's Zoning By-Laws and Flood Hazard Regulations. NFIP policies and claims are summarized in **Table 11**.[40]

TABLE 11: Ludlow National Flood Insurance Program Statistics

Ludlow	# of Policies	# of Policies in A Zone	# of Claims Since 1978	Claims Paid Since 1978	# of Repetitive Losses
Town	73	62	32	$1,640,750	0
Village	62	25	21	$1,193,681	0

5.2d. Severe Winter Weather

Winter storms and **blizzards**, with **snow**, **ice**, wind and extreme cold in varying combinations, are fairly commonplace in Ludlow and occur town wide. Heavy accumulation of snow accompanied by high winds causes drifting of snow and low visibility and makes it difficult to keep roads cleared. Sidewalks, streets, and highways can become extremely hazardous to pedestrians and motorists.

Heavy wet snows of early fall and late spring, as well as ice storms, can result in property damage and in loss of electric power, leaving people without adequate heating capability. Power loss is often the result of downed trees, which can also disrupt traffic and emergency response by making roads and driveways impassable.[41]

[40] FEMA Policy & Claim Statistics for Flood Insurance -Claim Information by State, https://www.fema.gov/policy-claim-statistics-flood-insurance

[41] 2018 State of Vermont Hazard Mitigation Plan

Severe winter storms in the northeastern United States develop through the combination of weather and atmospheric conditions including the moisture content of the air, direction of airflow, collision of warm air masses coming up from the Gulf Coast, and cold air moving southward from the Arctic.[42]

A winter storm is considered severe when there is a possibility of:

- Six or more inches of snow fall at a given location within 48 hours,
- Property damage, injuries or deaths, or
- An ice/glaze storm which causes property damage, injuries or death.

Severe winter storm alerts are communicated based on the terminology in the table below.

Term	Definition
Winter Storm Watch	Snowstorm conditions are possible in the specified area, usually within 36 hours.
Winter Storm Warning	Snowstorm conditions are expected in the specified area, usually within 24 hours.
Blizzard Warning	Sustained winds or gusts of 35 mph occurring in combination with considerable falling/blowing snow for a period of at least three hours are expected.
Heavy Snow Warning	Snow accumulations are expected to approach or exceed 6 inches in 12 hours.

A Nor'easter is a large weather system traveling from South to North, passing along, or near, the Atlantic seacoast. As the storm approaches New England and its intensity becomes increasingly apparent, the resulting counterclockwise cyclonic winds impact the coast and inland areas from a northeasterly direction. The sustained winds may meet or exceed hurricane force. There are no standard models or methodologies for estimating loss from winter storm hazards, however, extreme winter weather is considered a way of life in Vermont and many rural Towns are accustomed to and prepared for these events.

Blizzards are defined by the National Weather Service as "sustained winds or frequent gusts of 35 mph or greater (and) considerable falling and/or blowing snow reducing visibility frequently to 1/4 mile or less for a period of three hours or more[43]." These storms become a challenge in keeping roads plowed due to the snow drifts that occur.

Ice Storms are defined by the National Weather Service as "occasions when damaging accumulations of ice are expected during freezing rain situations. Significant accumulations of ice pull down trees and utility lines resulting in loss of power and communication. These accumulations of ice make walking and driving extremely dangerous. Significant ice accumulations are usually accumulations of ¼" or greater."[44]

[42] 2018 State of Vermont Hazard Mitigation Plan
[43] National Weather Service Glossary
[44] National Weather Service Glossary

Multiple sources state that a ¼ inch of ice accumulation from an ice storm can add 500 pounds of weight on the lines between two power lines.

Extent of Hazard –Severe Winter Weather

The most recent Federal Disaster Declaration for Windsor County due to a winter storm was February, 2015, with prior events in December 2010 and January 2001.

This year, Windsor County experienced its second Nor'easter in the month of March, 2018, dumping more than 2 feet of snow.

There have been 39 recorded winter storm/weather events in Windsor County since 2012 causing a total estimated $785,000 of damages, or an average of approximately $20,000 per event. The table below lists the 13 reported winter weather events since 2012 that caused an estimated $20,000 or more worth of damages. An early winter storm in 2014 resulted in an estimated $250,000 in damages for the county.

TABLE 12: Winter Storm/Weather Damages in Windsor County 1/1/2012 – 5/31/2018[45]

Property Damage	Crop Damage	Date of Storm	Fatalities
$20,000	0	2/13/2014	0
$25,000	0	3/12/2014	0
$50,000	0	11/26/2014	0
$250,000	0	12/9/2014	0
$25,000	0	1/18/2015	0
$25,000	0	2/2/2015	0
$25,000	0	11/29/2016	0
$20,000	0	3/14/2017	0
$25,000	0	3/31/2017	0
$25,000	0	4/1/2017	0
$20,000	0	12/12/2017	0
$40,000	0	3/7/2018	0
$20,000	0	3/13/2018	0

Historical data for snowfall and temperature for the Town of Ludlow are not available. However, the closest town to Ludlow for which data exists is the Town of Springfield and can be found online at U.S.

[45] NOAA, National Centers for Environmental Information

Climate Data from 2008 to current.[46] Selected temperature data from this source for the month of January, which is typically the coldest winter month in Vermont, is shown along with seasonal snowfalls.

	January Temperature °F		Snow Fall (inches)				
	Lowest	Average	Dec	Jan	Feb	Mar	Total
2008	-11	10.8	0	17	32	9	58
2009	-18	-0.8	28	30	12	5	75
2010	-4	11	19	9	23	0	51
2011	-20.9	7.4	14	35	30	5	84
2012	-11.9	14.1	0	9	2	13	25
2013	0	8.6	18	11	19	12	59
2014	-18	5.4	20	11	27	10	68
2015	-13	1.2	7	15	31	2	55
2016	0	15	5	4	6	10	25
2017	-5	19.2	23	7	26	13	69
2018	-20.9	8.6	19	13	23	NA*	55
	Average Snowfall		13.9	15	21	7	56
	Normal Average Low		7°F for January				
	* Not Yet Available						

Snowfall for neighboring Springfield has averaged a total of 57 inches for the winter season from December through March since 2008 with the highest amounts falling during the month of February. In Ludlow, residents can expect at least 60 pounds of weight per square foot on their infrastructure during winter months. The National Weather Service in Burlington, Vermont, has also recorded the following extreme events. As of August 15, 2012, a maximum recorded snowfall event of 56.7 inches occurred in December, 1970, with a record annual snowfall for that same season of 145.4 inches.

[46] https://www.usclimatedata.com/climate/springfield/vermont/united-states/usvt0505/2018/1

There is no specific region in Vermont that is more vulnerable to **ice storms**, according to the 2018 Vermont State Hazard Mitigation Plan. The state plan identifies accumulations for ice storms in December 2008 and January 1998 of 1/2-3/4" of ice plus 1-2" of sleet and 3" of ice, respectively. Heavy wet snow can cause similar secondary hazards such as tree damage and power outages. Northwest sections of Windsor County were impacted by heavy wet snow during the Federally declared ice and snow disaster in December 2014, DR-4207. Local data for ice storms is not available.

It can be seen from this table that temperature trends reflect a general winter warming with the average low temperature during the month of January above the normal average of 7°F for eight of the last 11 years. However, the town has also experienced extended periods of extreme cold January temperatures in 2009, 2014 and 2016. In January 2009, there were nine consecutive days and 20 total days of zero or below zero temperatures.

Vulnerable Assets –Severe Winter Weather

Statewide, damage from **blizzards**, **snow,** and **ice storms** can vary depending upon wind speeds, snow or ice accumulation, storm duration, tree cover, and structural conditions such as heavy snow and ice accumulation on large, flat roofed structures or aged structures in deteriorating condition. "According to the 2014 National Climate Assessment, there is an observable increase in severity of winter storm frequency and intensity since 1950. While the frequency of heavy snowstorms has increased over the past century, there has been an observed decline since 2000 and an overall decline in total seasonal snow fall."[47]

Vermont communities are well prepared to handle heavy snowfall. However, it is typically the secondary hazards that are most concerning to the town. Depending on the event, particularly with heavy, wet snow or ice, electricity may be knocked out for a few hours or days due to downed powerlines from falling trees. This is a time when residents are most vulnerable to structure fire hazard. Extended periods of extreme cold or loss of power during the winter months require continued vigilance on the safety of heating to reduce the risk of a structure fire as a secondary hazard. Many residents heat their homes with open flame heating sources including fireplaces and wood or pellet stoves, and will supplement with electric or kerosene space heaters.

Ludlow is served by two electric utilities, Green Mountain Power and Ludlow Electric Light Department. The Town will continue to work with both to insure tree trimming is maintained to keep branches clear of power lines.

5.2e. Extreme Temperatures Heat/Cold

Extreme Temperatures, both heat and cold, were identified during the hazard analysis and vulnerability assessment as relatively high hazards to the Town of Ludlow with scores of 9 and 8, respectively. In

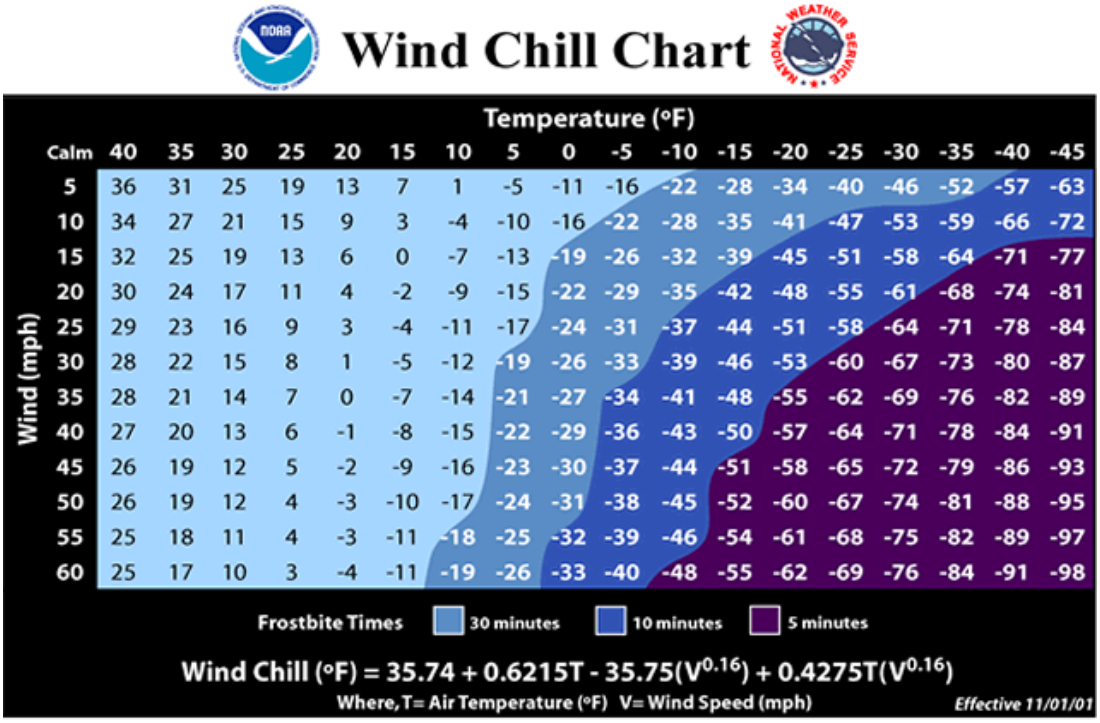
[47] 2018 Vermont State Hazard Mitigation Plan, p. 81

addition to the direct health impacts of extreme heat and cold events, both also have secondary impacts on the local economy and infrastructure. Local climate data is rare for Ludlow, and therefore statewide, county, and regional data is used in its place.

Extreme Cold temperatures are part of Vermont's climate tendency to stray above or below expected temperature values. Although Vermont's climate is steadily warming, Ludlow has experienced extreme cold in recent years, and incidents of extreme cold are expected to continue to occur over the course of the planning period. What constitutes 'extreme cold' can vary and is based on what a population is accustomed to in their respective climates.

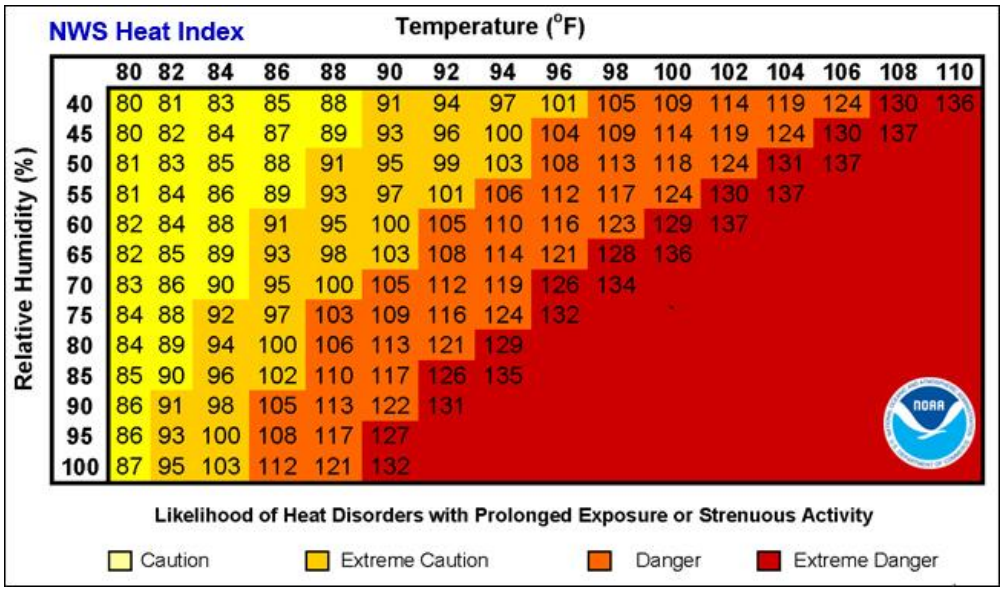
This hazard can have a significant effect on human health and on commercial/agricultural businesses, and primary and secondary effects on infrastructure including burst water pipes and power failure.[48]

As described in the 2018 Vermont State Hazard Mitigation Plan, "Exposure to cold temperatures can cause frostbite or hypothermia and even lead to heart attacks during physically-demanding outdoor activities like snow shoveling or winter hiking." High winds can exacerbate the health effects of extreme cold. The chart below illustrates the relationship between cold, wind, and the time it takes for exposed skin to develop frostbite. Furthermore, icy conditions create hazards for drivers and pedestrians. Extreme cold can lead to burst pipes, power failure, and damages to the road system, while unseasonable freezes can cause widespread damage to crops.[49]



[48] 2018 Vermont State Hazard Mitigation Plan
[49] 2018 Vermont State Hazard Mitigation Plan

Extreme Heat events are historically relatively rare in Vermont, but, as the climate warms, are expected to become increasingly common. As is the case with extreme cold, what constitutes extreme heat varies based on what a particular population is accustomed to. In Vermont, hospitals begin to experience a rise in heat-related emergency room visits at 87°F. As the climate warms, Vermont is expected to see an increase in the annual number of days with temperatures above 90°F, increasing the risk to public health and the burden placed on area hospitals. In addition to health impacts, high heat can damage infrastructure as in, for example, damage to asphalt roadways from softening.[50] Air temperature alone does not determine the severity of an extreme heat event, but relative humidity also plays a critical role. The combined effects of temperature and humidity are best reflected in the Heat Index, which is described by NOAAA as "a measure of how hot it really feels."



<u>Extent and Historical Trend – Extreme Cold/Heat</u>

Little local data exists for extreme temperatures in Ludlow, and therefore county and state data has been consulted in its place. NOAA keeps records of severe storms by county, including two extreme cold/wind chill events in Windsor County during the period from 2012-2018 and one extreme heat event. The National Weather Service (NWS) station in Burlington keeps a variety of climate and weather related records including heat wave and extreme temperature data.

Extreme Cold

January 7-8, 2015 – Temperatures in Windsor County ranged from -10 to -20, with wind chills of -25 to -40 degrees; a low of -16 was recorded in Ludlow[51]

[50] 2018 Vermont State Hazard Mitigation Plan
[51] NOAA National Centers for Environmental Information

February 1-28, 2015 – Vermont experienced the coldest month on record since December, 1989 or January, 1994; an estimated $1,000,000 of damage was done to infrastructure across Vermont[52]

According to the National Weather Service, the years of 2014 and 2016 had 16 days of zero or below zero temperatures in January. During this period, Ludlow residents had experienced a number of frozen water and sewer pipes impacting 55 homes. It is also worth noting that the area is seeing a greater range in temperature extremes. In the current year, winter temperatures ranged from -20.9 to 53.1°F° in January and -2.9 to 72.1°F in February. These swings of 75 degrees make for more hazardous conditions with flooding and ice jams.

Extreme cold temperature events as of July 22, 2013 were recorded to be, approximately, -30°F in 1/1994, 2/1979, 1/1957 and 12/1933. Since 2013, the Burlington Free Press reported a record low for the area of -37°F. [53]

Extreme Heat

March 17-22, 2012 – Vermont experienced record high temperatures, with highs 30 to 40°F above average. An estimated $1,000,000 of damage was done to the state's agriculture industry; the maple industry was hardest hit[54]

December 24, 2015 – Record High of 68°F recorded in Burlington

February 25, 2017 – Record high of 72°F recorded in Burlington

The NWS defines a heat wave as "3 or more consecutive days with highs 90 degrees or higher." The following table lists the heat waves recorded in Burlington from January 1, 2011 until July 6, 2018.

Dates	Temperatures (°F)					
Jul. 21-23, 2011	97	95	93			
Jul. 12-15, 2012	91	93	93	90		
Jul. 15-19, 2013	93	91	95	91	98	
Aug 17-20, 2015	90	91	90	91		
Sept. 24-27, 2017	91	92	91	90		
Jun. 30-Jul. 5, 2018	93	96	97	93	95	95

[52] NOAA National Centers for Environmental Information
[53] http://w2.weather.gov/climate/local_data.php?wfo=BTV
[54] NOAA National Centers for Environmental Information

Vulnerable Assets/Populations – Extreme Cold/Heat

Certain populations are more susceptible to the primary and secondary effects associated with extreme heat and cold. These include infants, the elderly, and those without sufficient shelter.[55] According to the 2016 American Community Survey, 45 Ludlow residents, or 2.2%, are under the age of 5, while 556, or 27.3%, are 65 or older. While data on homelessness for Ludlow is not available, the January 2017 Point in Time Count conducted by the Agency of Human Services recorded 118 homeless persons in Windsor County.

