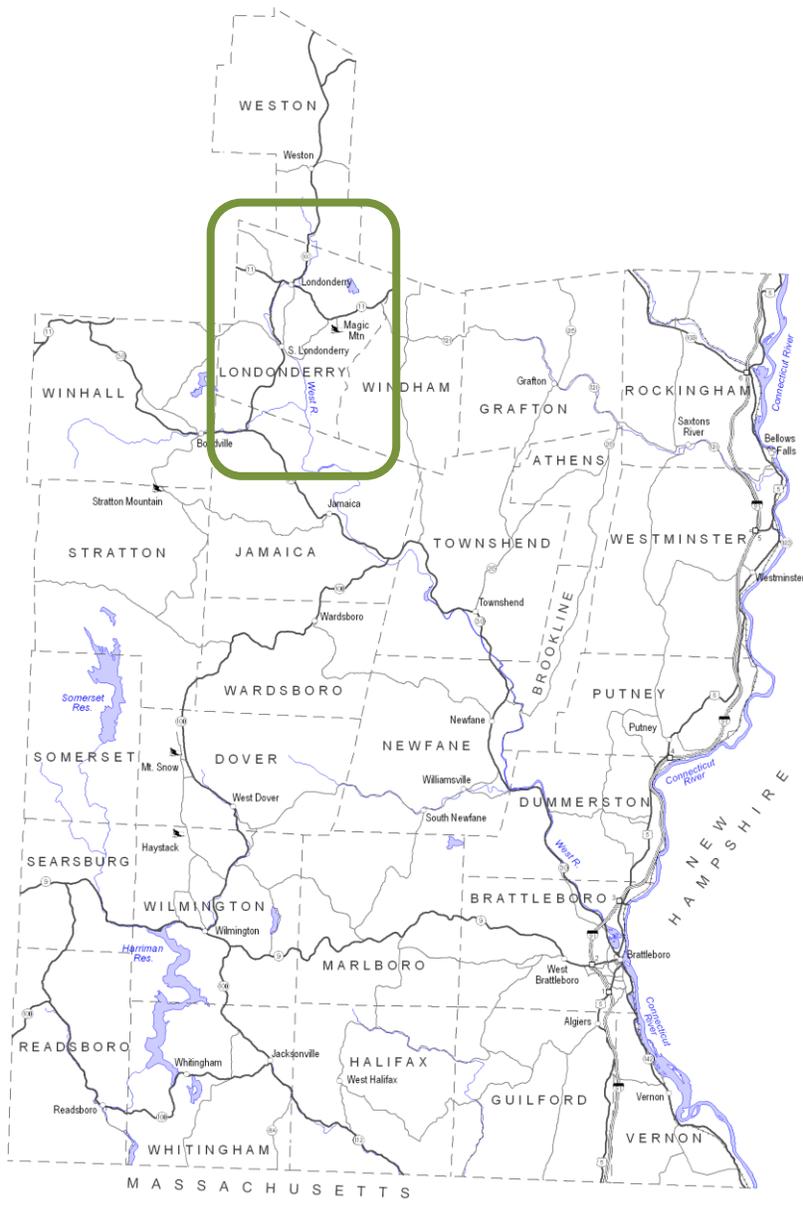


Town of Londonderry Local Hazard Mitigation Plan



Municipal Adoption Date: 5/23/2022

FEMA Formal Approval Date: 6/1/2022

Technical Assistance by the
Windham Regional Commission



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INTRODUCTION AND PURPOSE

This Single Jurisdiction Hazard Mitigation Plan is an UPDATE to a Plan approved by the Federal Emergency Management Agency (FEMA) effective January 15, 2015 and expired January 15, 2020.

The purpose of this plan is to assist the Town of Londonderry in identifying all of the hazards facing the town and to identify new and continuing strategies to reduce long term risks from identified hazards.

Hazard mitigation is any sustained action that reduces or eliminates risk to people and property from natural and human-caused hazards and their effects. Based on the results of previous project impact efforts, FEMA and state agencies have come to recognize that it is less expensive to prevent damage from disasters than to repeatedly repair damage after a disaster has struck. This plan recognizes that communities also have opportunities to identify mitigation strategies and measures during all of the other phases of Emergency Management – preparedness, response and recovery. Hazards cannot be eliminated, but it is possible to determine what the hazards are, where the hazards are most severe and identify what local actions can be taken to reduce the severity of hazard-related damage.

Hazard mitigation strategies and measures alter the hazard by: eliminating or reducing the frequency of occurrence; averting the hazard by redirecting the impact by means of a structure or land treatment; adapting to the hazard by modifying structures or standards; or avoiding the hazard by stopping or limiting development. Mitigation could include projects such as:

- Flood-proofing structures
- Tying down propane/fuel tanks in flood-prone areas
- Elevating furnaces and water heaters
- Identifying and modifying high traffic incident locations and routes
- Ensuring adequate water supply
- Elevating structures or utilities above flood levels
- Identifying and upgrading undersized culverts
- Planning for land use for floodplains and other flood-prone areas
- Proper road maintenance and construction
- Ensuring critical facilities are safely located
- Establishing and enforcing appropriate building codes
- Public information

WINDHAM REGION GEOGRAPHY

Situated in Vermont's southeastern corner, the Windham Region consists of 23 towns in Windham County, the neighboring towns of Readsboro, Searsburg, and Winhall in Bennington County, and Weston in Windsor County. The region is bordered by Massachusetts to the south and New Hampshire to the east. At over 920 square miles (590,000 acres), the region accounts for roughly 9.6% of the State's total land area. The Windham Region has several distinctive identities, largely defined by the diverse natural environment.

The Region's topography is relatively flat or gently rolling land in the Connecticut River valley in the east, while the western part of the region is characterized by the Green Mountain ridges and peaks with narrow



stream valleys. Stratton Mountain is the highest point in the region at 3,936 feet. The lowest point is along the Connecticut River in Vernon, at 200 feet.

In addition to the Connecticut, other major rivers of the region are the Deerfield, Green, North, Saxtons, West, and Williams, all tributaries of the Connecticut. There are two major flood control reservoirs on the West River, Ball Mountain and Townshend, and two major storage reservoirs for hydropower generation on the Deerfield River, Somerset and Harriman.

LONDONDERRY GEOGRAPHY & TOWN PROFILE

Londonderry is a rural town of 35.9 square miles in northern Windham County. Londonderry contains two villages; Londonderry village serves the commercial needs of the northwestern part of the Windham Region and the surrounding towns of Landgrove and Peru. South Londonderry village is home to the library and town offices. Magic Mountain Ski Area and Lowell Lake State Park are two of the town's outdoor recreation attractions. In addition, Stratton, Bromley and Okemo are all nearby skier destinations. During winter months there is greater traffic flow due to people traveling to and from these resorts. About 42% of the homes in Londonderry are seasonal residences for out-of-towners.



Londonderry's landscape retains important vestiges of the town's agricultural heritage. Working farmland not only provides a source of local food and fiber, but also helps define the town's scenic landscape, in itself an important economic asset. Significant timber resources exist in town, including hard and soft wood stands and sugar maple groves. Londonderry is built along the main stem of the West River and its major tributaries. The town's water resources include the West River, the Winhall River, Lowell Lake, Lily Pond, and Gale Meadows Pond, as well as various wetlands and floodplains. These waters are all included in the West River Watershed.

Outside of its water features, some of the natural features that stand out in Londonderry include Glebe Mountain and Cobble Hill. Glebe Mountain is the location of Magic Mountain Ski Area, but outside of that, development is carefully regulated here. Vermont's climate is dominated in winter months by cold, dry Canadian air and in summer by warm, moist air from the south. Weather patterns vary locally with topography and relief. Located in a high mountain valley east of the main range of the Green Mountains, Londonderry experiences slightly lower average winter temperatures and higher rates of precipitation than other parts of Vermont.¹

State Routes 100 and 11 are the town's main arterial highways.

Londonderry's population as of the 2020 census was 1,919². This is up from 1,769 in the 2010 Census. It is important to recognize the consequences of a visitor population in a resort community. Londonderry's population varies significantly from season to season. Once primarily

¹ 2017 Londonderry Town Plan.

² 2020 data on census.gov

a winter resort town, Londonderry has experienced an increase in the number of visitors during the summer and fall.

Geography, state land use regulations, historical settlement patterns, and commercial enterprises have driven land use patterns in Londonderry. The confluence of the West River and major east-west and north-south roadways resulted in the development of the north and south villages. The demise of rail transportation in 1935 and the emergence of tourism, the ski industry, and second home ownership have resulted in the north village becoming the predominant commercial area. Both villages have extensive residential development as well. Approximately 80% of the Town's land is forested.

Emergency Services

Londonderry currently depends on organizations located inside and outside of the community to provide necessary health care and emergency services. Mountain Valley Medical Clinic in Londonderry (now overseen by Springfield Hospital) provides area medical services. Nearby and regional hospitals in Bennington, Springfield, Rutland, Townshend, and Lebanon, New Hampshire serve Londonderry residents and visitors.

Emergency medical and rescue services are provided by the Champion and Phoenix Fire Departments, the Londonderry Volunteer Rescue Squad, and the Mountain Valley Medical Clinic. The Town is served by both the Champion and Phoenix Fire Departments. Both departments participate in a mutual aid program, making personnel and equipment available to neighboring towns in the event of a shortage. The fire departments and rescue squad are operated by volunteers and do their own fundraising with support from the Town. Members continually update their credentials and skills through monthly meetings, training seminars, and special courses. Dispatch is provided by Southwest New Hampshire mutual aid.

The Town Office building is the local emergency operations center and the Flood Brook Union School is a regional emergency shelter. Both are equipped with generators.

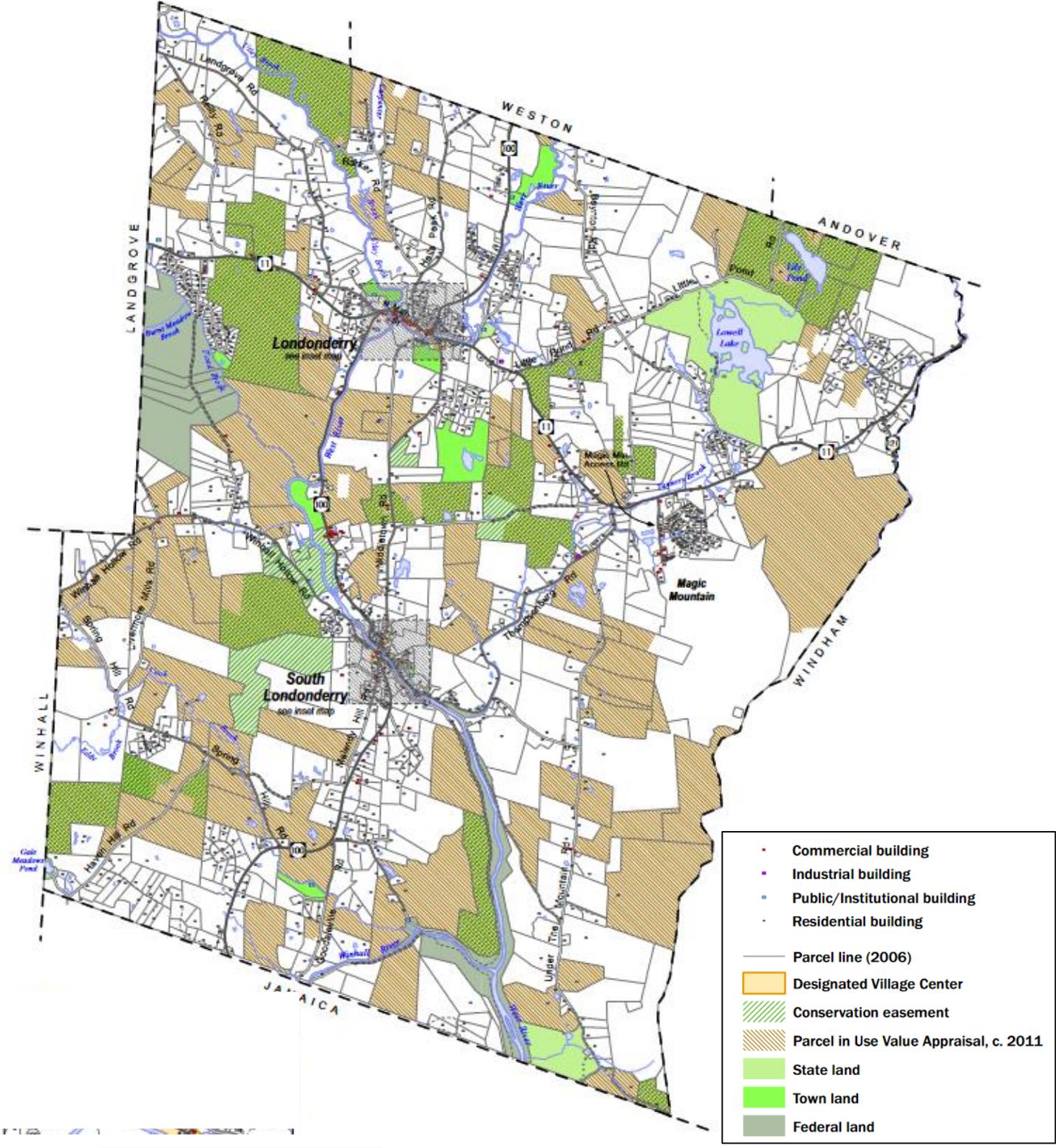
The Town contracts with the Windham County Sheriff's Department for 20 hours per week, with State Police backup as needed. They share a full time deputy with Jamaica.

Impact of Resorts

In winter, the town frequently experiences high winds, heavy wet snows, at least one event where the area is hammered by ice or rain on snow, creating havoc for the area residents. Typically, power outages occur after these types of weather events. At the same time these major snow events are happening, tourists are coming in droves to take advantage of the ski conditions. A small town quickly turns into a large town on a winter weekend. This causes significant impact to the police and fire departments. Manpower becomes inadequate when a small volunteer departments are suddenly faced with a huge temporary increase in population.

Any new developments the fire department needs to sign off on being able to serve them. The main resort is Magic Mountain and there is good communication between the resort and the town.