Extended periods of extreme cold or loss of power during the winter months require continued vigilance on the safety of heating to reduce the risk of a structure fire as a secondary hazard. Many residents heat their homes with open flame heating sources including fireplace, wood or pellet stoves, and will supplement with electric or kerosene space heaters. These same populations are also vulnerable to extended periods of extreme heat with the lack of air conditioning or adequate cooling systems in most homes.

5.2f. Landslide/Slope Failure

The following excerpts are taken from the 2013 Vermont State Hazard Mitigation Plan:

'The term "landslide" describes a wide variety of processes that result in the downward and outward movement of slope-forming materials including rock, soil, artificial fill, or a combination of these. The materials may move by falling, toppling, sliding, spreading, or flowing. Landslides are common on clayey to sandy lacustrine deposits throughout Vermont. In many cases, the displaced material has been at least partially eroded away by stream flow.'

Landslides can be triggered by one or a combination of factors, including fluvial erosion, soil saturation, natural geologic weathering processes such as the freezing and thawing of soils, human modification of the bank, increases in loading on top of the slope, surface or near surface drainage patterns, and loss of vegetation. Fluvial erosion, causing bed and bank erosion are associated with water flowing along the toe of the slope, removes bank material to over-steepen and potentially under-cut the slope.

Widespread slope failure occurred throughout much of central and southern Vermont as a result of Tropical Storm Irene. Many of these landslides occurred on the sites of earlier slides that were reactivated by subsequent heavy rains and floodwaters. [56]

While many of these slope failures occurred along riverbanks, others were initiated by strong stormwater flows that found a path of least resistance from impervious surfaces.

[55] CDC Extreme Cold Prevention Guide; CDC Extreme Heat Guide, Updated 2017
[56] 2013 Vermont State Hazard Mitigation Plan

Extent and Historical Trend – Landslides/Slope Failure

Historical data specific to Landslides in Ludlow is minimal, as is the case with the state of Vermont more generally. This is in part because landslides often occur together with significant rainfall and erosion.[57] Extensive landslides occurred in central Vermont in 2011 as a result of increased slope instability due to ground saturation from thick snowpack melt and heavy spring rains followed by Tropical Storm Irene in late August.

The 2018 Agency of Natural Resources Landslide Inventory records two slope failures in Ludlow, both in October, 2007. Both were eroding gullies. The first was 45 meters long and 3 meters high and was the result of stormwater from a culvert on High Street. The second was 95 meters long and 5 meters high and had developed within the channel carrying stormwater from the Shaw's parking lot.

Lack of data makes it difficult to anticipate future trends, but Vermont's increasing annual rainfall and intensifying storms mean more rain is falling in higher concentrations. This leads to increased slope instability due to ground saturation and an increased risk of fluvial erosion and will likely cause landslides and slope failures to increase in frequency.[58]

Vulnerable Assets – Landslides/Slope Failure

Fluvial erosion and stream toe erosion of steep slopes are considered the most important contributing factors to landslides in Vermont. These vulnerable areas can be located well above the FEMA flood hazard elevations and, therefore, not captured by floodplain mapping. Roads that sit along steep slopes near rivers are especially vulnerable to damage or complete failure from a landslide particularly with increased slope instability due to ground saturation.

6. MITIGATION PROGRAM

The following sections detail the mitigation goals and potential mitigation strategies identified by the Town and compiled and organized by the Hazard Mitigation Committee to reduce the impact of the hazards assessed in this plan. The implementation schedule that follows in **Table 14** is a comprehensive list of actions that the town has targeted for implementation during the five-year cycle of this plan.

6.1. Mitigation Goals and Objectives

Following the Hazard Analysis and the public involvement process for this update, the Hazard Mitigation Committee then reviewed the prior AHMP goals and strategies **(Table 1),** Existing Resources **(Table 2)**, the Town Plan and Regional and State Hazard Mitigation Plans, and formulated the following overarching

[57] 2018 Vermont State Hazard Mitigation Plan
[58] 2018 Vermont State Hazard Mitigation Plan
http://climatechange.vermont.gov

goals below. Note that the numbers do not indicate goal priority but are used to identify actions that support it.

Hazard Mitigation Goals and Objectives

1. Provide protection to the community from impact of hazardous events.
    a. Reduce the risk of potential loss of life, injuries, negative health impact, and property damage from hazard events, particularly flood, structure fire and erosion.
    b. Maintain and enhance Emergencies Operation Plan.

2. Improve efforts to raise municipal awareness of the Local Hazard Mitigation Plan.
    a. Incorporate hazard mitigation in the Ludlow Town Plan, Flood Hazard By-Laws, Planning and Zoning, Road Standards and Maintenance Programs, and related projects.
    b. Review progress on hazard mitigation plan strategies and actions during publicly noticed meetings (Selectboard or Planning Commission).
    c. Be proactive in seeking funding opportunities for hazard mitigation projects and informing the public on progress made.
3. Increase community awareness and resiliency to hazard events.
    a. Increase efforts to inform residents and businesses of known hazards.
    b. Improve efforts to help minimize and address financial losses due to hazard events incurred by residents and business owners.
4. Improve effectiveness of future Hazard Mitigation Planning efforts.
    a. Improve efforts to identify and inventory vulnerable community assets to future hazards including town infrastructure, and commercial and residential structures and properties.
    b. Develop and Implement a process for tracking plan implementation over the plan period.

6.2. 2018-2023 Mitigation/Preparedness Strategies and Actions

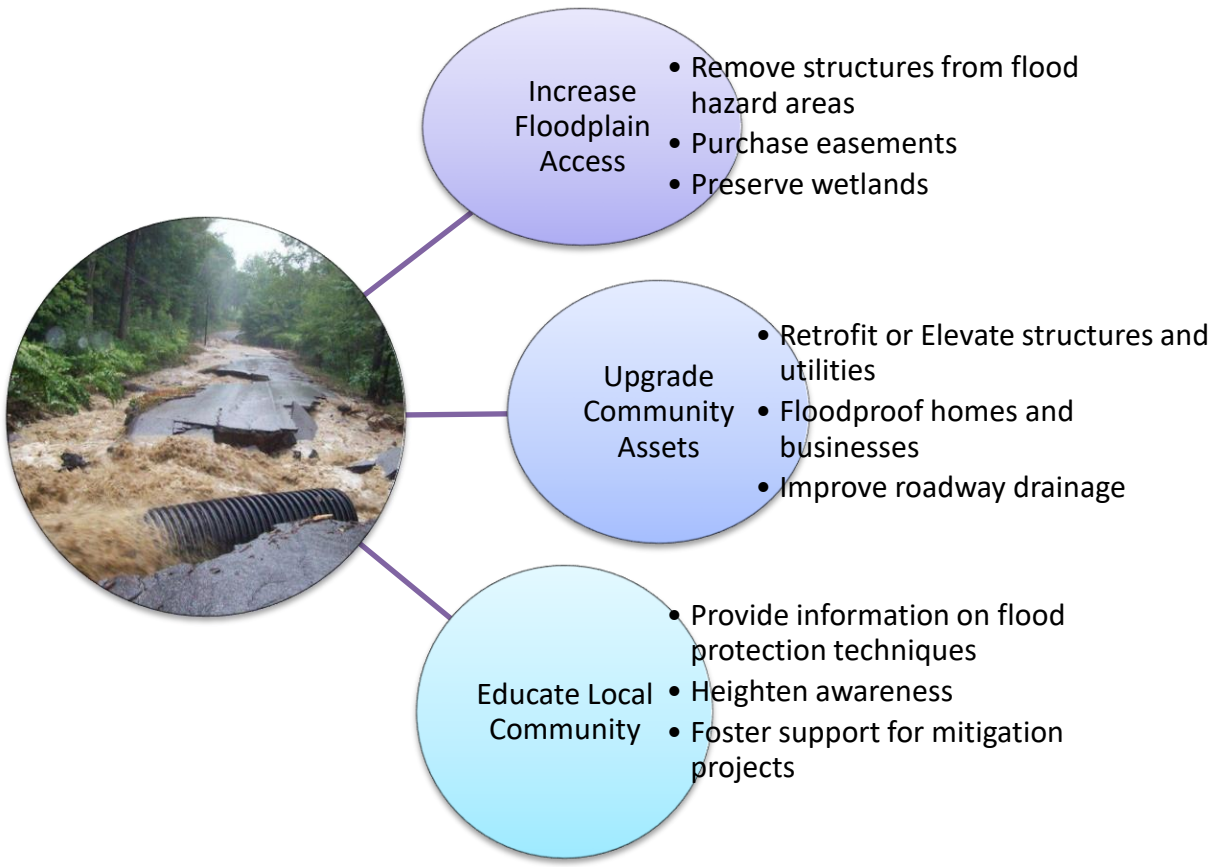
Strategy Selection and Prioritization Process

Following the update and review process, the Hazard Mitigation Committee has identified the following Mitigation and Preparedness Strategies and Actions for the 2018-2023 planning period as listed in **Table 14** below to achieve the goals outlined above.

These mitigation actions have been chosen by the committee as the most effective and feasible actions to be taken during this plan period to lessen the impacts of the hazards identified in Section 5. A new column has been added to identify the related goal and objective for each action. It was determined that some of the actions from the previous plan have been carried-over here with some modifications either because they have been expanded or because of their on-going cyclical nature. Compared to the previous Hazard Mitigation Plan, below are changes in the priority of hazards addressed and approach on formulating goals and actions:

- The Town has chosen to focus on only natural hazards in this update.

- Flood and Erosion hazards scored higher with an expanded number of flood and erosion related strategies to be given higher priorities than in previous years.
- Landslide/Slope Failure hazard was introduced in this update as a priority hazard due to the continued deterioration of eroded areas caused by TS Irene.
- This is the first plan in which Extreme Cold hazard is specifically profiled given the recent occurrences of extended periods of below zero temperatures.
- Efforts were made to better identify goals and more specific actions to improve plan effectiveness and clarity in tracking progress. The association of actions to specific goals is also new this plan.



Prioritization of Strategies and Actions

The Committee determined that the method of prioritizing mitigation strategies and actions be changed from a specific numbered priority order of individual action items to a 'categorizing' of priorities based on

two categories – High, Moderate, and Low (see color coded legend below). It was decided that a more general prioritization methodology would improve overall progress on implementation for the follow reasons:

- Offers the needed flexibility as priorities can change over time.
- Allows the Committee to take advantage of all funding opportunities as they arise.
- Implies that several actions can progress simultaneously.
- Encourages the Committee to keep all proposed actions in mind.

To assign action priority, a number of criteria were taken together, in addition to the Hazard Analysis Score in Section 5.1 but weighted subjectively. For example, a "High" priority action would typically score higher in the Hazard Analysis and have greater weight for the first two criteria listed below than those with a "Moderate" priority.

Criteria for prioritizing proposed mitigation strategies and actions in **Table 14**:

- Severity or immediacy of need and greatest potential impact. This subjective assessment would consider the potential extent of vulnerability in terms of structural damage repair costs, level of safety risk to residents impacted, and probability of occurrence.
- Number of residents impacted by hazard that would benefit from mitigation.
- Availability of funding and personnel resources to implement the project. Availability of town, state or federal funds, and availability of town or SWCRPC personnel are considered.

Project Cost related to funding feasibility. Ludlow is a small town and does not currently have the capacity to assess the potential damage and cost of repairs for each of the proposed actions. However, prior to pursuing any mitigation project, the Town would consider the costs and benefits of the project using FEMA methodology.

TABLE 14: 2018-2023 Town of Ludlow and the Village of Ludlow Mitigation/Preparedness Strategies and Actions

High Priority
Moderate Priority
Low Priority

MITIGATION ACTION OR STRATEGY	TYPE *	Town / Village**	HAZARD ADDRESSED	RELATED GOAL/ OBJECTIVE	RESPONSIBLE PARTY***	TIME FRAME	FUNDING SOURCE/ COST TO TOWN****
Identify vulnerable populations and residential areas to identified hazards, develop a formal database, and pro-actively advise or address potential hazard impact.	M, P	T, V	All Hazards	1a, 1b, 3a, 3b	Fire Dept., HMC, Emergency Management	3Q/2019-3Q/2020	EMPG, HMGP, High Town personnel cost, Town Match
Seek funding for development of emergency plans and flood hazard mitigation for the Waste Water Treatment Facility and Fire Station.	M	T, V	Flood, Erosion	1a,2a,2c	Water Treatment Facility Staff, Selectboard, VBT, Emergency Management, Fire Dept., SWCRPC	1Q/2018-4Q/2020	PDA, FMA, HMGP, CDBG, Town Match
Improve efforts to incorporate hazard mitigation into other town planning, discussions, and activities.	M	T, V	All Hazards	1a, 1b, 2a	HMC, Selectboard, VBT, P&Z, Planning Commission, SWCRPC	2018-2023	Moderate Town personnel cost

Develop informative pamphlet using information from the 2015 Flood Resiliency Study to distribute property owners in flood hazard areas.	M	T, V	Flood Erosion	1a, 3a, 3b	HMC, P&Z, Planning Commission, SWCRPC	1Q/2021-4Q/2021	VWC, VRG, Moderate Town personnel cost, Town Match
Continue progress on current East Hill FEMA Buyout project and seek other potential FEMA buyout opportunities.	M	T, V	Flood Erosion	1a, 2a, 2c, 3b	Selectboard, P&Z, Planning Commission, SWCRPC	2019-2023	HMGP, FMA, PDM, Town Match
Inform developers working in resort and other areas of concerns regarding lack of wildfire breaks on-site and make suggestions regarding development and forest setbacks.	M	T	Wildfire	1a,2a,3a, 3b	Selectboard, Fire Dept, P&Z, DRB, Planning Commission, OMR	1Q/2018-4Q/2022	Moderate Town Personnel Cost, VT Dept of Forests, Parks & Recreation
Actively seek funding for redundant power supply at Ludlow Community Center/Town American Red Cross Shelter.	P	T	Severe Weather, Flood, Erosion, Ice Storms	1b, 3a	Emergency Management, Selectboard	3Q/2019-3Q/2020	HMGP, Town Match
Continue efforts to move forward on retrofitting existing drainage system at Commonwealth intersection.	M	T	Flood, Erosion	1a, 3b	Highway Dept, Selectboard, VBT	1Q/2018-4Q/2019	In progress, Town Match
Complete Road Erosion Inventory, identify road infrastructure vulnerable to flood and erosion hazards and seek funding to implement mitigation projects.	M	T, V	Flood, Erosion	1a, 2a, 2c	Highway Dept, Selectboard, VBT, SWCRPC	1Q/2018-4Q/2023	BRGP, MRGIA, VTrans, CWBG, THSGP, THC2RP, TAP, Town Capital, Town Match

Prioritize hydrologically connected road segments and prepare a 5-year plan for upgrade to incorporate new Municipal Road General Permit standards to reduce road erosion and runoff.	M	T, V	Flood, Erosion	1a, 2a	Highway Dept, Selectboard, VBT, SWCRPC	1Q/2019-4Q/2022	High Town personnel cost
Actively seek funding to install recommended best management practices on local roads to meet new Municipal Roads General Permit state road standards based on identified priorities above.	M	T, V	Flood, Erosion	1a, 2a, 2c	Highway Dept, Selectboard, VBT, SWCRPC	1Q/2018-$Q/2023	MRGIA, BRGP, TAP, THC2RP, THSGP, Town Capital, Town Match, Moderate Town personnel cost
Work with SWCRPC to seek grant funding to identify specific site recommendations based on strategies identified in the Black River Corridor Plan and stream geomorphic assessments that will reduce Town's flood and erosion risk.	M	T, V	Flood, Erosion, Ice Jams	1a, 2c, 3b	Selectboard, VBT, P&Z, Planning Commission, Highway Dept., HMC, Emergency Management, SWCRPC	1Q/2022-4Q/2023	All, Town Match
Review and prioritize the vulnerable areas identified in the 2015 Flood Resiliency Study and in Appendix E. Assess potential mitigating actions and funding sources and implement if feasible.	M	T, V	Flood, Erosion, Ice Jams	1a, 2a, 2c, 3b	HMC, SWCRPC, Highway Dept., P&Z, Planning Commission, Selectboard, VBT	2Q/2020-2Q/2021	All, Moderate Town Personnel Cost to evaluate, Town Match.
Work with SWCRPC to more pro-actively seek grant opportunities for bridge and culvert upgrades to supplement town maintenance programs.	M	T, V	Flood, Erosion, Ice Jams	1a, 2a, 2c	Highway Dept, Selectboard, VBT, SWCRPC	3Q/2018-3Q/2020	BRGP, MRGIA, ERGP, HMGP, FMA, VTrans, TAP, THC2RP, THSGP, Town Match, Town Capital

Review recommended activities from the "Firewise" Program to enhance annual outreach for fire safety to all residents.	M	T, V	Structure Fire, Wildland Fire	1a, 1b, 2a, 3a, 3b	HMC, Fire Dept.	2Q/2019-4Q/2021	Moderate Town personnel cost
Develop a community outreach program (webpage) to include this hazard mitigation plan and useful information on community hazards and mitigation ideas for residents and businesses.	M, P	T, V	All	1a, 1b, 3a, 3b	HMC, SWCRPC	2Q/2020-2Q/2021	HMGP, Moderate Town personnel cost, Town Match
Work with SWCRPC and Vermont Conservancy to explore opportunities for conservation easements to restore and protect floodplain access.	M	T	Flood, Erosion, Ice Jams	1a, 2a, 2c, 3a, 3b	Selectboard, P&Z, Planning Commission, HMC, SWCRPC	1Q/2020-4Q/2022	RCCEG, CRC, VLT Private Funds, VRC, PDM, FMA, Moderate Town personnel cost to explore, Town Match
Seek funding to develop a Stormwater Master Plan for the Town and Village.	M	T, V	Flood, Erosion, Ice Jams	1a, 2a, 2c, 3b	Selectboard, VBT, P&Z, Planning Commission, SWCRPC,	3Q/2019-3Q/2021	ERGP, High Town personnel cost, Town Match
Formalize plan monitoring process with periodic updates to Selectboard, Planning Commission and Village Trustees. Inform public on progress.	M	T, V	All	2a, 2b, 4a, 4b	Selectboard, VBT, HMC	3Q/2019 and annually 3Q	Moderate Town personnel cost

* M- Mitigation, P- Preparedness

** Applies to Town (T) or Village (V)

*** HMC - Hazard Mitigation Committee
SWCRPC – Southern Windsor County Regional Planning Committee
OMR- Okemo Mountain Resort
VBT- Village Board of Trustees

**** Funding Acronyms:

HMGP - Hazard Mitigation Grant Program (VT State Department of Emergency Management)
EMPG – Emergency Management Performance Grant (VT State Department of Emergency Management)
BRGP - Better Roads Grant Program
MRGIA – Municipal Roads Grants-In-Aid
ERGP - Ecosystem Restoration Grant Program
CWBG – Clean Water Block Grant
CDBG – VT ACCD Community Development Block Grant
THSGP – Town Highway Structures Grant Program
THC2RP – Town Highway Class 2 Roadway Program
MHSMP – Municipal Highway Stormwater Mitigation Program
TAP – Transportation Alternatives Program
VWG – Vermont Watershed Grant
VLT – Vermont Land Trust
RCCEG – River Corridor Conservation Easement Grant (ERGP)
CRC – Connecticut River Conservancy
VRC – Vermont River Conservancy
FMA – Flood Mitigation Assistance (FEMA)
PDM – Pre-Disaster Mitigation (FEMA)

6.3. Plan Monitoring and Maintenance Process

Plan Monitoring

The Hazard Mitigation Committee, with guidance from the Southern Windsor County Regional Planning Commission, will be responsible for monitoring this plan as outlined below, to ensure that progress is made and identified mitigation actions are implemented as resources or opportunities become available. This includes identifying funding opportunities and assisting with funding applications.

New this plan update is an effort to formalized a method for monitoring and evaluating the Town of Ludlow and The Village of Ludlow Local Hazard Mitigation Plan to track progress on action items and improve hazard data collection. The monitoring process has been identified as an action item to be implemented annually (at a minimum) over the plan period and will include a noticed annual meeting of the Hazard Mitigation Committee, to review and track the following:

- progress on hazard mitigation strategies in **Table 14**;
- improvements in effectiveness of other resources in **Table 2**;
- updates to local, regional or State hazard data occurrences and extent;
- changes in prioritization of identified hazards;
- whether stated goals are being achieved; and
- consistency with other Town Plan goal, policies, and recommendations.

This formal review process will be conducted annually by the Hazard Mitigation Committee prior to the Town's annual budgeting process each fall and will include completion of **Hazard Mitigation Plan Monitoring Forms** in **Appendix G.** Completed forms will be made part of this plan, distributed to the Town Selectboard and Planning Commission and Village Trustees for review, and made available for public viewing by posting on the Town website and making copies available at Town Hall.

An opportunity to provide public input will be scheduled for a Selectboard meeting once each year following the annual committee review above. These public meetings will have the Hazard Mitigation Committee provide updates on the progress made on plan strategies and discussion on potential new hazard mitigation strategies. For these scheduled meetings, input will be requested, and involvement encouraged, from representatives of the Planning Commission, Planning & Zoning, Emergency Management, Ludlow Fire and Highway Departments, and Okemo Mountain Resort along with local volunteer boards and interested members of the public. A separate review will be provided for the Village Trustees if requested.

The Southern Windsor County Regional Planning Commission will assist the Hazard Mitigation Committee in encouraging and guiding the Town and Village to consider and incorporate hazard mitigation goals and strategies as part of their planning process for updates to the Town Plan, Planning and Zoning Regulations, and Flood Hazard By-Laws, as well as for future stormwater master planning and community development projects.

The Hazard Mitigation Committee will also be responsible for reviewing the plan to ensure proposed mitigation actions remain in line with current town goals, strategies, and policies.

Plan Maintenance Process

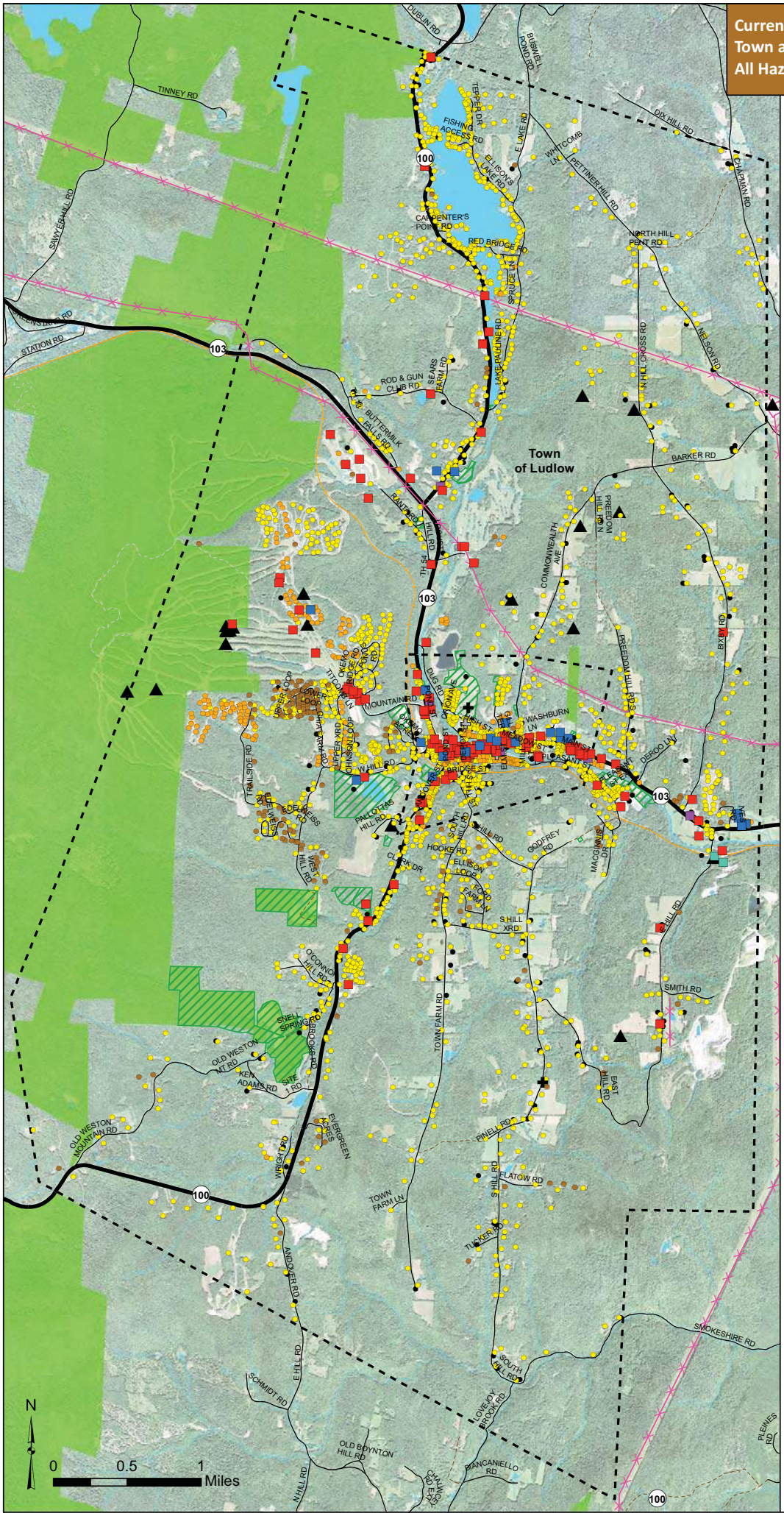
Four years into the plan period, the SWCRPC will assist the Town in reconvening the Hazard Mitigation Committee to kick-off the update process with an initial meeting to discuss the prior plan monitoring and the update process.

The Local Hazard Mitigation Plan update process will begin in summer 2022 with the first public meeting of the Hazard Mitigation Committee. All public meetings will be warned following town protocols. These public meetings will discuss the topics outlined in the Process Flow Chart (**Appendix C**).

Following the public meetings, SWCRPC will incorporate updates into a draft plan which will be made available for public comment. The plan will be available on the town and SWCRPC websites, https://www.ludlow.vt.us/, www.swcrpc.org, and hard copies will be available at the town office. A second publicly warned meeting will be held no later than fourth quarter 2022 during which any substantial revisions gathered during the public input period will be discussed. Additional meeting will be held if needed. The SWCRPC will make all necessary edits to the plan and provide the Hazard Mitigation Committee with a revised version for final review. Subsequently, the plan will be sent to the Vermont State Hazard Mitigation Officer for referral to FEMA for Approval Pending Adoption (APA). Following APA, the Ludlow Town Selectboard and the Village of Ludlow Board of Trustees may then adopt the Town of Ludlow and Village of Ludlow Local Hazard Mitigation Plan and forward a copy of the adoption resolution for FEMA to complete the plan approval and adoption process.

Appendix A

Current Land Use Map
Town and Village of Ludlow
All Hazard Mitigation Plan



- Civic/ Public
- Commercial
- Industrial
- Health Center
- Cemetery
- House of Worship
- Lodging, seasonal housing, or commercial with residential
- Multi-family residential
- Single Family Residential or Mobile Home
- Other
- Telecommunications Facility
- Town Owned Land
- Protected Lands
- Transmission Line
- River/ Stream
- Lakes/ Ponds
- State Highway
- Class 1 Town Highway
- Class 2 and 3 Town Highway
- Class 4 Town Highway
- Forest Road, Legal Trail, or Private Road
- Railroad
- Town and Village Boundary

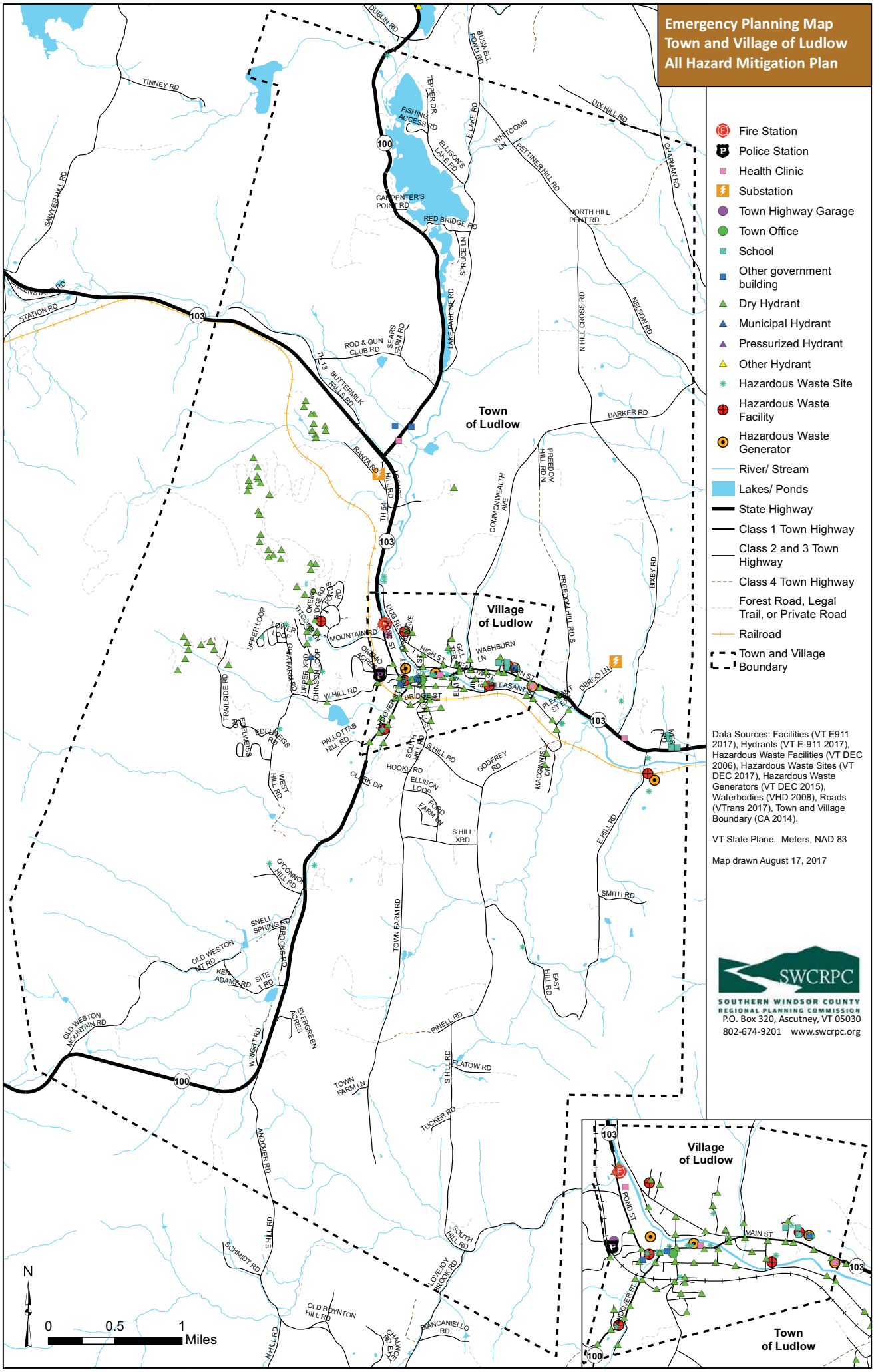
Data Sources: Telecommunications Tower (Natural Resources Board 2007 and SWCRPC 2013), Electric Transmission Line Corridor (VCGI 2003 and SWCRPC 2015), Protected Lands (Public Land and Privately Conserved Land) (VCGI and others 2016), Town Owned Land (RPC 2011), Site types (E911 2015 and RPC 2016), Cemeteries (E911 2015 and RPC 2016), Railroad (VTrans 2014), Waterbodies (VHD 2008), Roads (VTrans 2017), Town and Village Boundary (CA 2014).

Note: Use of public lands may be restricted.

VT State Plane. Meters, NAD 83

Map drawn August 17, 2017

SWCRPC
SOUTHERN WINDSOR COUNTY REGIONAL PLANNING COMMISSION
P.O. Box 320, Ascutney, VT 05030
802-674-9201 www.swcrpc.org


Emergency Planning Map
Town and Village of Ludlow
All Hazard Mitigation Plan
Fire Station
Police Station
Health Clinic
Substation
Town Highway Garage
Town Office
School
Other government building
Dry Hydrant
Municipal Hydrant
Pressurized Hydrant
Other Hydrant
Hazardous Waste Site
Hazardous Waste Facility
Hazardous Waste Generator
River/ Stream
Lakes/ Ponds
State Highway
Class 1 Town Highway
Class 2 and 3 Town Highway
Class 4 Town Highway
Forest Road, Legal Trail, or Private Road
Railroad
Town and Village Boundary
Town of Ludlow
Village of Ludlow
Data Sources: Facilities (VT E911 2017), Hydrants (VT E-911 2017), Hazardous Waste Facilities (VT DEC 2006), Hazardous Waste Sites (VT DEC 2017), Hazardous Waste Generators (VT DEC 2015), Waterbodies (VHD 2008), Roads (VTrans 2017), Town and Village Boundary (CA 2014).
VT State Plane. Meters, NAD 83
Map drawn August 17, 2017
SWCRPC
SOUTHERN WINDSOR COUNTY REGIONAL PLANNING COMMISSION
P.O. Box 320, Ascutney, VT 05030
802-674-9201 www.swcrpc.org
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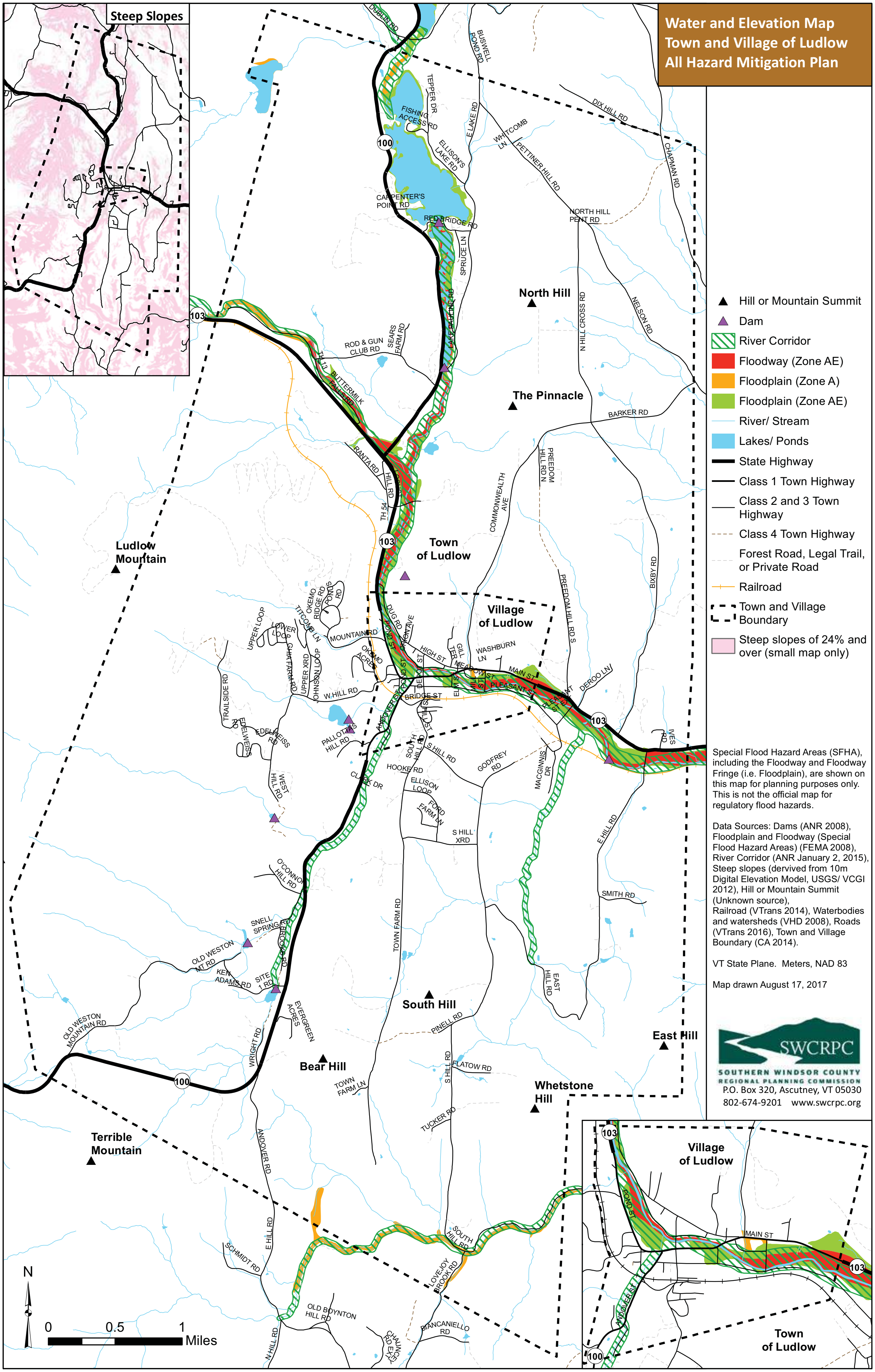
0 0.5 1 Miles
Village of Ludlow
Town of Ludlow