Existing Land Use Map from the 2017 Londonderry Town Plan³



³ 2017 Londonderry Town Plan available at http://windhamregional.org/images/docs/towns/Londonderry/Londonderry_TownPlan_2017-10-02.pdf

PLANNING PROCESS

Town residents who took part in the planning process for developing the Local Hazard Mitigation Plan for Londonderry tend to be affiliated with more than one association for the town. In rural areas of Vermont, it is typical that people who are most interested in the safety, health and welfare of their community will participate on more than one board and may for example, hold the role of Fire Chief, or school teacher, or a small business owner, in addition to owning personal property in the town. Therefore, although the meeting may not have as many people in attendance as a more populated community would, those present at the meeting are representing not only a variety of roles, but many roles that would be held by numerous individuals in a more populated area.

Documentation of the Plan Update Process

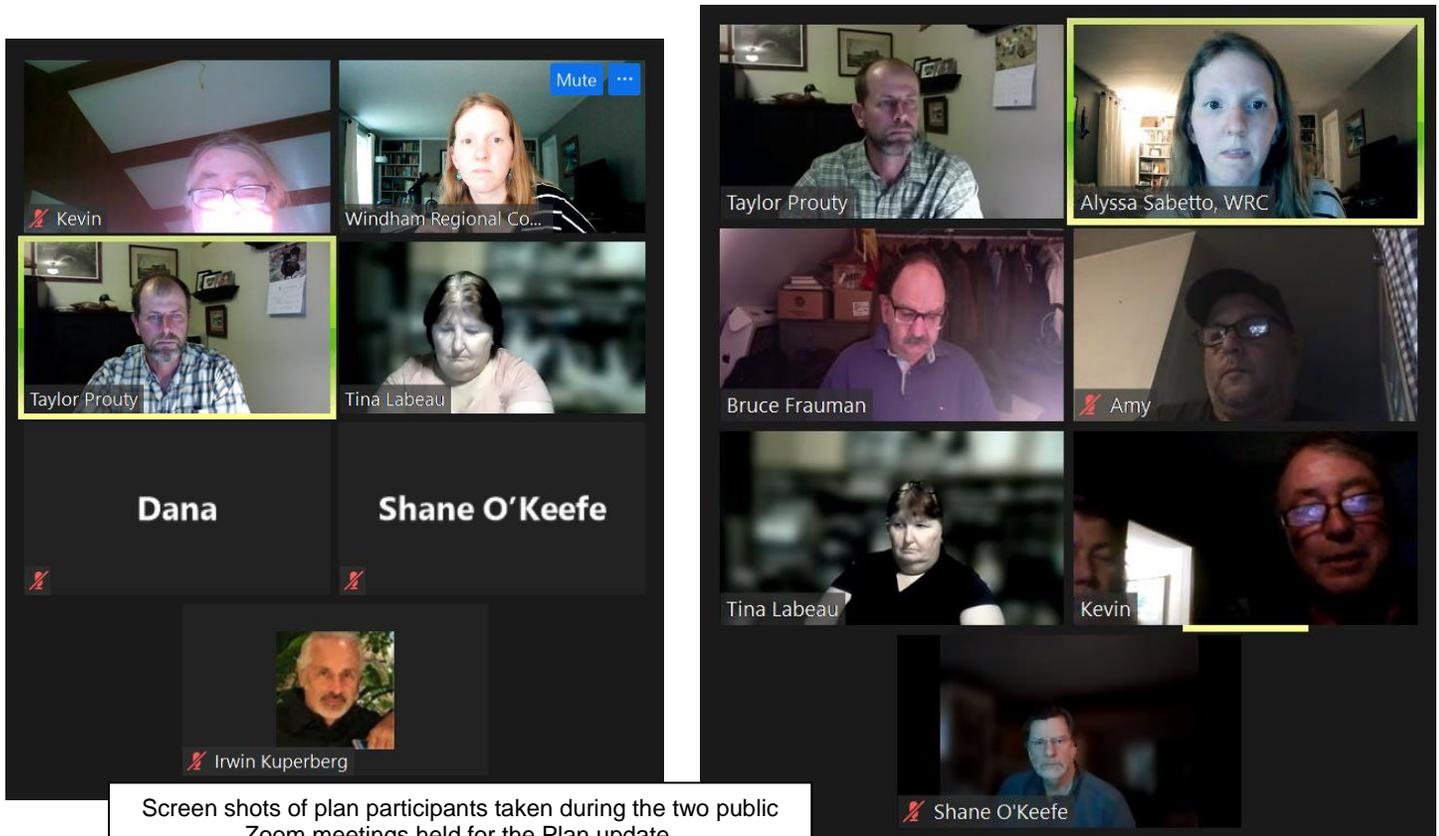
This Single Jurisdiction Hazard Mitigation Plan is an UPDATE to a Plan approved by the Federal Emergency Management Agency (FEMA) effective January 15, 2015 and expired January 15, 2020.

The Town began the plan update process in May 2021. It is important to keep in mind the context of the update process taking place during the Covid-19 pandemic. This pandemic meant that the update process was done remotely using a variety of virtual tools. Alyssa Sabetto, Emergency Planner for the Windham Regional Commission met with a group of planning participants at two virtual public meetings, as well as having separate conversations with the numerous town officials. The Hazard Mitigation Planning participants convened on May 19th and June 2nd via Zoom to provide input into the plan update. The Town Administrator and Emergency Management Director led the effort at the town level, directly inviting town officials. The general public was informed through advertisement on the town website, on the town Facebook page, and physical postings at all normal posting locations in Town. The update meeting lasted for 2 hours each. Over the course of the meetings the group completed and discussed:

- **Update of the 2015 Londonderry Local Hazard Mitigation Plan**
 - Purpose
 - Process
- **Hazard assessment included:**
 - Discussion of hazard events that have occurred since the last Plan
 - Virtual hazard assessment survey using Google Forms
 - Discussion of meeting participant survey results
- **Brief review of existing/expired Londonderry Local Hazard Mitigation Plan**
 - Decision on what hazards the updated Plan will address
 - Marking up of the online Vermont Natural Resources Atlas with local hazard notes
- **Mitigation Goals and Actions**
 - Review/edit 2015 Mitigation Goals
 - Brief review of the 2015 Mitigation Actions Table that the EMD/Town updated
 - Creation of an updated Mitigation Actions Table for the updated Plan
 - Identify current gaps and capabilities with implementation

- **Other Updates**

- Discussion of recent mitigation work completed by the town
- Discussion of development trends – new developments, upcoming developments
- Overall resiliency concerns or ideas



Alyssa updated the plan to meet the current standards and guidelines of FEMA for hazard mitigation plans. She took the information from the public meeting, along with follow-up information gathered in conversations and emails with the Emergency Management Director, Zoning Administrator, Conservation Commission Chair, and Town Administrator. Alyssa also reviewed and utilized the data sources noted and cited throughout this plan to gather further information. The draft was presented for internal town review by the Committee, town personnel, Planning Commission and Selectboard on April 5, 2022. This internal town review period was from April 5-14. No comments were received during this comment opportunity. Alyssa then finalized the draft for public comment.

The revised draft plan was put out for public comment on April 19, 2022. This was done by posting an electronic copy on the town website⁴ and providing a mailed hard copy of the plan available to those that can't access website. Flyers were posted around town advertising its availability for review and comment. One comment was received back, but no comments requiring changes to the draft were received from the public during the two-week comment period. It was simultaneously distributed to the adjacent towns and regional commissions of/for:

⁴ See appendix for flyer.