Water and Elevation Map
Town and Village of Ludlow
All Hazard Mitigation Plan
Steep Slopes
Hill or Mountain Summit
Dam
River Corridor
Floodway (Zone AE)
Floodplain (Zone A)
Floodplain (Zone AE)
River/ Stream
Lakes/ Ponds
State Highway
Class 1 Town Highway
Class 2 and 3 Town Highway
Class 4 Town Highway
Forest Road, Legal Trail, or Private Road
Railroad
Town and Village Boundary
Steep slopes of 24% and over (small map only)
Special Flood Hazard Areas (SFHA), including the Floodway and Floodway Fringe (i.e. Floodplain), are shown on this map for planning purposes only. This is not the official map for regulatory flood hazards.
Data Sources: Dams (ANR 2008), Floodplain and Floodway (Special Flood Hazard Areas) (FEMA 2008), River Corridor (ANR January 2, 2015), Steep slopes (dervived from 10m Digital Elevation Model, USGS/ VCGI 2012), Hill or Mountain Summit (Unknown source), Railroad (VTrans 2014), Waterbodies and watersheds (VHD 2008), Roads (VTrans 2016), Town and Village Boundary (CA 2014).
VT State Plane. Meters, NAD 83
Map drawn August 17, 2017
SWCRPC
SOUTHERN WINDSOR COUNTY REGIONAL PLANNING COMMISSION
P.O. Box 320, Ascutney, VT 05030
802-674-9201 www.swcrpc.org
North Hill
The Pinnacle
Town of Ludlow
Village of Ludlow
Ludlow Mountain
South Hill
Bear Hill
East Hill
Whetstone Hill
Terrible Mountain
N
0 0.5 1 Miles

Summary of Buildings within Flood Hazard Zones

Flood Zone	Building Type	Village # Units	Village %	Town # Units	Town %	Total # Units	Total %
Floodway	Accessory	2	9.5%	1	4.5%	3	7.0%
	Single-Family Dwelling	3	14.3%	6	27.3%	9	20.9%
	Multi-Family Dwelling	1	4.8%	6	27.3%	7	16.3%
	Mobile Homes	6	28.6%	2	9.1%	8	18.6%
	Camps		0.0%	1	4.5%	1	2.3%
	Commercial	8	38.1%	3	13.6%	11	25.6%
	Lodgings		0.0%	1	4.5%	1	2.3%
	Civic	1	4.8%	1	4.5%	2	4.7%
	Other		0.0%	1	4.5%	1	2.3%
	SUBTOTAL	*21*	*100.0%*	*22*	*100.0%*	*43*	*100.0%*
Floodway Fringe	Accessory	5	8.2%	5	5.6%	10	6.6%
	Single-Family Dwelling	23	37.7%	70	77.8%	93	61.6%
	Multi-Family Dwelling	3	4.9%	2	2.2%	5	3.3%
	Mobile Homes	9	14.8%	0	0.0%	9	6.0%
	Camps			7	7.8%	7	4.6%
	Commercial	14	23.0%	4	4.4%	18	11.9%
	Lodgings	1	1.6%	0	0.0%	1	0.7%
	Civic	6	9.8%	0	0.0%	6	4.0%
	Other			2	2.2%	2	1.3%
	SUBTOTAL	*61*	*100.0%*	*90*	*100.0%*	*151*	*100.0%*
SHFA TOTAL		**82**		**112**		**194**	
Local Flood Hazard Area (Stream Buffers)	Accessory			2	50.0%	2	50.0%
	Single-Family Dwelling			2	50.0%	2	50.0%
	All Other Types					0	0.0%
	SUBTOTAL			*4*	*100.0%*	*4*	*100.0%*
TOTAL All FLOOD ZONES		**82**		**116**		**198**	

Source: DFIRM & E911/ESITE, VCGI

Town & Village of Ludlow Flood Hazard Areas

Town of Ludlow

NFIP Enrollment Date: 09/01/1978

61 flood insurance policies/ 60% Structures within SFHA has flood insurance

Village of Ludlow

NFIP Enrollment Date: 09/01/1978

26 flood isurance policies/ 34% structures within SFHA has flood insurance

For Planning Purposes Only

- FEMA Floodway
- FEMA Floodway Fringe (Floodplain)
- Town 50 ft Setback
- Village 15 ft Setback
- River/ Stream
- Lakes/ Ponds
- State and Town Highways (Class 1-3)
- Other Public Roads/ Trails
- Private Road
- Railroad
- Village Boundary
- Parcels (2013)

N

0 0.25 0.5 0.75 1 Miles

Data sources: Parcels (2013), Road names (VTrans 2012), Railroad (VTrans/ VCGI 2003), Local Flood Hazard Area (RPC 2014), Floodway and Floodplain (FEMA 2008), Rivers, streams and ponds (VHD/VCGI 2008).

VT State Plane. Meters, NAD 83

Map drawn March 4, 2015

SWCRPC
SOUTHERN WINDSOR COUNTY REGIONAL PLANNING COMMISSION
P.O. Box 320, Ascutney, VT 05030
802-674-9201 www.swcrpc.org

Ludlow Flood Hazard Zones by Land Area

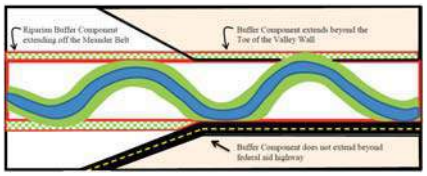
Hazard Zone	Area in Village Acres	Area in Village %	Area in Town Acres	Area in Town %	Total Area Acres	Total Area %
Floodway	41.7	5%	188.0	1%	229.7	1%
Floodway Fringe	49.4	6%	443.8	2%	493.2	2%
Local Stream Buffer	3.9	0%	164.1	1%	168.0	1%
Not in Hazard Zones	735.3	89%	20,968.3	96%	21,703.6	96%
Total	***830.3***	***100%***	***21,764.2***	***100%***	***22,594.5***	***100%***

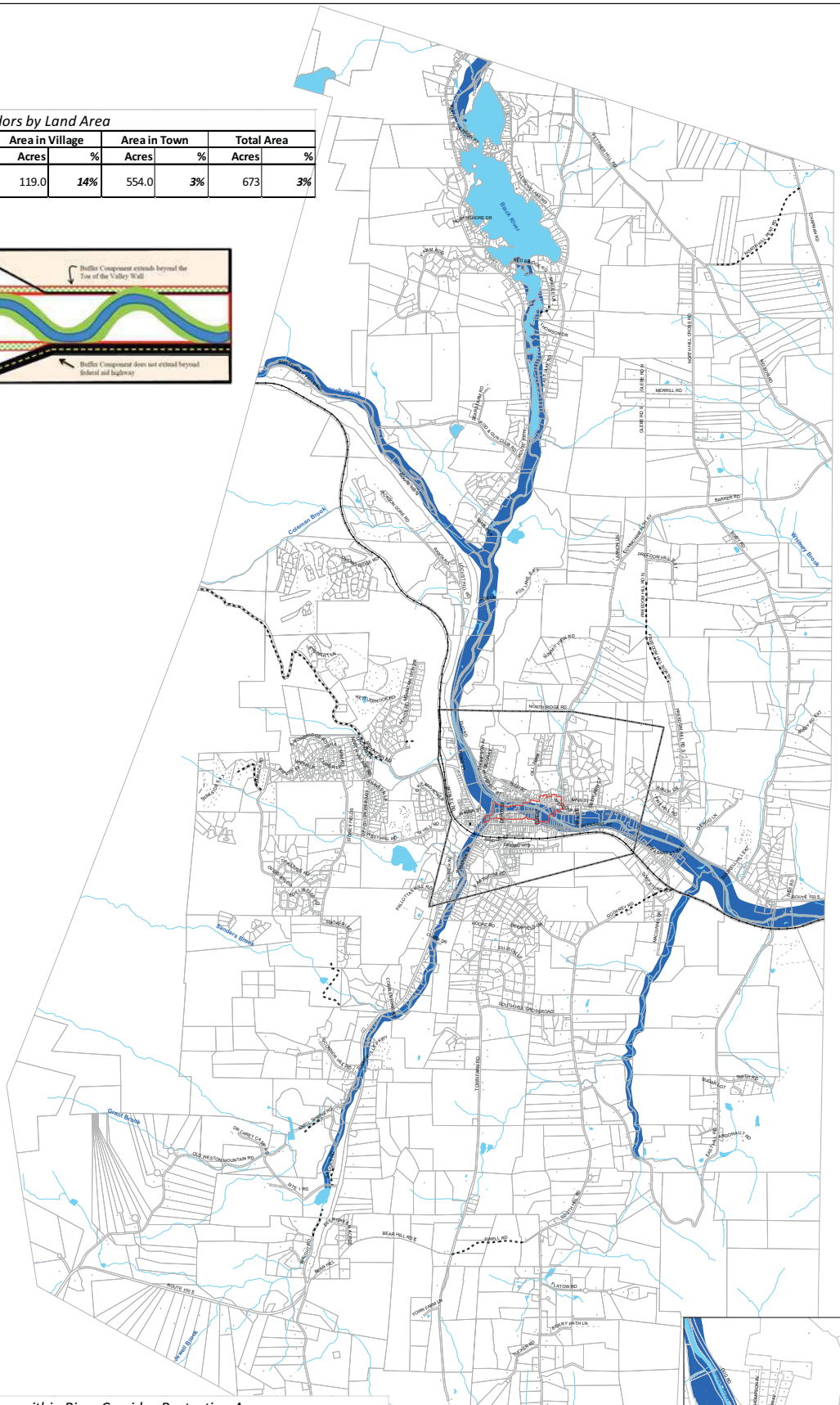
Town & Village of Ludlow River Corridor Protection Areas

River Corridor Protection Areas: "…the area within a delineated river corridor subject to fluvial erosion that may occur as a river establishes and maintains the dimension, pattern, and profile associated with its dynamic equilibrium condition and that would represent a hazard to life, property, and infrastructure placed within the area." (24 V.S.A. §4303)

Ludlow River Corridors by Land Area

Hazard Zone	Area in Village		Area in Town		Total Area	
	Acres	%	Acres	%	Acres	%
River Corridor Protection Area	119.0	*14%*	554.0	*3%*	673	*3%*



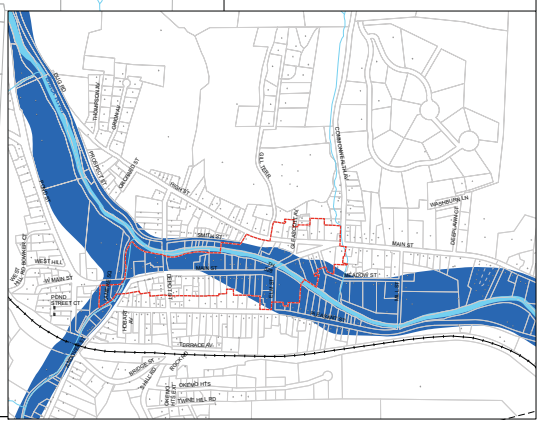


Data sources: Parcels (2013), Road names (VTrans 2012), Railroad (VTrans/ VCGI 2003), Local Flood Hazard Area (RPC 2014), Floodway and Floodplain (FEMA 2008), Rivers, streams and ponds (VHD/VCGI 2008).

VT State Plane. Meters, NAD 83

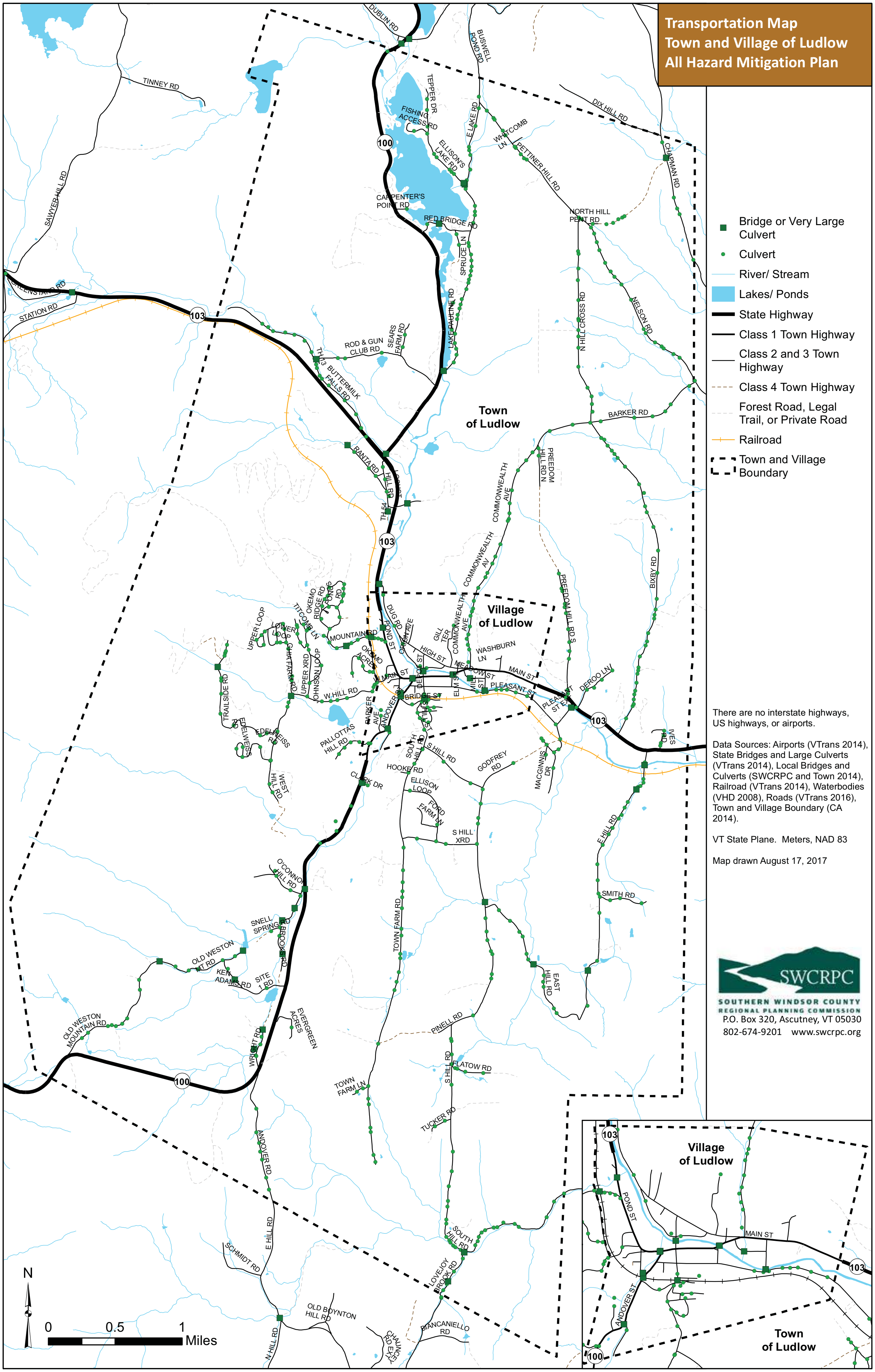
Map drawn March 4, 2015

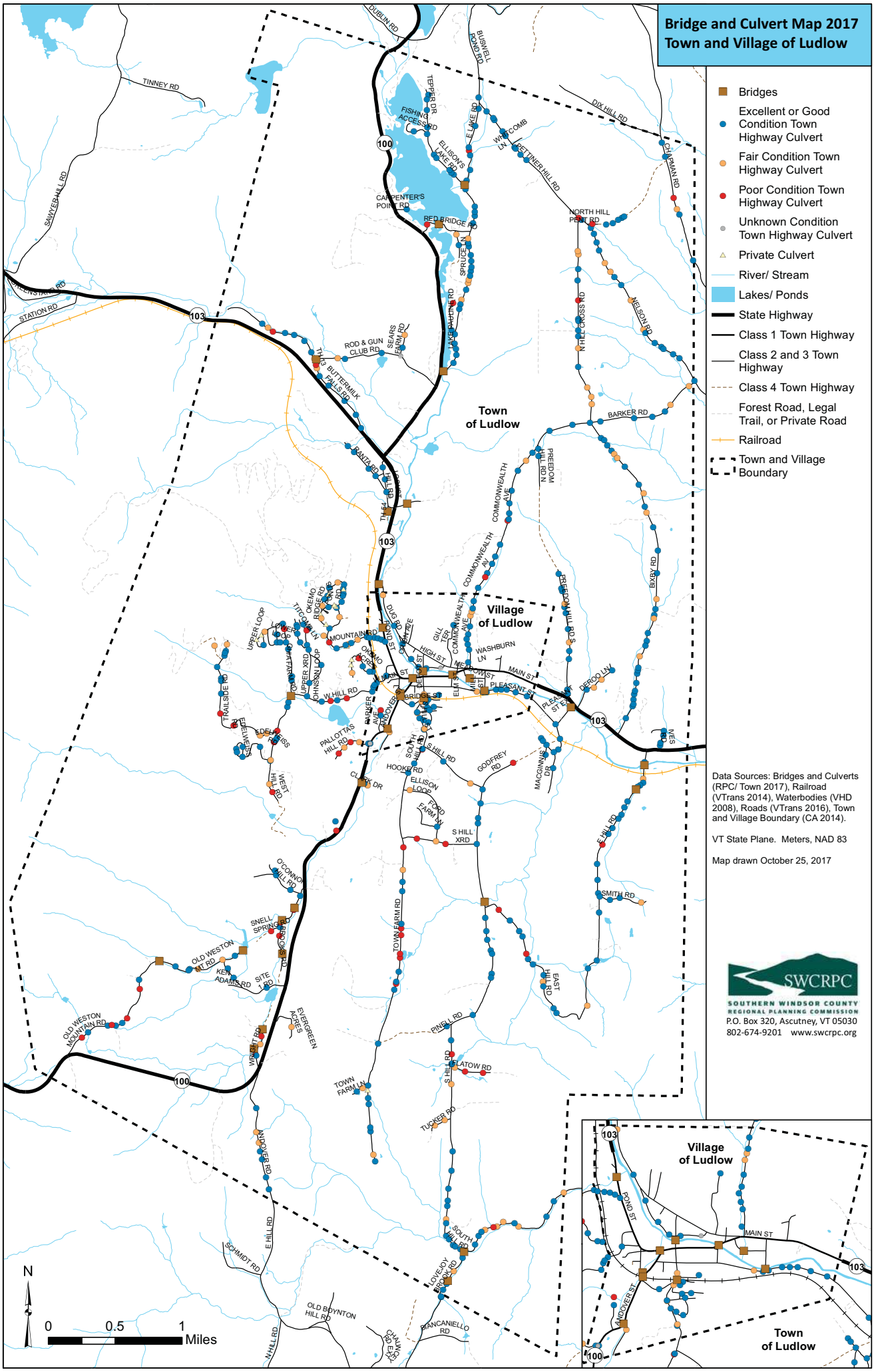
SWCRPC
SOUTHERN WINDSOR COUNTY REGIONAL PLANNING COMMISSION
P.O. Box 320, Ascutney, VT 05030
802-674-9201 www.swcrpc.org

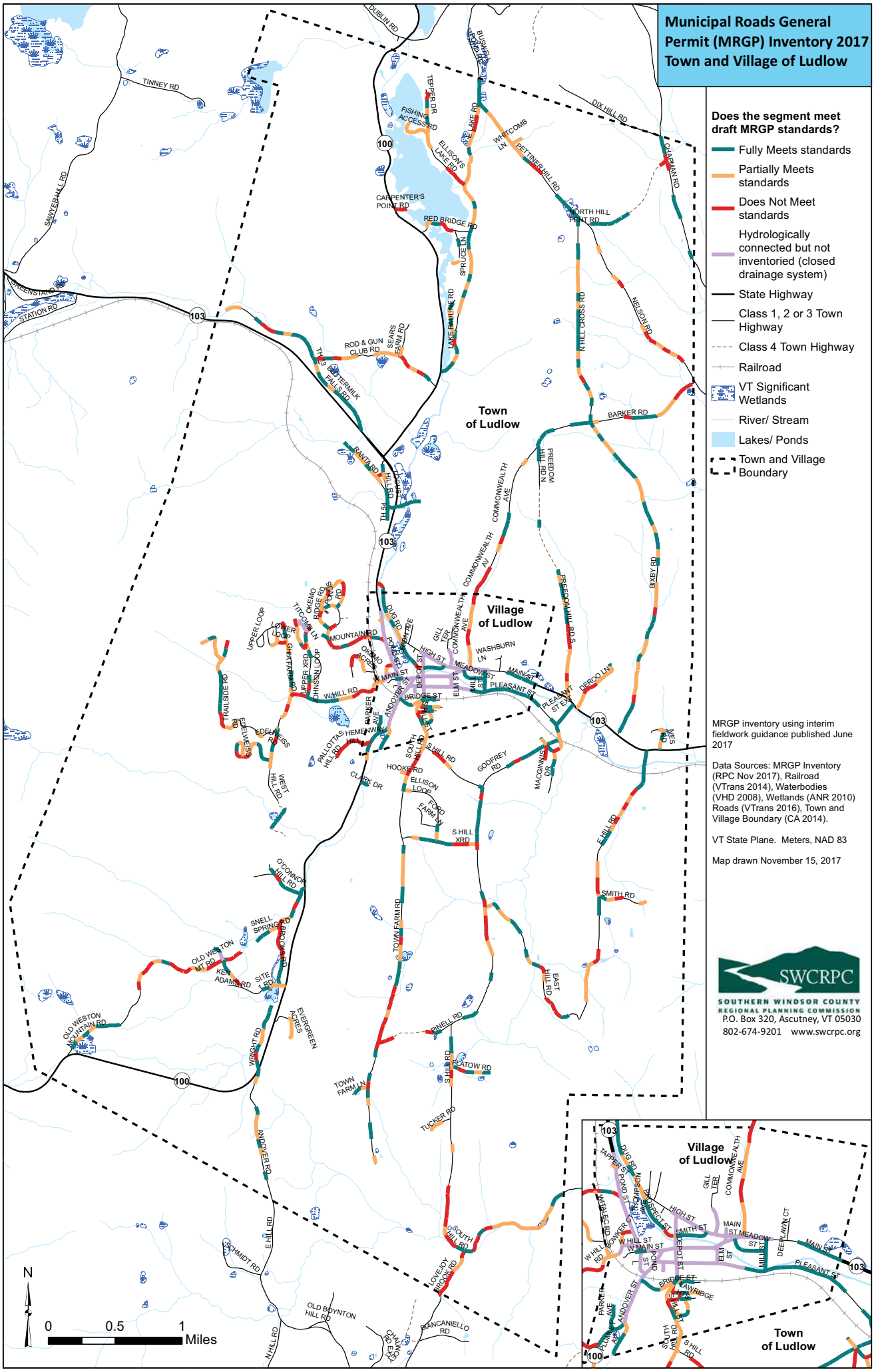


Summary of Buildings within River Corridor Protection Area

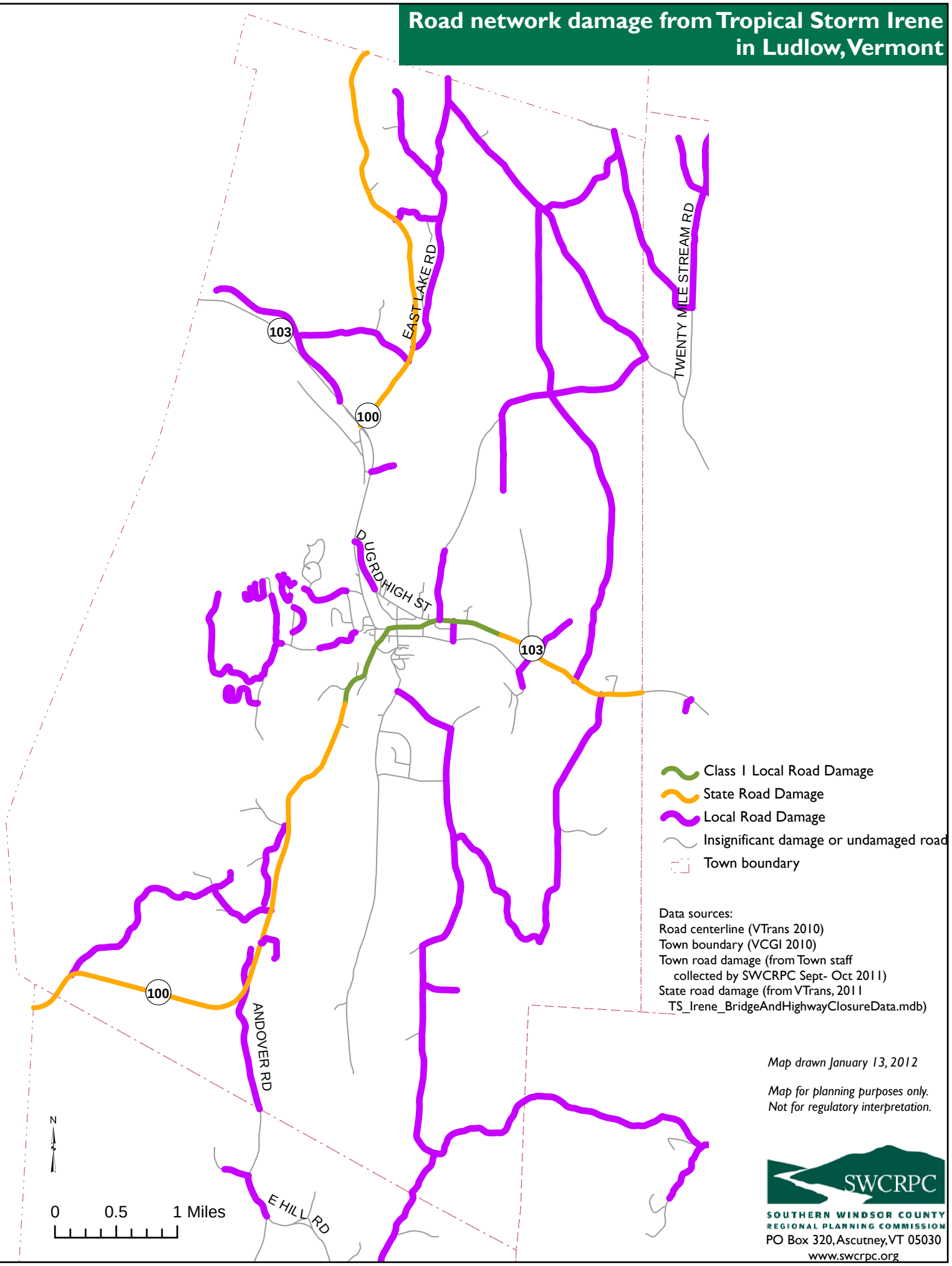
Flood Zone	Building Type	Village		Town		Total	
		# Units	%	# Units	%	# Units	%
River Corridor	Accessory	10	6.5%	10	8.5%	20	7.3%
	Single-Family Dwelling	66	42.6%	84	71.2%	150	54.9%
	Multi-Family Dwelling	17	11.0%	6	5.1%	23	8.4%
	Mobile Homes	14	9.0%	5	4.2%	19	7.0%
	Camps	0	0.0%	3	2.5%	3	1.1%
	Commercial	37	23.9%	7	5.9%	44	16.1%
	Lodgings	2	1.3%	1	0.8%	3	1.1%
	Civic	5	3.2%	1	0.8%	6	2.2%
	Other	4	2.6%	1	0.8%	5	1.8%
	SUBTOTAL	*155*	*100.0%*	*118*	*100.0%*	*273*	*100.0%*


Transportation Map
Town and Village of Ludlow
All Hazard Mitigation Plan
Bridge or Very Large Culvert
Culvert
River/ Stream
Lakes/ Ponds
State Highway
Class 1 Town Highway
Class 2 and 3 Town Highway
Class 4 Town Highway
Forest Road, Legal Trail, or Private Road
Railroad
Town and Village Boundary
There are no interstate highways, US highways, or airports.
Data Sources: Airports (VTrans 2014), State Bridges and Large Culverts (VTrans 2014), Local Bridges and Culverts (SWCRPC and Town 2014), Railroad (VTrans 2014), Waterbodies (VHD 2008), Roads (VTrans 2016), Town and Village Boundary (CA 2014).
VT State Plane. Meters, NAD 83
Map drawn August 17, 2017
SWCRPC
SOUTHERN WINDSOR COUNTY REGIONAL PLANNING COMMISSION
P.O. Box 320, Ascutney, VT 05030
802-674-9201 www.swcrpc.org
Town of Ludlow
Village of Ludlow
N
0 0.5 1
Miles
DUBLIN RD
BUSWELL POND RD
TINNEY RD
TEPPER DR
FISHING ACCESS RD
E LAKE RD
WHITCOMB LN
DIX HILL RD
CHAPMAN RD
ELLISON'S LAKE RD
PETTINER HILL RD
SAWYER HILL RD
CARPENTER'S POINT RD
RED BRIDGE RD
NORTH HILL PENT RD
SPRUCE LN
STATION RD
LAKE PAULINE RD
N HILL CROSS RD
NELSON RD
ROD & GUN CLUB RD
SEARS FARM RD
TH 13
BUTTERMILK FALLS RD
BARKER RD
RANTA RD
HILL RD
TH 54
COMMONWEALTH AVE
PREEDOM HILL RD N
BIXBY RD
PREEDOM HILL RD S
OKEMO RIDGE RD
PONDS RD
UPPER LOOP
LOWER LOOP
TITCOMB LN
MOUNTAIN RD
DUG RD
POND ST
ORCHARD AVE
GILL TER
HIGH ST
WASHBURN LN
MAIN ST
MEADOW ST
PLEASANT ST
DEROO LN
OKEMO ACRES
UPPER XRD
JOHNSON LOOP
W HILL RD
TRAILSIDE RD
BRIDGE ST
ELM ST
PARKER AVE
ANDOVER ST
EDELWEISS RD
PALLOTTAS HILL RD
SOUTH HILL RD
S HILL RD
GODFREY RD
MACGINNIS DR
IVES RD
WEST HILL RD
HOOKE RD
CLARK DR
ELLISON LOOP
FORD FARM LN
E HILL RD
S HILL XRD
O'CONNOR HILL RD
SMITH RD
TOWN FARM RD
SNELL SPRING
BROOK RD
OLD WESTON MT RD
KEN ADAMS RD
SITE 1 RD
EAST HILL RD
EVERGREEN ACRES
OLD WESTON MOUNTAIN RD
WRIGHT RD
PINELL RD
S HILL RD
FLATOW RD
TOWN FARM LN
TUCKER RD
ANDOVER RD
SOUTH HILL RD
SCHMIDT RD
LOVEJOY BROOK RD
OLD BOYNTON HILL RD
BIANCANIELLO RD
N HILL RD
100
103


Bridge and Culvert Map 2017
Town and Village of Ludlow
Bridges
Excellent or Good Condition Town Highway Culvert
Fair Condition Town Highway Culvert
Poor Condition Town Highway Culvert
Unknown Condition Town Highway Culvert
Private Culvert
River/ Stream
Lakes/ Ponds
State Highway
Class 1 Town Highway
Class 2 and 3 Town Highway
Class 4 Town Highway
Forest Road, Legal Trail, or Private Road
Railroad
Town and Village Boundary
Town of Ludlow
Village of Ludlow
Data Sources: Bridges and Culverts (RPC/ Town 2017), Railroad (VTrans 2014), Waterbodies (VHD 2008), Roads (VTrans 2016), Town and Village Boundary (CA 2014).
VT State Plane. Meters, NAD 83
Map drawn October 25, 2017
SWCRPC
SOUTHERN WINDSOR COUNTY REGIONAL PLANNING COMMISSION
P.O. Box 320, Ascutney, VT 05030
802-674-9201 www.swcrpc.org
N
0 0.5 1 Miles
Village of Ludlow
Town of Ludlow


Municipal Roads General Permit (MRGP) Inventory 2017
Town and Village of Ludlow
Does the segment meet draft MRGP standards?
Fully Meets standards
Partially Meets standards
Does Not Meet standards
Hydrologically connected but not inventoried (closed drainage system)
State Highway
Class 1, 2 or 3 Town Highway
Class 4 Town Highway
Railroad
VT Significant Wetlands
River/ Stream
Lakes/ Ponds
Town and Village Boundary
Town of Ludlow
Village of Ludlow
MRGP inventory using interim fieldwork guidance published June 2017
Data Sources: MRGP Inventory (RPC Nov 2017), Railroad (VTrans 2014), Waterbodies (VHD 2008), Wetlands (ANR 2010) Roads (VTrans 2016), Town and Village Boundary (CA 2014).
VT State Plane. Meters, NAD 83
Map drawn November 15, 2017
SWCRPC
SOUTHERN WINDSOR COUNTY REGIONAL PLANNING COMMISSION
P.O. Box 320, Ascutney, VT 05030
802-674-9201 www.swcrpc.org
N
0 0.5 1 Miles
Village of Ludlow
Town of Ludlow

Road network damage from Tropical Storm Irene in Ludlow, Vermont



Class 1 Local Road Damage
State Road Damage
Local Road Damage
Insignificant damage or undamaged road
Town boundary

Data sources:
Road centerline (VTrans 2010)
Town boundary (VCGI 2010)
Town road damage (from Town staff collected by SWCRPC Sept- Oct 2011)
State road damage (from VTrans, 2011 TS_Irene_BridgeAndHighwayClosureData.mdb)

Map drawn January 13, 2012

Map for planning purposes only.
Not for regulatory interpretation.

SWCRPC
SOUTHERN WINDSOR COUNTY REGIONAL PLANNING COMMISSION
PO Box 320, Ascutney, VT 05030
www.swcrpc.org

Appendix B

TOWN & VILLAGE OF LUDLOW

SPECIAL MEETING

HAZARD MITIGATION COMMITTEE MEETING

WEDNESDAY, NOVEMBER 1, 2017

TOWN HALL CONFERENCE ROOM
9:00 AM

1. Call to order
2. Overview of Preliminary Hazard Analysis & Vulnerability
3. HM Plan Process & Public Outreach Overview
4. Compile List of Hazards for Analysis
5. Discuss Methodology for Scoring Hazards
6. Perform Initial Mapping Exercise to Identify Vulnerabilities
7. Draft Community Asset Vulnerability Chart by Hazard
8. Schedule Next Meeting
9. Adjourn

Committee Members:
Frank Heald
Cindy Ingersoll, SWCRPC
Ron Bixby
Brett Sanderson
Rosemary Goings
Ron Tarbell
Chuck Craig
Jeffrey Billings
Carl Matteson

VOLUNTEER FORM TO DOCUMENT IN-KIND SERVICES - MATCH INFORMATION

PROGRAM: Ludlow LHMP
DATE OF MEETING: November 1, 2017
MEETING LOCATION: Town Hall Conference Room
TOPIC: Overview HM planning process
MEETING TIME: 9:00 AM

VOLUNTEER ATTENDEES - CLAIMED

No.	NAME	AFFILIATION	MILEAGE ROUND TRIP	MEETING HOURS	TOTAL MILEAGE	TOTAL TIME
					0.545	$20.00
1	Rosemary Goings	Planning & Zoning		1.5	-	30.00
2	Pam Cruickshank	Municipal Office		1.5	-	30.00
3	Ron Tarbell	Highway Foreman		1.5	-	30.00
4	Chuck Craig	Water/Wastewater		1.5	-	30.00
5	Jeffrey Billings	Police		1.5	-	30.00
6	Ron Bixby	Fire/EMD		1.5	-	30.00
7	Frank Heald	Municipal Manager		1.5	-	30.00
8	Carl Matteson	Ambulance		1.5	-	30.00
9					-	-
10					-	-
11					-	-
12					-	-
13					-	-
14					-	-
15					-	-
16					-	-
17					-	-
18					-	-
		Sub Total	**0.00**	**12.00**	**$0.00**	**$240.00**

FEDERALLY SUPPORTED PERSONNEL - CAN NOT CLAIM

No.	NAME	AFFILIATION				
					0	$0.00
1	Cindy Ingersoll	SWCRPC			-	-
2					-	-
3					-	-
4					-	-
5					-	-
6					-	-
7					-	-
		Sub Total	**0.00**	**12.00**	**$0.00**	**$0.00**

TOWN & VILLAGE OF LUDLOW

SPECIAL MEETING

HAZARD MITIGATION COMMITTEE MEETING

WEDNESDAY, NOVEMBER 8, 2017

TOWN HALL CONFERENCE ROOM
9:00 AM

1. Call to order
2. Review of Past HM Strategies
3. Status of Current Policies, Programs & Other Resources
4. Review Town Plans (Town Plan, FH, P&Z)
5. Other Reviews (Regional & State HMP)
6. Schedule Next Meeting
7. Adjourn