Jamaica, Winhall, Landgrove, Andover, Weston and Windham, for comment via email.⁵ Two comments were received, but no comments requiring changes to the draft were received. The plan was finalized by Alyssa Sabetto for submittal to Vermont Emergency Management (VEM). This submittal allows VEM to make suggested revisions on the draft, and allows for any revisions to be made before the final draft is adopted and submitted to the Federal Emergency Management Agency Region 1 (FEMA) for final approval.

The following people were involved in the hazard mitigation planning process in one or more meetings:

Committee Member	Affiliations
Shane O'Keefe	Town Administrator
Tine Labeau	Town Treasurer
Josh Dryden	Road Foreman
Taylor Prouty	Selectboard member and Road Commissioner
Kevin Beattie	Emergency Management Director and Londonderry Rescue Squad
Sharon Crossman	Planning Commission Chair
Irwin Kuperberg	Conservation Commission
Bruce Frauman	Londonderry Community Resilience Organization
Hunter Kaltsas	Resident and business owner

Public Involvement and Input from Neighboring Communities

Making the Londonderry Hazard Mitigation Plan available for public comment included the following efforts:

- All of the meetings discussed in the above sections were advertised and open to the public.⁶
- The Hazard Mitigation Planning participants convened two times on May 19th and June 2nd 2021 for public meetings to provide input into the plan update.
- Alyssa had numerous follow-up calls with the Town Administrator, Emergency Management Director (EMD) and the Road Foreman to gather details for the Plan. Additionally, verbiage was developed by the Conservation Commission and EMD for the invasive species section.
- A draft of the plan was posted from April 19-May 3, 2022 on the town website for public comment.⁷
- Flyers were put up around town for public comment on the draft.⁸
- On April 18, 2022, an invitation was extended via email to neighboring towns to provide a means and opportunity to review and comment on the draft Londonderry Hazard Mitigation Plan. Two comments were received, but no comments requiring changes to the draft were received back. Inter-town communication will repeat for future revisions of this Plan.

⁵ See appendix for email.

⁶ See appendix for public meeting flyer.

⁷ See appendix for website ad.

⁸ See appendix for flyer.

RISK ASSESSMENT

The risk assessment portion of a Hazard Mitigation Plan contributes to the decision-making process for allocating available resources to mitigation projects. 44 CFR Part 201.6(c)(2) of FEMA's mitigation planning regulations requires local municipalities to provide sufficient hazard and risk information from which to identify and prioritize appropriate mitigation actions to reduce losses from identified hazards.

Methodology

A **vulnerability analysis** for each community begins with an inventory of possible hazards and an assessment of the risk that they pose. These are the questions to be answered. What hazards can affect your community? How bad can it get? What is the likelihood of future events occurring? What areas of your town are most vulnerable to these hazards? How does climate change impact your town currently and what are you worried about for future impacts? Information collected from the core planning team went into this vulnerability assessment to identify the hazards the town feels most vulnerable to.

The following table is the scale used to rank each hazard that is analyzed:

Hazard Assessment Ranking Criteria	
	Frequency of Occurrence: Probability of a plausibly significant event
1	Unlikely: <1% probability of occurrence in the next 100 years
2	Occasionally: 1–10% probability of occurrence per year, or at least 1 chance in next 100 years
3	Likely: >10% but <75% probability per year, or at least 1 chance in next 10 years
4	Highly Likely: 100% probability in a year

Potential impact was considered and scored separately for impacts to infrastructure, life, economy and the environment. Additionally, seasonal patterns that may exist are considered, what areas are likely to be affected most, the probable duration of the hazard, the speed of onset (amount of warning time, considered with existing warning systems).

The combination of the frequency scores for each hazard and the impact ranking for each hazard related to infrastructure, life, economy and the environment, were together used determine the hazard ranking score for each hazard. These results were analyzed in real time with the planning participants. Results along with community input were used to determine which hazards the plan would address. The participants used the results to formulate their discussion, however, local knowledge and the will to act or not act did impact their choices on the chosen hazards to address.

Results

While all hazards were considered by the Hazard Mitigation Planning participants for inclusion in this plan, it is not feasible to study each in depth. For hazards that are not profiled in this plan, the reader is directed to the Vermont State Hazard Mitigation Plan. The rationale for not addressing all of the hazards is that Londonderry has a low level of risk associated with them and/or the town does not choose to mitigate for them at this time. This plan will only focus on the hazards that Londonderry has decided are pertinent to their community and they have chosen to mitigate for at this time which are High Winds, Flooding and Fluvial Erosion together, Ice Storms, and Invasive Species. Additionally, this Plan will discuss power outages as an

impact of natural hazards and the Williams Dam. The below tables show the results of the hazard assessment:

Frequency of Hazard Occurrence: Ranking by scores	
Frequency of Occurrence	Totals
Significant Snow Event	19
Below Normal Cold	19
Significant Ice Storm	18
Damaging High Winds	17
Infectious Disease Outbreak / Pandemic	17
Above Normal High Heat	16
Drought	16
Invasive Plant or Insect Species	16
Inundation Flooding	15
Fluvial Erosion	14
Significant Hail Event	14
Wildfire	12
Landslide	11
Earthquake	9

The above frequency ranking table highlights in orange the hazards that the Town has chosen to address. As shown, the Town has not chosen to address all of the highest ranking hazards. Particular to snow and cold, these are hazards that Londonderry is accustomed to handling due to the location of the Town. It is felt that current measures for handling these hazards are adequate. Heat and drought are not chosen for profiling but did score relatively high for frequency (they scored less for impact on the next page). This higher frequency scoring indicates that the town feels these hazards are occurring more often than in the past, which may be linked to a changing climate. At this point however, these hazards did not rise to the level of the 'will to mitigate' with the town. It is also worth noting that the high score for "infectious disease/pandemic" may be due in part to the fact that the survey was taken in the midst of the Covid-19 pandemic, and hence is a part of everyone's immediate life at this time. Hail and wildfire scored somewhat high on the frequency ranking, indicating that these hazards may be rising in frequency over time and may become more pressing in terms of the 'will to mitigate' over time. At this point, however, these hazards are seen as rare enough that mitigation is not justified on a wide scale.

The table below shows the results of the same hazards when surveyed separately from frequency and just in relation to their impacts to infrastructure, life, the economy and the natural environment. The chosen hazards are again highlighted in orange so that one can see clearly where they lie in the rankings. In this ranking, the chosen hazards are the top ranking hazards for impact. Of note in this table is that snow ranks somewhat high for impact, just as it did for frequency, but the impacts are accustomed to in Londonderry. Also of interest is that inundation flooding scores higher in the rankings on impact than it did for frequency, and fluvial erosion scores lower on the impact rankings. My sense is that the difference between inundation flooding and fluvial erosion is not widely understood, and the more common feeling is that

'flooding' generally is seen as the issue, which in Vermont includes both fluvial erosion and inundation damage.

I've highlighted in blue what I consider to be impact scores worth noting. Of note below is that inundation flooding scores highest in its impact to the economy, whereas fluvial erosion scores much lower in its impact to the economy. Flooding in developed areas and villages of Londonderry is a continual concern. Fluvial erosion scores much higher in its impact on the environment. This may indicate that most of the erosion damage is not affecting the built environment, which is being more affected by rising inundation flood waters. For infectious disease/pandemic, it again scores high in these rankings, in particular because of the impacts to life and the economy. In the 2015 Londonderry LHMP, pandemic was not included in the hazard assessment, so a direct comparison cannot be made about the realization of vulnerability to pandemic. However, in larger society, the awareness of humanities vulnerability to pandemic has been heightened due to the experience of Covid-19. Through this experience we see not only our physical vulnerability, but the vulnerability of everything in our society to the impacts of mass shutdowns required by pandemics. This realization will likely last generations, but like most hazard events, as the memory of the experience fades the preparation level for the next event will diminish if certain preparatory protocols are not kept in place. On a separate note, but again highlighted in blue in the below table are the rankings for heat and drought. The awareness of potential impact of heat and drought is likely increasing in the population, though the current impact level remains on the lower end to justify mitigation at this time. The town may choose to mitigate them in the future. For the remaining hazards, either the possibility is considered too low to mitigate them or current methods of handling them are deemed adequate.

Hazard	Impact of Hazard Occurrence to:				Ranked
	Infrastructure	Life	Economy	Environment	Totals
Inundation Flooding	4	3	5	3	15
Damaging High Winds	4	1	1	2	8
Infectious Disease Outbreak / Pandemic	0	4	4	0	8
Invasive Plant or Insect Species	1	1	2	4	8
Fluvial Erosion	2	1	1	4	8
Significant Snow Event	3	3	0	1	7
Significant Ice Storm	3	2	2	0	7
Below Normal Cold	0	2	0	0	2
Above Normal High Heat	0	0	0	1	1
Drought	0	0	0	1	1
Landslide	1	0	0	0	1
Significant Hail Event	0	0	0	0	0
Wildfire	0	0	0	0	0
Earthquake	0	0	0	0	0

The natural hazards addressed in the 2015 Londonderry LHMP were Flooding/Fluvial Erosion, Winter & Ice Storm, and High Winds. Snow Storms are not addressed in this Plan as the Town representatives involved in this update considered the hazard impact too low to mitigate them or current methods of handling them are deemed adequate.

HAZARD PROFILES

The following sections include a narrative with a Description, Geographic Area of the Hazard, Impact, Extent, Probability, and discussion of Past Occurrences of three natural hazards affecting Londonderry.

Flooding and Fluvial Erosion

Flooding Description

Flooding is the most widespread and destructive hazard in the United States. Flooding has also been the most common and costly hazard to affect Londonderry. Flooding can occur anytime of the year as a result of heavy rains, thunderstorms, tropical storms, hurricanes or Nor'easters. It can result from the overflow of major rivers and their smaller tributaries, or inadequate local drainage. Historically, floods have been a factor in over 80 percent of all federally declared disasters. People living in close proximity to bodies of water such as rivers, lakes, and streams are at greater risk from flooding than those not living in the floodplain. There is a 26 percent chance of experiencing a flood during the life of a 30-year mortgage compared to a 4 percent chance of a fire. Londonderry has an NFIP compliant floodplain ordinance, which gives residents access to discount flood insurance and enables the Town to regulate development within the Special Flood Hazard Area (SFHA). SFHAs are subject to inundation by the 1% annual chance flood (100-year flood). Maps of these areas can be found at the Town Office or online at the FEMA Map Service Center.⁹ The mapped FEMA SFHA primarily includes the West River along Route 100 and Route 11, including the tributaries Flood Brook, Cook Brook and Thompsonburg Brook and Utley Brook. The Williams River flows north into Andover and along a portion of Route 11.

Fluvial Erosion Description

Much of the destruction from flooding in Londonderry, and in Vermont generally, is due to fluvial erosion rather than inundation, which is the type of flooding targeted in FEMA mapping. Fluvial erosion is the destruction of river banks caused by the movement of rivers and streams, when stream power overcomes resistance of bed and bank material. This can range from gradual bank erosion to catastrophic changes in river channel location and dimension during flood events. This occurs when the stream has more energy than is needed to transport its sediment load, due to channel alterations or runoff events that increase water speed in the channel, leading to erosion.

Gravity and water power are the forces driving fluvial erosion. Factors that allow the force of gravity to overcome the resistance of earth material to erosion include: saturation by water, steepening of slopes by erosion or construction, alternate freezing or thawing, removal of trees and other vegetation and earthquake shaking. Major erosion events are typically associated with periods of heavy rainfall or rapid snow melt and tend to worsen the effects of flooding that often accompany these events. Associated issues in Londonderry are related to road cutting and bank erosion for the most part, areas where roads have been built between steep slopes on one side of the road, and slopes to a river or brook on the opposite side. Existing homes are dotted on the landscape along these roads which have existed for 200 years or more, so cannot be easily closed or relocated.

⁹ <https://msc.fema.gov/portal>

The historic road network of many Vermont towns and villages typically follows waterways. This historic settlement pattern creates vulnerability for the road network, infrastructure and development within and along what are called River Corridors. River Corridor mapping was released by the Vermont Agency of Natural Resources in early December 2014; small stream mapping was released in January 2016. This mapping delineates fluvial erosion hazard areas and includes a 50-foot buffer beyond those designated areas. For small streams, a 50-foot buffer from top-of-bank on either side of the waterway constitutes the River Corridor. This mapping can assist municipalities in developing bylaws and effective mitigation strategies to regulate development within fluvial erosion hazard zones. Londonderry does not currently have a fluvial erosion bylaw.



Though not taken in Londonderry, this photo shows the real connection of river and road during TS Irene, as the river reclaims its floodplain, edging in on the road. Photo courtesy of wilmingtonvtfloodrelief.com.

Bends in the river are prone to movement as part of natural river processes, and their movements can be even more dramatic when manmade impacts and development upstream impinges on these natural stabilizing forces. The interaction of the natural and unnaturally dramatic forces of

river movement, combined with the stationary location of the closely located roads is what leads to road damages during heavy weather events. Property owners outside of the FEMA floodplain can purchase flood insurance at a lesser expense, and it still covers damages resulting from fluvial erosion in events that damage multiple properties.

Impact, Vulnerability Assessment and Hazard Location

Flash floods are not uncommon in Londonderry, and in the past damage to Route 100 or Route 11 has limited access to Town. Some of the highest hazard areas associated with flash floods are areas along Route 11 and the West River floodplain corridor in the two villages. Other areas of concern during flooding events are homes located along tributaries that are subject to flash floods during brief heavy rain events.

Flash floods typically occur in high elevation drainage areas as a result of summer thunderstorm activity. Damage from flash floods is difficult to predict since flash flood areas are not mapped at this time. Infrastructure and structures along higher elevation streams and drainage areas are most susceptible to damage from flash flooding. Drainage ditches and culverts are the biggest concern for local flash flooding events.

Reoccurring flooding areas noted in the 2017 Town Plan and updates on them:

- Magic Mountain access road and Magic Circle flooding events that damaged infrastructure and cause cellar flooding in structures. Update in 2022 –There was a catchment pond that didn't have good outlet and would flood Blue Gentian Hotel basement. There have been some drainage improvements made, so this recurring situation is resolved.

- Under the Mountain Road that drains from Glebe Mountain, run-off events cause perpetual flooding due to the area being heavily wooded, thereby causing culverts to plug up with leaves and broken off tree limbs. Update in 2022 – Most of the culverts have been upsized on Mountain Road.

Ice jam flooding occurs in two locations in Londonderry, neither of which endanger structures:

- Just above the Rescue Squad on Route 100 when the ice comes down the West River it collects there and generally comes onto Route 100. Very seldom closes the road. Common to occur but not a huge issue.
- In 2021-21 in South Derry just below Alexander Bridge there was an ice jam. No damage.