Committee Members:
Frank Heald
Cindy Ingersoll, SWCRPC
Ron Bixby
Brett Sanderson
Rosemary Goings
Ron Tarbell
Chuck Craig
Jeffrey Billings
Carl Matteson
Pam Cruickshank

VOLUNTEER FORM TO DOCUMENT IN-KIND SERVICES - MATCH INFORMATION

PROGRAM: Ludlow LHMP
DATE OF MEETING: November 8, 2017
MEETING LOCATION: Town Hall Conference Room
TOPIC: Review past strategies/plans and current status
MEETING TIME: 9:00 AM

VOLUNTEER ATTENDEES - CLAIMED

No.	NAME	AFFILIATION	MILEAGE ROUND TRIP	MEETING HOURS	TOTAL MILEAGE	TOTAL TIME
					0.545	$20.00
1	Rosemary Goings	Planning & Zoning		1.5	-	30.00
2	Pam Cruickshank	Municipal Office		1.5	-	30.00
3	Ron Tarbell	Highway Foreman		1.5	-	30.00
4	Chuck Craig	Water/Wastewater		1.5	-	30.00
5	Jeffrey Billings	Police		1.5	-	30.00
6	Ron Bixby	Fire/EMD		1.5	-	30.00
7	David Van Guilder	Ludlow Dispatch/EMD		1.5	-	30.00
8					-	-
9					-	-
10					-	-
11					-	-
12					-	-
13					-	-
14					-	-
15					-	-
16					-	-
17					-	-
18					-	-
		Sub Total	**0.00**	**10.50**	**$0.00**	**$210.00**

FEDERALLY SUPPORTED PERSONNEL - CAN NOT CLAIM

No.	NAME	AFFILIATION				
					0	$0.00
1	Cindy Ingersoll	SWCRPC			-	-
2					-	-
3					-	-
4					-	-
5					-	-
6					-	-
7					-	-
		Sub Total	**0.00**	**10.50**	**$0.00**	**$0.00**

TOWN & VILLAGE OF LUDLOW

SPECIAL MEETING

HAZARD MITIGATION COMMITTEE MEETING

WEDNESDAY, NOVEMBER 15, 2017

TOWN HALL CONFERENCE ROOM
9:00 AM

1. Call to Order

2. Review Town Plan (Town Plan, FH, P&Z)

3. Complete Review of Plans, Studies, Reports

4. Begin Discussion of Mitigation Plan
    a. Other Plans or Studies (River Corridor Plan, SGA Studies, Flood Resiliency Study)
    b. Overview of FEMA Mitigation Ideas

5. Overview of Mitigation Plan Monitoring

6. Schedule Next Meeting

7. Adjourn

Committee Members:
Frank Heald
Cindy Ingersoll, SWCRPC
Ron Bixby
David VanGuilder
Brett Sanderson
Rosemary Goings
Ron Tarbell
Chuck Craig
Jeffrey Billings
Carl Matteson
Pam Cruickshank

VOLUNTEER FORM TO DOCUMENT IN-KIND SERVICES - MATCH INFORMATION

PROGRAM: Ludlow LHMP
DATE OF MEETING: November 15, 2017
MEETING LOCATION: Town Hall Conference Room
TOPIC: Review other plans/studies, overview of monitoring
MEETING TIME: 9:00 AM

VOLUNTEER ATTENDEES - CLAIMED

No.	NAME	AFFILIATION	MILEAGE ROUND TRIP	MEETING HOURS	TOTAL MILEAGE	TOTAL TIME
					0.545	$20.00
1	Rosemary Goings	Planning & Zoning		1.5	-	30.00
2	Pam Cruickshank	Municipal Office		1.5	-	30.00
3	Ron Tarbell	Highway Foreman		1.5	-	30.00
4	Jeffrey Billings	Police		1.5	-	30.00
5	Carl Matteson	Ambulance		1.5	-	30.00
6					-	-
7					-	-
8					-	-
9					-	-
10					-	-
11					-	-
12					-	-
13					-	-
14					-	-
15					-	-
16					-	-
17					-	-
18					-	-
		Sub Total	**0.00**	**7.50**	**$0.00**	**$150.00**

FEDERALLY SUPPORTED PERSONNEL - CAN NOT CLAIM

No.	NAME	AFFILIATION				
					0	$0.00
1	Cindy Ingersoll	SWCRPC			-	-
2					-	-
3					-	-
4					-	-
5					-	-
6					-	-
7					-	-
		Sub Total	**0.00**	**7.50**	**$0.00**	**$0.00**

TOWN & VILLAGE OF LUDLOW

SPECIAL MEETING
HAZARD MITIGATION COMMITTEE MEETING

WEDNESDAY, NOVEMBER 29, 2017

TOWN HALL CONFERENCE ROOM
9:00 AM

1. Call to Order

2. Review HMP Status

3. Review Draft Plan Monitoring Process

4. Preparations for First Draft

5. Schedule Board Meetings
   a. Select Board
   b. Village Trustees

6. Other Business

7. Adjourn

Committee Members:
Frank Heald
Cindy Ingersoll, SWCRPC
Ron Bixby
David VanGuilder
Brett Sanderson
Rosemary Goings
Ron Tarbell
Chuck Craig
Jeffrey Billings
Carl Matteson
Pam Cruickshank

VOLUNTEER FORM TO DOCUMENT IN-KIND SERVICES - MATCH INFORMATION

PROGRAM: Ludlow LHMP
DATE OF MEETING: November 29, 2017
MEETING LOCATION: Town Hall Conference Room
TOPIC: Review Plan monitoring, preparations for 1st draft
MEETING TIME: 9:00 AM

VOLUNTEER ATTENDEES - CLAIMED

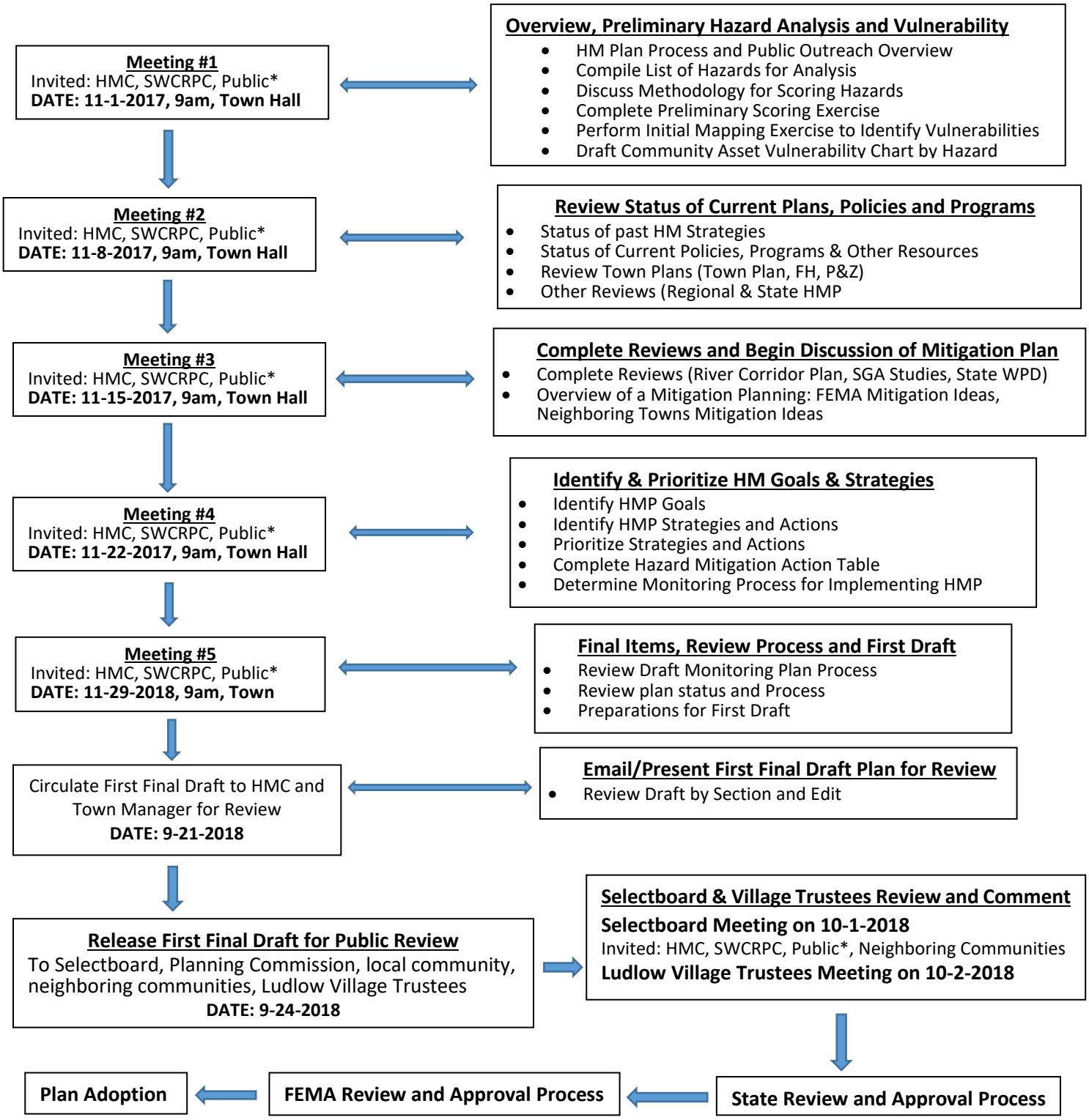
No.	NAME	AFFILIATION	MILEAGE ROUND TRIP	MEETING HOURS	TOTAL MILEAGE	TOTAL TIME
					0.545	$20.00
1	Rosemary Goings	Planning & Zoning		1.5	-	30.00
2	Pam Cruickshank	Municipal Office		1.5	-	30.00
3	Ron Tarbell	Highway Foreman		1.5	-	30.00
4	Jeffrey Billings	Police		1.5	-	30.00
5	Carl Matteson	Ambulance		1.5	-	30.00
6	Frank Heald	Municipal Manager		1.5	-	30.00
7	Chuck Craig	Water/Wastewater		1.5	-	30.00
8					-	-
9					-	-
10					-	-
11					-	-
12					-	-
13					-	-
14					-	-
15					-	-
16					-	-
17					-	-
18					-	-
		Sub Total	**0.00**	**10.50**	**$0.00**	**$210.00**

FEDERALLY SUPPORTED PERSONNEL - CAN NOT CLAIM

No.	NAME	AFFILIATION				
					0	$0.00
1					-	-
2					-	-
3					-	-
4					-	-
5					-	-
6					-	-
7					-	-
		Sub Total	**0.00**	**10.50**	**$0.00**	**$0.00**

Appendix C

APPENDIX C
Town and Village of Ludlow
2018-2023 Hazard Mitigation Committee Schedule & Process Flow Chart



**Public refers to the local Springfield Community*

Appendix D

APPENDIX D

2017 Ludlow Town Plan Review

Below are goals, policies, and recommendations from the 2017 Ludlow Town Plan subsections there were determined to be related to hazard mitigation.

Agricultural Resources (p. 10)

Policies:

- State-adopted Accepted Agricultural Practices and Acceptable Management Practices shall be used in agricultural and forestry activities, implementation of Best Management Practices (BMPs) are encouraged in such operations, and point and non-point source pollution should be minimized.
- Development should be sited in order to avoid unstable soils that offer poor support for foundations or footings and are subject to slippage, or are poorly suited for road construction. Extensive site investigations and erosion control plans may be required to determine the development suitability of such soils.

Recommendations:

- Review land use regulations for addressing prime agricultural soils and development on steep slopes and fragile soils.

Water Resources (pgs. 11, 16-18)

Encouraging flood resilience for Ludlow is a major theme for this Municipal Plan. This involves evaluating risks, such as floodway, floodplains, river corridors, wetlands, and land adjacent to streams. This also involves identifying mitigation activities, such as maintaining upland forests to help reduce flood and fluvial erosion risks to surrounding lower-lying areas.

The following Water Quality sub-sections combine to address flood resilience. In addition, Ludlow's Hazard Mitigation Plan evaluates flood-related risks and identifies a number of strategies to mitigate those risks. The Hazard Mitigation Plan, as most recently amended, is hereby adopted by reference as a part of this Municipal Plan.

Goal:

- Protect water resources for the health, safety and enjoyment of Ludlow citizens.

Policies:

- Ensure that development in the watershed areas of Lake Rescue and Lake Pauline does not adversely affect water quality and the scenic value of these lakes.
- Protect shorelines and stream banks from surface runoff that could lead to excessive erosion, sedimentation, and/or other pollution of surface waters.
- Protect the quality and capacity of groundwater consistent with state statute and zoning bylaws.
- Encourage compatible uses of surface waters for recreation, tourism, and economic benefit where such uses will not impair water quality, or wildlife and/or aquatic habitat.

- Development in flood hazard areas shall be in compliance with the Ludlow's Flood Hazard Regulations.
- Destruction of Class 1 and 2 wetlands and construction in wetlands should be avoided.
- Land uses within the Aquifer Protection District and wellhead protection areas shall not threaten the quality of groundwater supplies.
- The storage or use of chemicals that could contaminate groundwater within Source Protection Areas shall not be allowed.
- Encourage Low Impact Development (LID), including but not limited to rain gardens, limiting impervious surface lot coverage, and protecting existing natural vegetation, in order to maximize on-site stormwater infiltration and minimize off-site stormwater and erosion impacts.
- Support efforts to improve the water quality of the lakes, such efforts may include preventing the spread of Eurasian water milfoil, upgrading failing septic systems along lakeshores, implementing proper stormwater management activities to prevent sediment migrating from roads and driveways.
- Water quality should be maintained and improved according to policies and actions identified in the VT ANR's Tactical Basin Plan for the Black River watershed (Basin 10).

<u>Recommendations</u>:

- Work cooperatively with the Connecticut River Joint Commissions, the Black River Watershed Association, the Lake Association and others involved in water quality issues in order to implement the following water quality protection strategies:
- Obtain and distribute existing literature and educational handouts to homeowners around the lakes, river corridors and FEMA-mapped special flood hazard areas regarding the impacts of floodplain loss on water quality and increases in public hazards;
- Obtain grant funding/volunteers/river corridor easements for stream bank and lakeshore stabilization identified in recent water quality studies.
- Coordinate with the SWCRPC, VT Agency of Natural Resources, Black River Watershed Association, Lake Association to explore regulatory and non-regulatory implementation measures to address river corridor issues identified in recent Phase 1 and 2 Stream Geomorphic Assessments.
- Investigate options to better protect the river corridors, such as preserving or restoring the river channel access to the surrounding floodplains, reducing flood flows with streambank buffers, protection of channel-contiguous wetlands, preserving or supporting a return to more natural channel dimensions, and avoiding new development and infrastructure within river corridors.
- Develop appropriate measures to protect or improve water quality in Ludlow's lakes, ponds, rivers, streams, and wetlands. Measures shall include requirements for adequate vegetative buffers and standards for development to control density, soil erosion, sedimentation, and pollution.
- Identify existing buildings located within flood and erosion hazard areas (i.e. regulatory floodway, floodway fringe, and fluvial erosion hazard areas) that have experienced repeated flood damage, and explore options to mitigate future flood or erosion hazards for those properties.
- Explore ways to best discourage development on slopes over 25% and minimize impacts of development on slopes between 15 and 25%.

- Work with ANR to identify locally appropriate policies and actions that are likely to result in improved water quality in Ludlow.

Earth Mineral Resources (p. 19)

Policies:

- Ensure that abandoned and un-reclaimed extraction sites do not present an unsightly appearance, pose health and safety hazards, reduce the property value of abutting land, and require expensive reclamation efforts.

Housing (p. 34)

Policies:

- Locate affordable housing or housing for individuals with special needs, such as the elderly or those with physical or mental disabilities, in areas where services are available.

Utilities, Facilities, and Services: Water and Sewer (pgs. 52-53)

Goals:

- Continue to provide safe drinking water and sanitary sewage disposal efficiently within the existing service areas.

Policies:

- Promote expansion of municipal services only in land use areas defined by the municipality as desirable for growth and development.
- Promote proper installation of properly designed, appropriate onsite systems for development occurring beyond the municipal service area.
- The quality of municipal drinking water shall be protected.
- Water conservation techniques should be used in new development, and in the rehabilitation of existing development, in order to lengthen the life of wastewater treatment facilities and avoid the depletion of groundwater resources.
- Encourage owners of parcels with existing onsite systems within the municipal water and sewer service areas, to obtain municipal service before system failure.
- Ensure that development within municipal service areas is connected to municipal water and sewer services.
- Support efforts to educate owners concerning proper maintenance of onsite systems.
- Encourage low impact development or other on-site stormwater retention techniques in order to reduce wastewater system capacity demands during snow melt and rain events.
- Encourage the development and use of alternative technologies with regards to the handling of wastewater (e.g.: composting toilet systems).

Recommendations:

- Expand sewer service to include parcels contiguous with the existing service area, when hazardous onsite problems have been identified or where soils are unsuitable for onsite systems.
- Within the service area, supply municipal service to new development and to owners of existing failed or failing septic systems.

- Encourage maintenance and upgrading of onsite systems to prevent well contamination, pollution or other problems associated with improperly installed or failed systems.
- Continue regular updates of the Capital Budget and Program for municipal water and wastewater system needs.

Utilities, Facilities, and Services: Electrical Services (p. 53)

Policies:

- Continue to evaluate the placement of electric lines and facilities for health, safety, and aesthetic concerns.

Utilities, Facilities, and Services: Communication Services (p. 54)

The maintenance of a modern and accessible telecommunications network is considered essential to the public welfare, access to educational opportunities and economic development efforts. Countless economic, social, and cultural benefits are available to communities, which possess free and open access to people and ideas in other parts of the world. Public safety agencies, such as emergency medical services, fire, and police departments, rely on wireless communication to provide essential services.

Utilities, Facilities, and Services: Health and Safety Services (pp. 59-60)

Goals:

- Provide high quality municipal police, fire, and ambulance services to ensure the protection of public health and safety.

Policies:

- Ensure that new development includes sufficient accessibility for emergency vehicles.
- In order to protect the safety of residents and emergency services personnel, new development shall not exceed the existing or anticipated capacity to provide adequate emergency services.
- Support measures to reduce the time needed by health and safety services for responding to calls for assistance.
- Evaluate emergency communications facilities to ensure sufficient capacity to support police and ambulance service.

Recommendations:

- Ensure that new development includes sufficient accessibility for emergency vehicles.
- Provide continued training opportunities for police, fire and ambulance department staffs.
- Maintain the Ludlow Capital Budget and Program with regular updates to address anticipated capital needs for emergency services. Continue to buy as much technology/equipment available to off-set staffing limitations.

Utilities, Facilities, and Services: Additional Facilities (p. 64)

Policies:

- Support the development of an emergency care facility to provide more immediate access for Ludlow and surrounding communities.

Recommendations:

- Seek grant funding for an emergency electric generator for the new community center.

Transportation (pgs. 73-74)

Goals:

- Provide for the safe, efficient and cost-effective movement of people, goods and services.

Policies:

- Proposed developments shall not cause undue congestion or safety hazards.
- Promote sound access management along VT Routes 103 and 100, including improving safety, minimizing traffic delays, avoiding the creation of unnecessary, road intersections and curb cuts, and sharing commercial access roads and parking areas.
- Ensure that all pedestrian and bicycle pathways are clearly marked and maintained for safety.
- Development roads and driveways must meet all applicable municipal standards in order to provide adequate safety and emergency vehicle access.

Recommendations:

- Maintain local road, bridge and culvert inventories, and use the inventories as a basis for managing the local transportation system and to inform an on-going six-year capital budget and planning process.
- Explore cost-effective ways to improve safety and intersection performance at high crash locations in coordination with the Southern Windsor County Regional Planning Commission and Vermont Agency of Transportation.

Flood Resilience Chapter (pgs. 8-9)

Goals:

- To encourage flood resilient communities.

Policies:

- New development in identified flood hazard and River Corridors should be avoided. If new development is to be built in such areas, it should not exacerbate flooding and fluvial erosion.
- Any development within the flood hazard areas is subject to the Flood Hazard Review Procedures in Article 6 of the zoning bylaws for both the Village and Town of Ludlow.
- Redevelopment in River Corridors shall be within a comparable footprint as the legally existing structure.
- Infill development in River Corridors shall be allowed in accordance with the VT Department of Environmental Conservation's Flood Hazard Area and River Corridor Protection Procedure.
- The protection and restoration of floodplains and upland forested areas that attenuate and moderate flooding and fluvial erosion should be encouraged.
- Maintain adequate development setbacks along the streams in accordance with the Local Flood Hazard Area provisions in the zoning bylaws for both the Village and Town of Ludlow.
- Where buffers are required for Act 250 projects, provide reasonable flexibility with these buffer standards in order to allow for recreational uses (e.g. water access, multi-use paths), water

crossings (e.g. roads, driveways and utilities), and management activities (e.g. removal of hazardous trees, eradicating exotic invasive species or contaminated soil remediation).

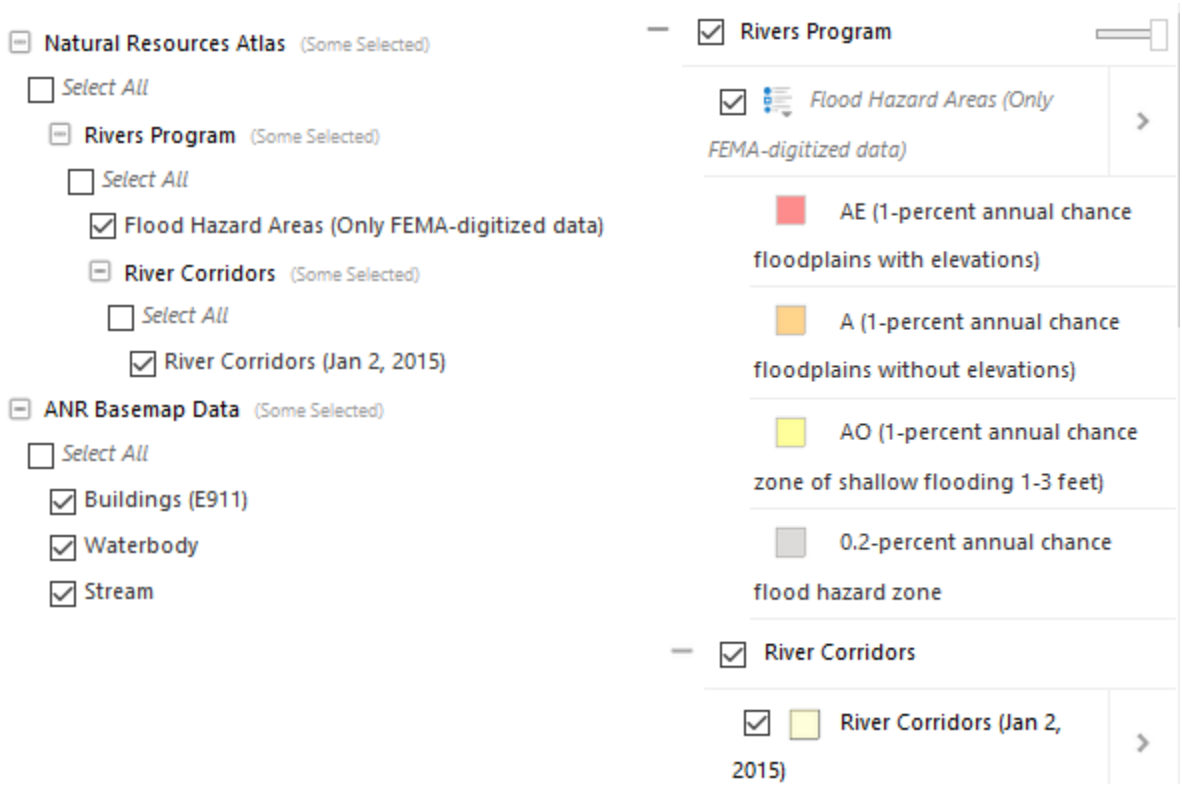
- Maximize onsite stormwater infiltration to help promote flood resiliency.
- Preserve the flood retention functionality of wetlands that serve as important components of local flood resilience efforts.
- Ludlow's All Hazard Mitigation Plan, as most currently amended, is hereby adopted by reference as a component of this Municipal Plan.

Strategies:

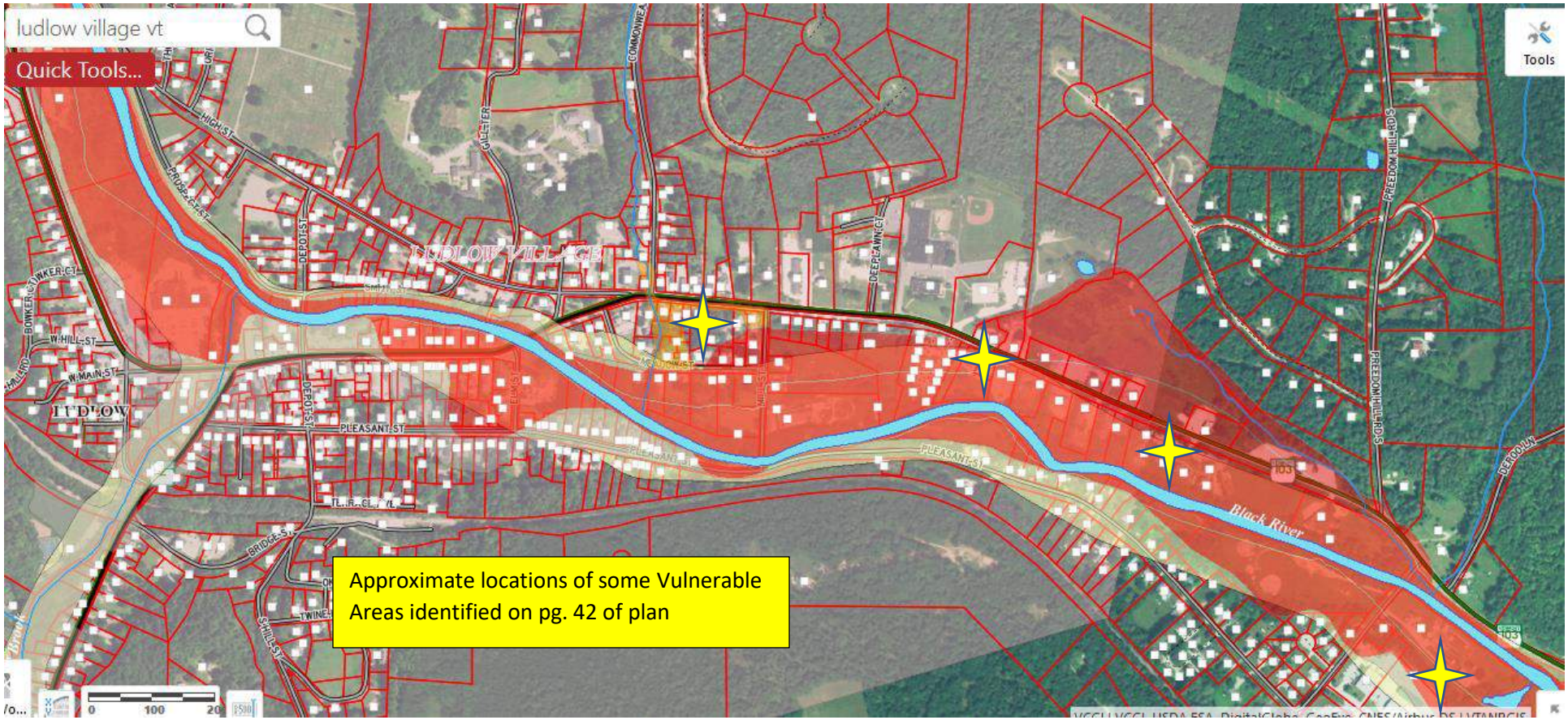
- Implement a community wide education program on promoting flood resilience.
- Complete property acquisitions in Smithville along Route 103 South.
- Retrofit existing drainage system to allow for greater water passage at Commonwealth Ave. intersection.
- The Town and Village should develop adequate emergency preparedness and response planning including, but not limited to:
- Maintaining an up to date Local Emergency Operations Plan;
- Updating the Local All Hazard Mitigation Plan on a five-year timeframe, or as needed;
- Develop an evacuation plan for businesses and residents within the identified hazard areas (i.e. flood hazard and river corridor).
- Evaluate existing regulations and standards to ensure that the goal and policies of this Chapter are adequately addressed.
- Maintain enrollment in the National Flood Insurance Program.
- Update the bridge and culvert inventory and condition assessment, and maintain an annual culvert upgrade and maintenance program to address the priority needs identified in the inventory.
- Encourage flood resiliency by prioritizing land conservation efforts for those lands that serve important flood retention or attenuation functions.
- Mitigate risks in the Designated Village Center and other vulnerable areas by:
- Including strategic infrastructure investments in the capital improvement plan (e.g. upgrades to bridges, culverts and storm drainage systems);
- Avoiding new critical facilities from locating within flood hazard or River Corridors;
- Implement flood-proofing improvements when making major reinvestments in municipal buildings within flood hazard areas;
- Prevent the storage of important public records (e.g. Municipal archives, library collections) in flood-prone areas, which may require relocation to a different site, dry flood proofing buildings, or to be moved at least one-foot above the base flood elevation.