Both inundation flooding and fluvial erosion are potential hazards in Londonderry along the:

- West River
- Winhall River
- North Branch of the Williams River
- Cook Brook
- Utley Brook
- Flood Brook
- Beaver Meadow Brook
- Tannery Brook
- Eddy Brook

as well as along the streams that drain watersheds extending to the town border with Jamaica and Winhall. Inundation flooding can also happen along Lowell Lake and Lily Pond¹⁰.

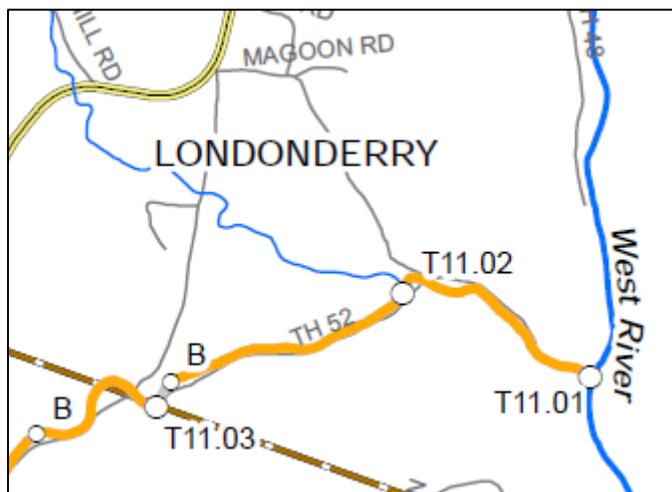
The most detailed information regarding the waterways was contained in the *2014 Winhall River Watershed Corridor Plan*¹¹. The Corridor Plan only covers the southwestern area of Londonderry that lies in the watershed. The Plan divides the Londonderry portion of the watershed into two sections and overall takeaways for each section are as follows:

T11.01 The reach begins at the confluence with the West River and continues upstream

¹⁰ 2017 Londonderry Town Plan, pg. 43.

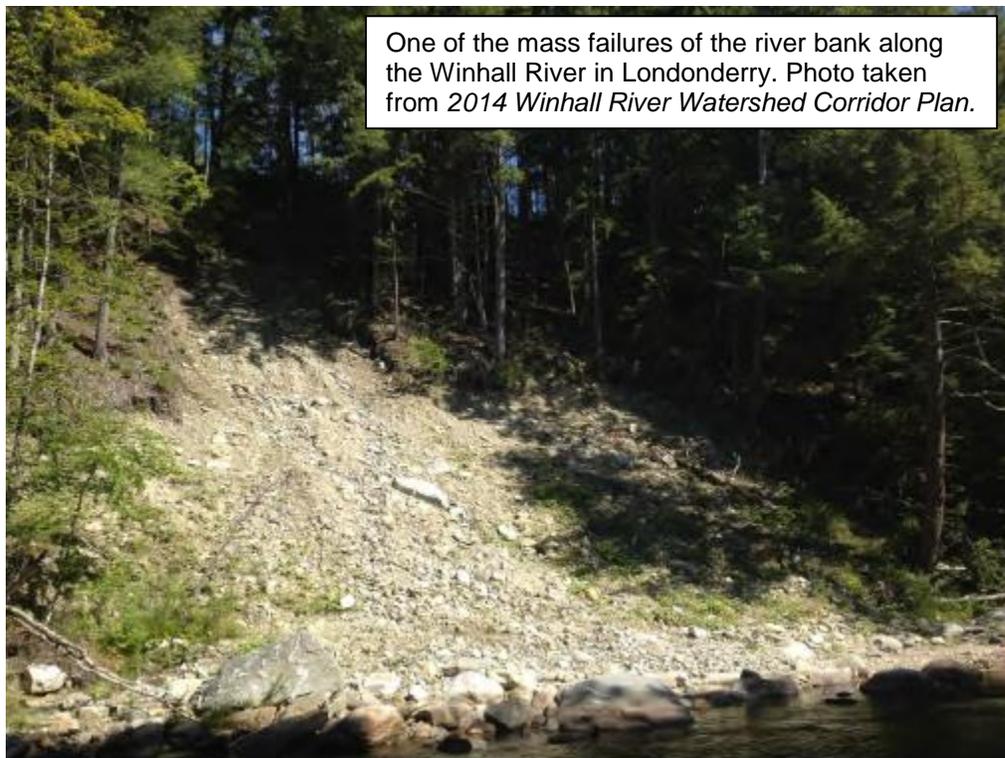
¹¹ Available online: <https://dec.vermont.gov/water-investment/watershed-planning/tactical-basin-planning/basin11>

for 4,000 feet to the reach break. The stream channel flows through a broad valley as it enters the West River. This reach is an *alluvial fan*, which occurs as the channel slope drops to meet the West River, creating a depositional area. Corridor encroachments throughout the reach, including Winhall Station Road, are limiting floodplain access in many areas. Residential development has impacted buffers greatly, particularly on the southern side of the river. Erosion is frequent along the south bank in areas where the riparian buffer is lacking... reach T11.01 is in fair geomorphic condition. The reach is also in fair habitat condition due to its impacted buffers, eroding banks, and lack of large woody debris.



T11.02-A This segment begins just upstream of the TH52 bridge and continues upstream almost 4,400 feet to where a bedrock gorge begins... T11.02-A has very little floodplain access. Several mass

failures are present along the northern valley wall, and stormwater inputs from Cohen Road abound on the southern river bank... Overall, it is in fair geomorphic condition. Habitat condition is also fair due to impacted buffers along Cohen Road and lacking bank vegetation.



Improvement project recommendations from the Corridor

Plan - Passive Restoration by planting native trees and shrubs species along the south bank of the river. (Consider utilizing the Trees for Streams program to assist.)

T11.02-B This segment is located within a bedrock gorge in a narrowly confined valley. The segment begins approximately 1,000 feet downstream of the Cohen Road stream crossing and continues upstream 500 feet. T11.01-B was not fully assessed due to the presence of the bedrock gorge. Administrative judgment was used to determine reference and existing stream

type, bed material, and bedform. Overall, the segment is in good geomorphic condition due to the stability of the bedrock grade controls.