Appendix E

Legend for Flood Ready Maps

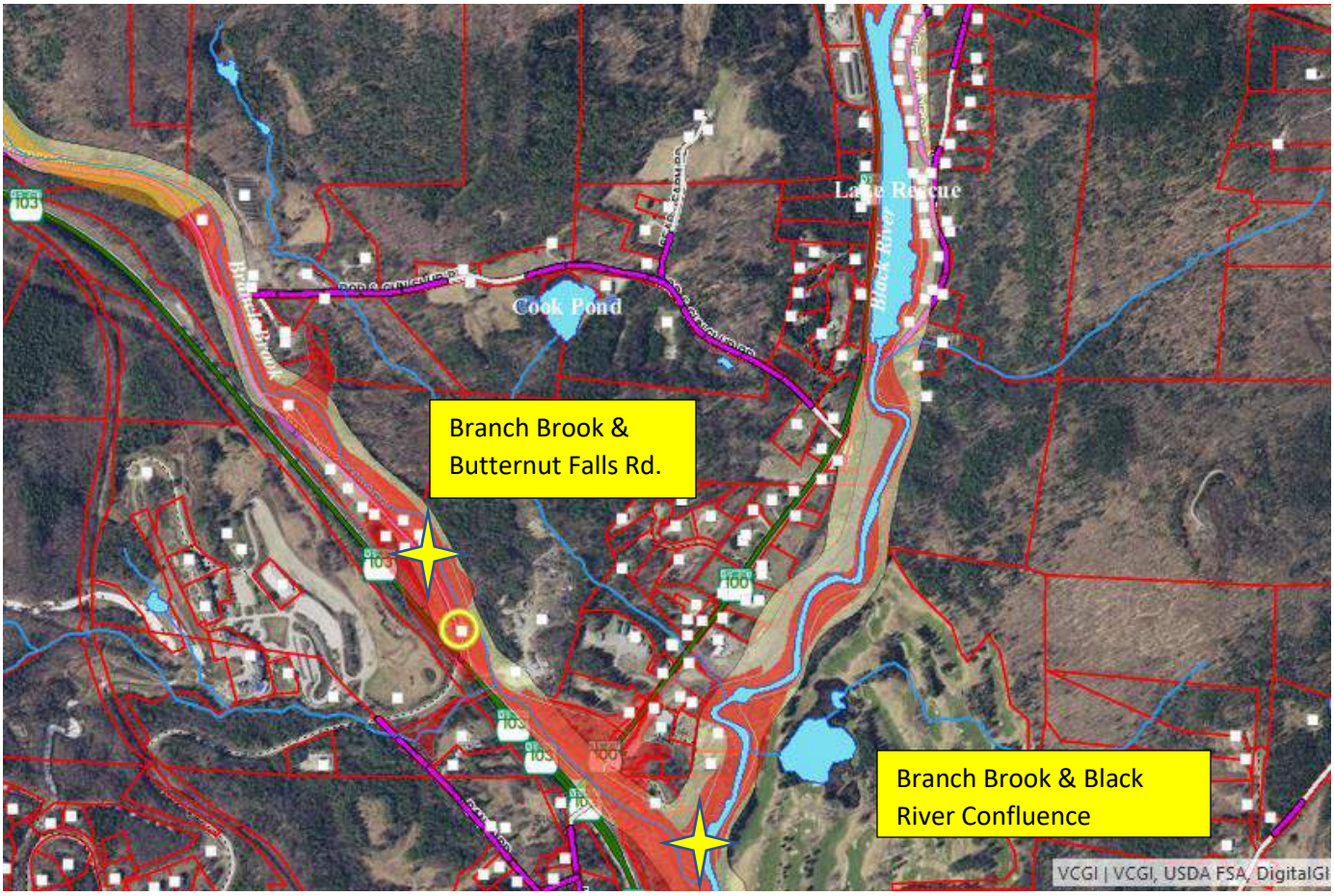


Village of Ludlow Main Street Area

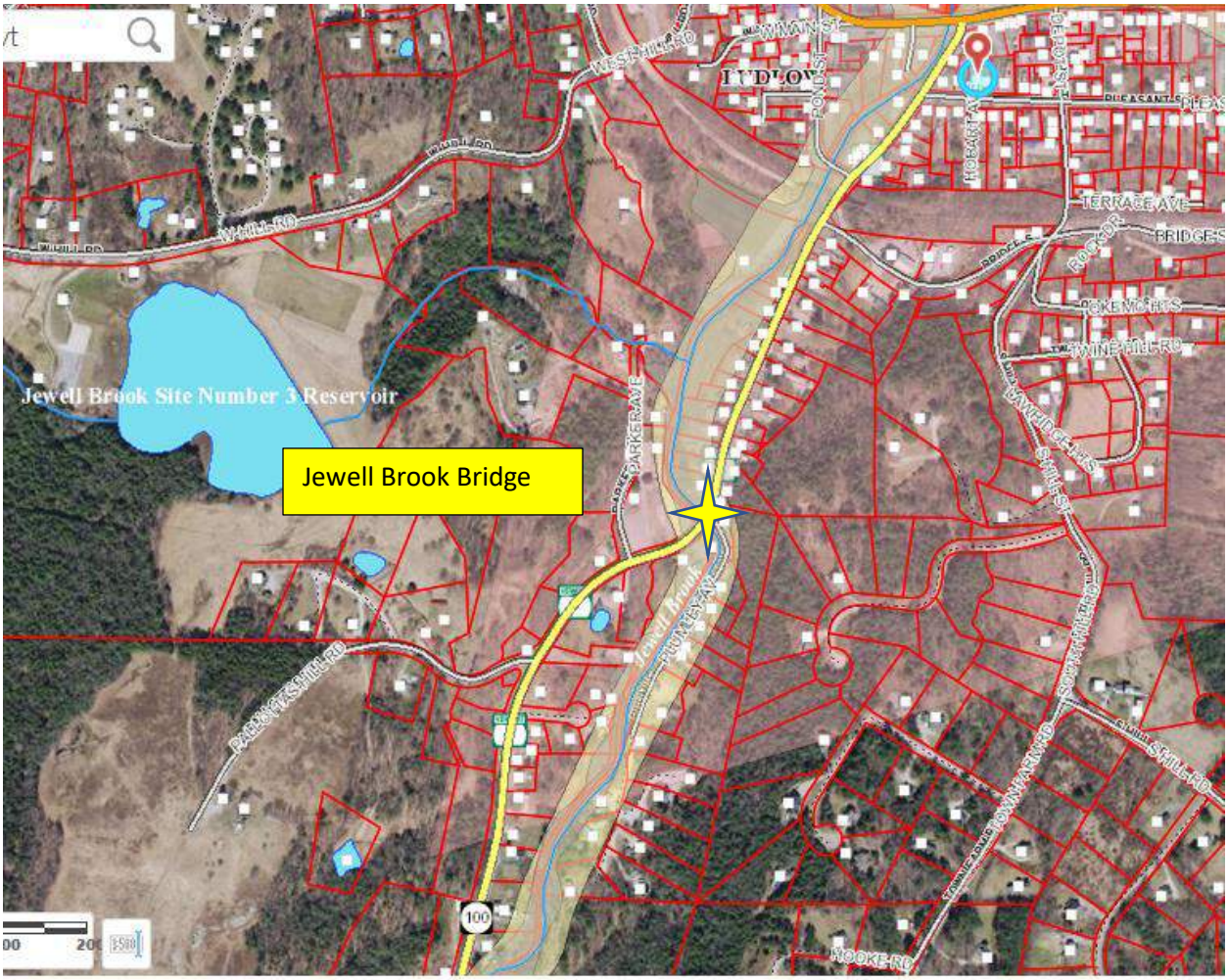


Dug Rd. Near Okemo Access and Fire Department

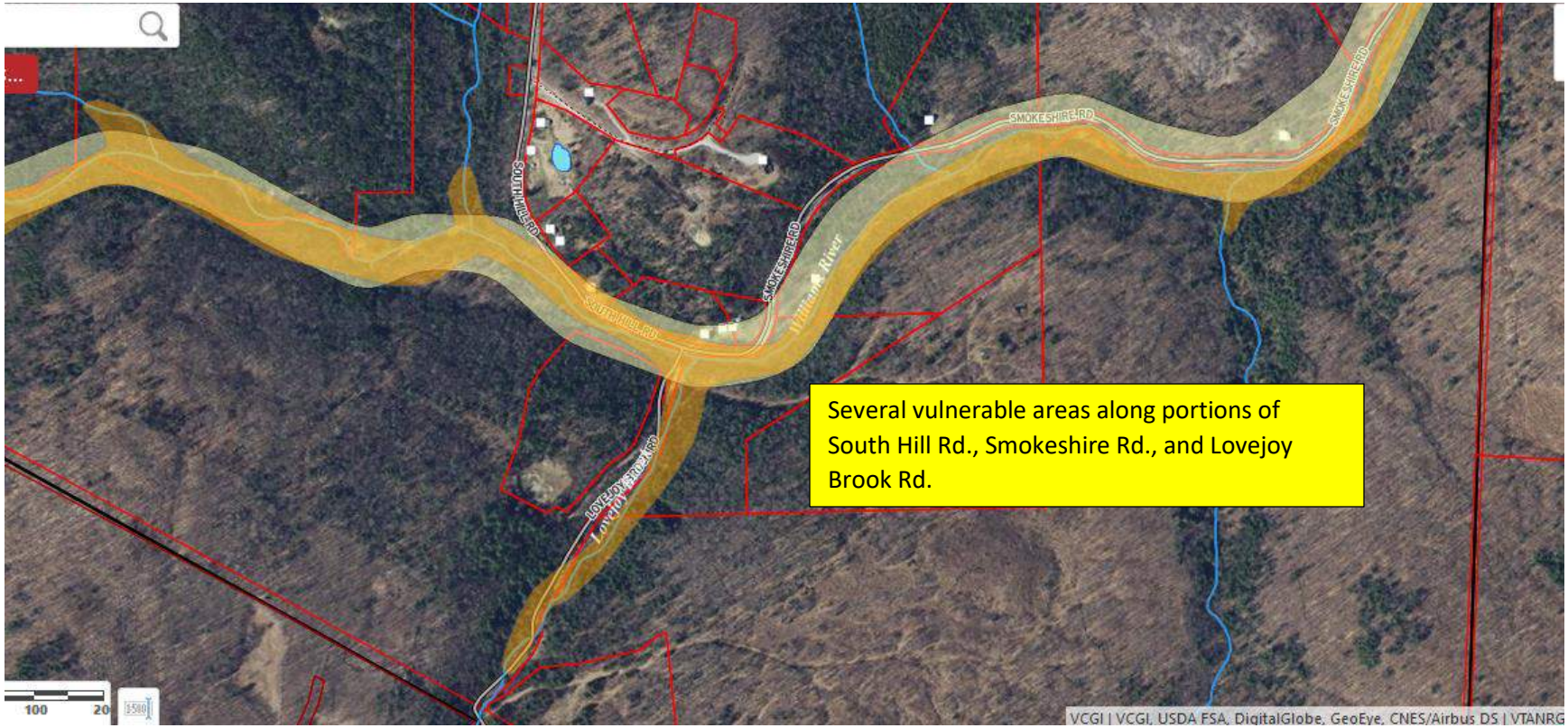
Confluence of Branch Brook and Black River Below Lake Rescue



Jewell Brook Area and Jewell Brook Bridge



Williams River and Confluence with Lovejoy Brook Area



Appendix F

Appendix F

Excerpts from the Black River Corridor Management Plan for Ludlow reaches

Black River Main Stem. Upstream of Cavendish Gorge (Cavendish and Ludlow)

Parallel to Route 131 from the eastern edge of Proctorsville to just below the Mill Street Bridge in Cavendish (M30[1])

This section of the Black River, running between the eastern edge of Proctorsville to just below Mill Street in Cavendish, has a variety of land uses, with some conversion of agricultural lands to residential uses. The dam at the CVPS hydroelectric power generating station (in reach 29) impounds some water in this reach. The steep forested slopes on one bank are part of Proctor-Piper State Forest. Green Mountain Railroad occasionally encroaches on floodplain. There is streambank armoring in one section where mass failure threatened the stability of Route 131 (see 2009 Phase 2 SGA: E33).

Reach sensitivity and priority actions:

- Sensitivity: High
- River Corridor Protection: High Priority
- Increase vegetated buffer widths and continuity: High priority.

Parallel to Route 131 through Proctorsville from Route 103 bridge crossing to near Twentymile Stream Road (M31)

Running through Proctorsville from the Route 103 bridge crossing to near Twentymile Stream Road, this part of the Black River runs alongside high river terraces where the village and Route 103 were constructed. There have been some floodplain modifications 300ft downstream of Depot Street bridge. Green Mountain Railroad encroaches on floodplain and constrains channel alittle. The Depot Street bridge and pier may constrict the floodprone width of the river channel. Long narrow tree buffers along both banks of the river are believed to have moderated adjustment of the river channel. Greven Field floods occasionally.

Reach sensitivity and priority actions:

- Sensitivity: High
- River Corridor Protection: Moderate Priority

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1 *Throughout these sections are references to sections (or "reaches") of river numerically. As part of the Phase 1 Stream Geomorphic Assessment, each reach of the river was assigned a number for reference. The higher the number, the further upstream the river section is. "M" denotes sections of the Black River Main Stem. "T" denotes a tributary of the Black River. Sections of the Black River Main Stem are labeled "M32", "M31", "M30", "M29" and so on. As an example of a tributary, Twentymile Stream sections are labeled "M26T2.12", "M26T2.07", "M26T2.06" – where "T2" denotes Twentymile Stream (which meets the Black River Main Stem in Reach M26), and the ".06" refers to which section of Twentymile Stream.*

Parallel to Route 103 from the Ludlow wastewater treatment facility near Deroo Lane to the bridge crossing of Route 103 over the Black River near Greven Road in Proctorsville (M32)

This section of the Black River runs parallel to Route 103 from the Ludlow wastewater treatment facility near Deroo Lane to the bridge crossing of Route 103 over the Black River near Greven Road in Proctorsville.. There has been some floodplain encroachment by roads, the Green Mountain Railroad and some residential and commercial development along this section of river. There is some evidence in this section of the Black river of armoring, channelization, berming and dredging, as well as channel straightening near Winery Road. Three bridges constrict the river channel – two at bankfull conditions and one in floodprone conditions.

There is evident to suggest that there has been an increase in the amount of sediment that the river carries through this section of river recently. There is also evidence that some of the more recent movement of the river across the land has allowed the river to access a small section of a developing floodplain.

Reach sensitivity and priority actions:

- Sensitivity: High and Very High
- River Corridor Protection: Very High Priority
- Old abutment removal: High priority (pending hydraulic analysis)
- Possible active restoration on incised reach (see 2009 Phase 2 SGA: page 81).
- Conduct a geomorphic assessment of the tributary that joins the Black River main stem just downstream of the Ludlow wastewater treatment facility in an effort to mitigate point sources of increased stormwater and sediment loading.

Parallel to Route 103 through the Village of Ludlow – from the Jewell Brook confluence just west of Depot Street to Ludlow wastewater treatment facility near Deroo Lane (M33)

Road, residential, commercial and industrial development has historically encroached this section of river channel and floodplain which runs through the Village of Ludlow from the Jewell Brook confluence just west of Depot Street to Ludlow wastewater treatment facility near Deroo Lane. The river channel was intensively managed upstream from Mill Street bridge with evidence of channelization, armoring, reinforced banks and berming. There has been less intensive channel management downstream of the Mill Street bridge. In connection with the Ludlow wastewater treatment facility there has been some channel alteration, including straightening, for the installation of the plant, and treated sewage discharge enters the river in this reach. There are some small “delta” sediments near tributary confluences.

The area is “highly susceptible to catastrophic erosion in future high flow events” upstream from Mill Street bridge (2009 Phase 2 SGA :Appendix E, page 23). Channel constriction by the “somewhat undersized Pleasant Street Extension bridge” in conjunction with armoring near Ludlow wastewater treatment facility make it “a likely site of avulsion and/or debris jam in future flood” (E-24). More ready access to the floodplain downstream of Mill Street makes this area less susceptible to catastrophic erosion in high flow events (E-25).

Reach sensitivity and priority actions:

- Sensitivity: Very High and Extreme
- River Corridor Protection: Very High Priority

- Increase vegetated buffer widths and continuity: High priority.
- Conduct a geomorphic assessment of Jewell Brook in an effort to mitigate point sources of increased stormwater and sediment loading
- Evaluate and "mitigate stormwater runoff and sources of sediment to the tributary that drains steep slopes along Commonwealth Avenue to the north of Ludlow village and joins the Black River main stem between the Main Street and Mill Street bridge crossings" (page 83).

Parallel to Route 103 from firehouse just north of Okemo Marketplace to Jewell Brook confluence just west of Depot Street (M34)

Running from the firehouse just north of Okemo Marketplace to the Jewell Brook confluence just west of Depot Street, there has been notable commercial and residential development in area, including possible filling of wetlands and floodplains. There is also evidence of channel alteration. In conjunction with the water withdrawal for snowmaking, which redirects water to Okemo Snow Pond, flow and sediments in this area are monitored by inflatable bladder during snowmaking season. The water withdrawal and monitoring alters river and sediment flow around this area. Historic incision of this reach makes it "highly susceptible to catastrophic erosion in future high flow events." (E-20).

Reach sensitivity and priority actions:

- Sensitivity: Extreme
- Evaluate and mitigate stormwater runoff from the commercial parking lot in Ludlow that appears to be associated with development of gully erosion and sedimentation to of the Black River main stem. (page 83)

Parallel to VT-103 from Pond Street intersection to Dug Road Bridge (M35)

This stretch, running parallel to VT-103 from its Pond Street to Dug Road Bridge, has valley confinement by roads on either bank and extensive bank armoring. There is also notable water withdrawal from this section for the Okemo Mountain snowmaking pond.

Reach sensitivity and priority actions:

- Sensitivity: High
- Evaluate and mitigate potential sources of sediment to M35 via a culvert under Route 103. (page 83)

Black River from the Branch Brook confluence north of Fox Lane to near the Dug Road bridge in Ludlow (M36) and Branch Brook parallel to VT-103 from north of Buttermilk Falls Road to its confluence with the Black River (M36T4.01)

These river sections – the Black River main stem from the Branch Brook confluence north of Fox Lane (and east of the intersection of VT-103 and VT-100) to near the Dug Road bridge in Ludlow, and the Branch Brook as it joins the Black River Main Stem from north of Buttermilk Falls Road – includes the area where a pre-1994 avulsion caused the Branch Brook confluence has shifted downstream by approximately 600ft.

This area has some residential and commercial development. Expansion of Okemo Valley Golf Club since 1990s resulting in reduced vegetated buffer widths along banks. There have also been water withdrawals to irrigation pond at Okemo Valley Golf Club. Expansion of Okemo Mountain Resort and residential development into Coleman Brook watershed occurred in the early 2000s in connection with the Jackson Gore base area (see figure 9 on following page). Route 103 encroachment reduces valley

width slightly, but has little impact. There has, however, been increased channel degradation in places which may be due to increased stormwater runoff via the Coleman Brook.

Despite a history of extensive channelization and berming along the river that reduces access to floodplains, the reach still appears to have good access to the floodplain. This could have been for a variety of reasons: cohesive materials in the banks and beds, presence of forested buffers, or historic incision was offset by aggradation during flood events (E-12). There have been some meander changes and active flood chutes. Two bridges constrict the floodprone channel width in this section (E-6).

Reach sensitivity and priority actions for M36 (Black River):

- Sensitivity: High and Extreme
- River Corridor Protection: Very High Priority

Reach sensitivity and priority actions for M36T4.01 (Branch Brook):

- River Corridor Protection: Very High Priority
- Nick point should be monitored and evaluation of Coleman Brook watershed should be carried out before attempting to stabilize the nick point.
- Evaluate the geomorphic condition of the Coleman Brook watershed, which drains into this section of the Branch Brook, with a focus on possible impacts of stormwater runoff" (page 83)

Ludlow, parallel to Route 100 from Lake Pauline to near intersection with Route 103 at Okemo Valley Golf Club (M37)

This reach, running in Ludlow parallel to Route 100 from Lake Pauline to the the intersection with Route 103 at Okemo Valley Golf Club, remains relatively undeveloped with reasonable vegetated buffers along river banks although expansion of Okemo Valley Golf Course has led to a reduction of forested buffer in the area. The southern part of this reach was not assessed due to the predominance of wetland characteristics.

Reach sensitivity and priority actions:

- Sensitivity: Very High
- River Corridor Protection: Very High Priority

Parallel to Route 100 between Echo Lake in Plymouth and Lake Rescue in Ludlow (M40)

Assessed as part of the 2010 Phase 2 SGA of Patch Brook this section of the Black River Main Stem between Echo Lake and Lake Rescue has some berming near where both Patch and Tiny Pond Brooks flow into the river. There is also evidence of dredging of this river reach which, in connection with the berming, suggests notable straightening of the river channel. There is a bridge across this reach that is a bank-full constrictor to the river.

There is river flow regulation about one mile upstream of this reach at the dam on Amherst Lake in Plymouth, as well as flow regulation just over a mile downstream of this reach at the dam for Lake Rescue. This reach flows directly into Round Pond which is a small area at the north end of Lake Rescue where there is a large sediment delta.

Reach sensitivity and priority actions:

- Sensitivity: Very High
- Bridge Replacement: Moderate Priority

Appendix G

2018-2023 Ludlow & Ludlow Village Local Hazard Mitigation Plan
Annual Monitoring Form
Progress on Mitigation Strategies & Actions (Table 14)

Period Covered: _____
Date: _____

High Priority
Moderate Priority
Low Priority

MITIGATION ACTION	PROGRESS MADE*	FUNDING SOUGHT	NEXT STEPS	RESPONSIBLE PARTY	TIME FRAME
Identify vulnerable populations and residential areas to identified hazards, develop a formal database, and pro-actively advise or address potential hazard impact.					
Seek funding for development of emergency plans and flood hazard mitigation for the Waste Water Treatment Facility and Fire Station.					
Improve efforts to incorporate hazard mitigation into other town planning, discussions, and activities.					
Develop informative pamphlet using information from the 2015 Flood Resiliency Study to distribute property owners in flood hazard areas.					

Continue progress on current East Hill FEMA Buyout project and seek other potential FEMA buyout opportunities.					
Inform developers working in resort and other areas of concerns regarding lack of wildfire breaks on-site and make suggestions regarding development and forest setbacks.					
Actively seek funding for redundant power supply at Ludlow Community Center/Town American Red Cross Shelter.					
Continue efforts to move forward on retrofitting existing drainage system at Commonwealth intersection.					
Complete Road Erosion Inventory, identify road infrastructure vulnerable to flood and erosion hazards and seek funding to implement mitigation projects.					
Prioritize hydrologically connected road segments and prepare a 5-year plan for upgrade to incorporate new Municipal Road General Permit standards to reduce road erosion and runoff.					
Actively seek funding to install recommended best management practices on local roads to meet new Municipal Roads General Permit state road standards based on identified priorities above.					
Work with SWCRPC to seek grant funding to identify specific site recommendations based on strategies					

identified in the Black River Corridor Plan and stream geomorphic assessments that will reduce Town's flood and erosion risk.					
Review and prioritize the vulnerable areas identified in the 2015 Flood Resiliency Study and in Appendix E. Assess potential mitigating actions and funding sources and implement if feasible.					
Work with SWCRPC to more pro-actively seek grant opportunities for bridge and culvert upgrades to supplement town maintenance programs.					
Review recommended activities from the "Firewise" Program to enhance annual outreach for fire safety to all residents.					
Develop a community outreach program (webpage) to include this hazard mitigation plan and useful information on community hazards and mitigation ideas for residents and businesses.					
Work with SWCRPC and Vermont Conservancy to explore opportunities for conservation easements to restore and protect floodplain access.					
Seek funding to develop a Stormwater Master Plan for the Town and Village.					
Formalize plan monitoring process with periodic updates to Selectboard, Planning Commission and Village Trustees. Inform public on progress.					

Identify vulnerable populations and residential areas to identified hazards, develop a formal database, and pro-actively advise or address potential hazard impact.					
Seek funding for development of emergency plans and flood hazard mitigation for the Waste Water Treatment Facility and Fire Station.					
Improve efforts to incorporate hazard mitigation into other town planning, discussions, and activities.					
Develop informative pamphlet using information from the 2015 Flood Resiliency Study to distribute property owners in flood hazard areas.					
Continue progress on current East Hill FEMA Buyout project and seek other potential FEMA buyout opportunities.					
Inform developers working in resort and other areas of concerns regarding lack of wildfire breaks on-site and make suggestions regarding development and forest setbacks.					
Actively seek funding for redundant power supply at Ludlow Community Center/Town American Red Cross Shelter.					
Continue efforts to move forward on retrofitting existing drainage system at Commonwealth intersection.					

Complete Road Erosion Inventory, identify road infrastructure vulnerable to flood and erosion hazards and seek funding to implement mitigation projects.					
Prioritize hydrologically connected road segments and prepare a 5-year plan for upgrade to incorporate new Municipal Road General Permit standards to reduce road erosion and runoff.					
Actively seek funding to install recommended best management practices on local roads to meet new Municipal Roads General Permit state road standards based on identified priorities above.					
Work with SWCRPC to seek grant funding to identify specific site recommendations based on strategies identified in the Black River Corridor Plan and stream geomorphic assessments that will reduce Town's flood and erosion risk.					

2018-2023 Ludlow & Ludlow Village Local Hazard Mitigation Plan
Monitoring Form
Annual Hazard Occurrences Over Plan Period

Period Covered: _____
Date: _____

Hazard	Occurrence Date	Extent (units)	Impact (Area Impacted, roadway, infrastructure, buildings, property, $ in damage)
Flood/Flash Flood			
Fluvial Erosion			
Landslide/Slope Failure			
Severe Weather*			
Hurricanes/Tropical Storms			
Extreme Temperatures-H/C			
Structure Fire			
Brush Fire			
Wildland Fire			
Severe Winter Weather **			
Ice Jams			
Hail			
Dam Failure			
Drought			
Earthquake			
Tornado			

** High Wind, Power Outage, Microburst, Thunderstorm