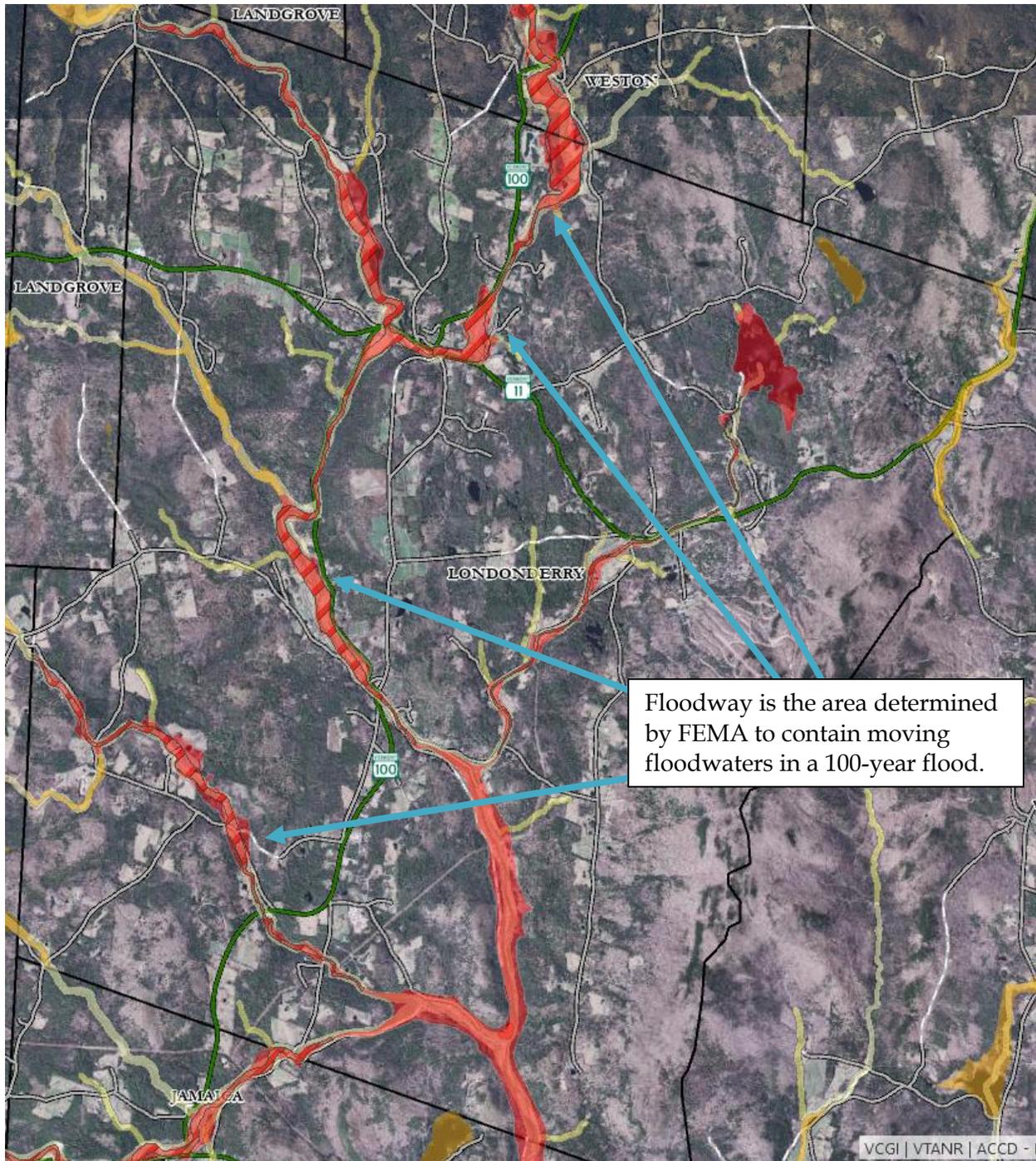
Improvement project recommendations from the Corridor Plan - Active Restoration by stabilizing a gully, which is delivering stormwater and sediment from Cohen Road directly into the river.

In understanding impacts of flooding and fluvial erosion on a town, it is useful to combine the discussion with a look at floodplain mapping. The below maps were created using the Vermont Agency of Natural Resources (ANR) 'Natural Resources Atlas' which is an online mapping tool¹². This map shows the special flood hazard areas (SFHAs) that FEMA has designated in Londonderry, as well as the VT ANR designated River Corridors. SFHAs in Londonderry are "AE" zones, shown in red below and "AE with Floodway" which is shown in red with hatching, as well as "A" zones which are shown in orange below. "A" zones are the flood prone areas that have not undergone detailed study with FEMA and "AE" zones have undergone detailed study. The floodplains shown in these maps are based on the FEMA Flood Insurance Rate Maps (FIRMs) available through the FEMA Map Service Center.¹³ The map effective date for the latest FIRMs for Windham County is 9/28/2007.

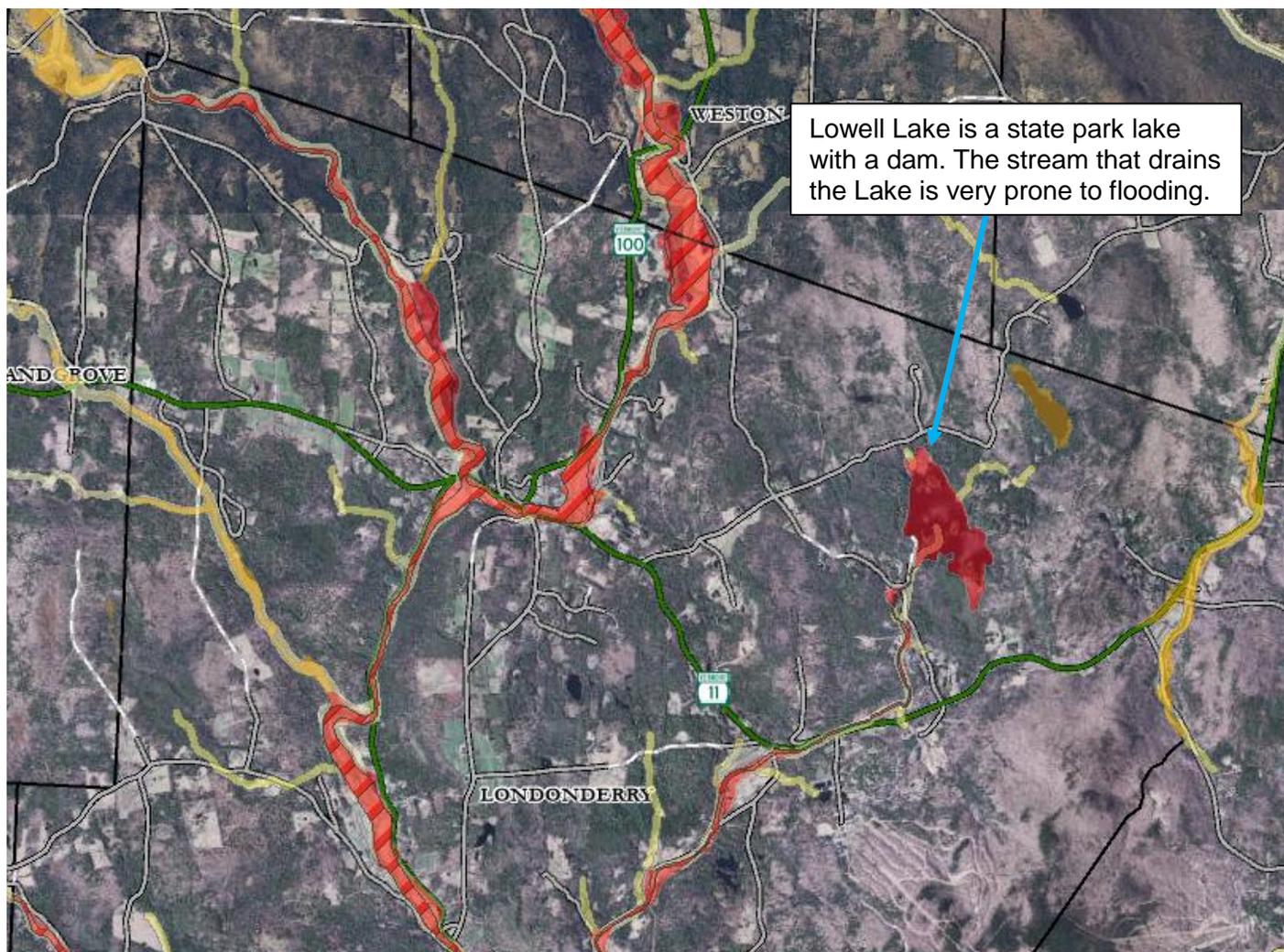
The River Corridors are shown in cream color, and this map includes the small streams with a watershed size between .5 and 2 square miles also in cream. Small streams require a 50-foot setback from top of bank, but haven't been designated with bounds on the mapping. For the purposes of Act 250, there is River Corridor regulation of streams down to .25 miles of watershed size, which are not included on the below map but can be seen on the online Atlas.

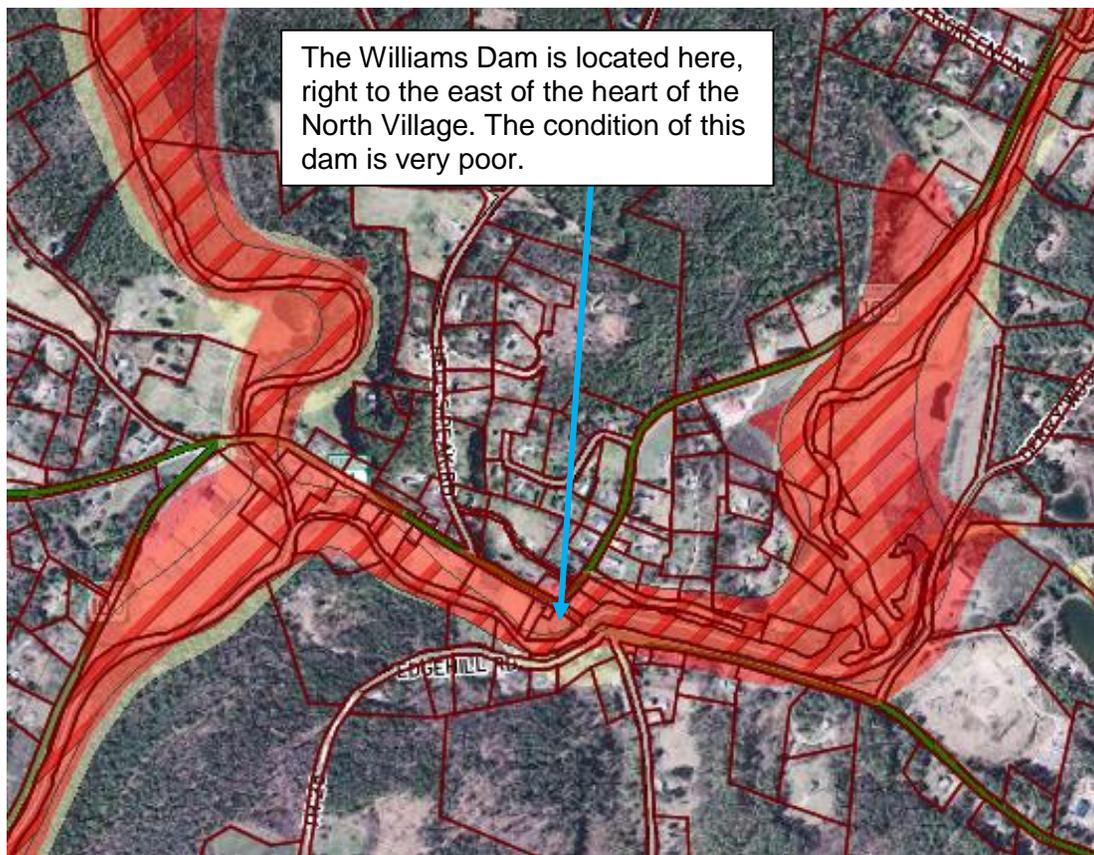
¹² Vermont Agency of Natural Resources, Natural Resources Atlas <<https://anrmaps.vermont.gov/websites/anra5/>>

¹³ <https://msc.fema.gov/portal/search?AddressQuery=wndham%2C%20vermont>.



Taking a more detailed look at the northern half of Londonderry, shown above, we can see that a significant amount of developed area lies in SFHA and/or River Corridor. There is a very strong river and road connection. This is primarily the West River, which lies along Route 100 and a portion of Route 11, and Thompsonburg Brook along Thompsonburg Road. This leaves a majority of North Londonderry Village in the SFHA. Areas where flooding typically occurs are Flood Brook, the West River (biggest in magnitude), Tannery Brook (most re-occurring), Cook Brook, and the stream next to Boynton Road (headwaters are in Andover and Weston, starts as a beaver pond).

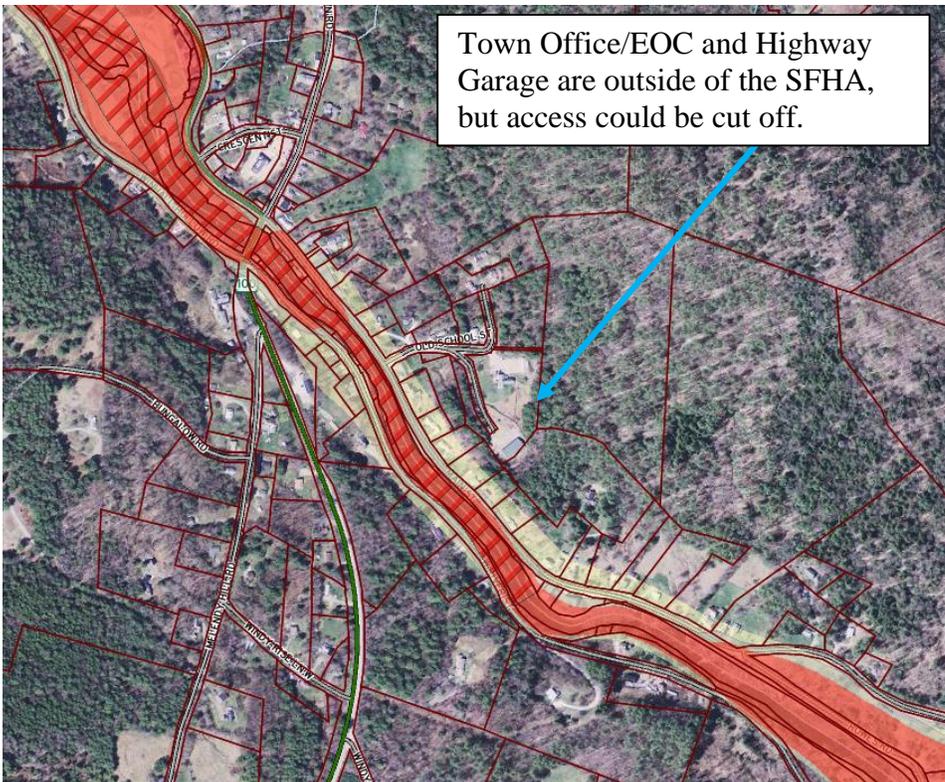




The Village of North Londonderry, shown at left top, is a frequent area for flooding. All of the properties on the south side of Main Street, closest to the river, have experienced flood damage¹⁴. The Town has concerns about the future potential of the remaining buildings in this area, and there is planning underway now to develop a sustainable long term vision for the North Village. A number of buyouts have occurred, in addition to some FEMA funded

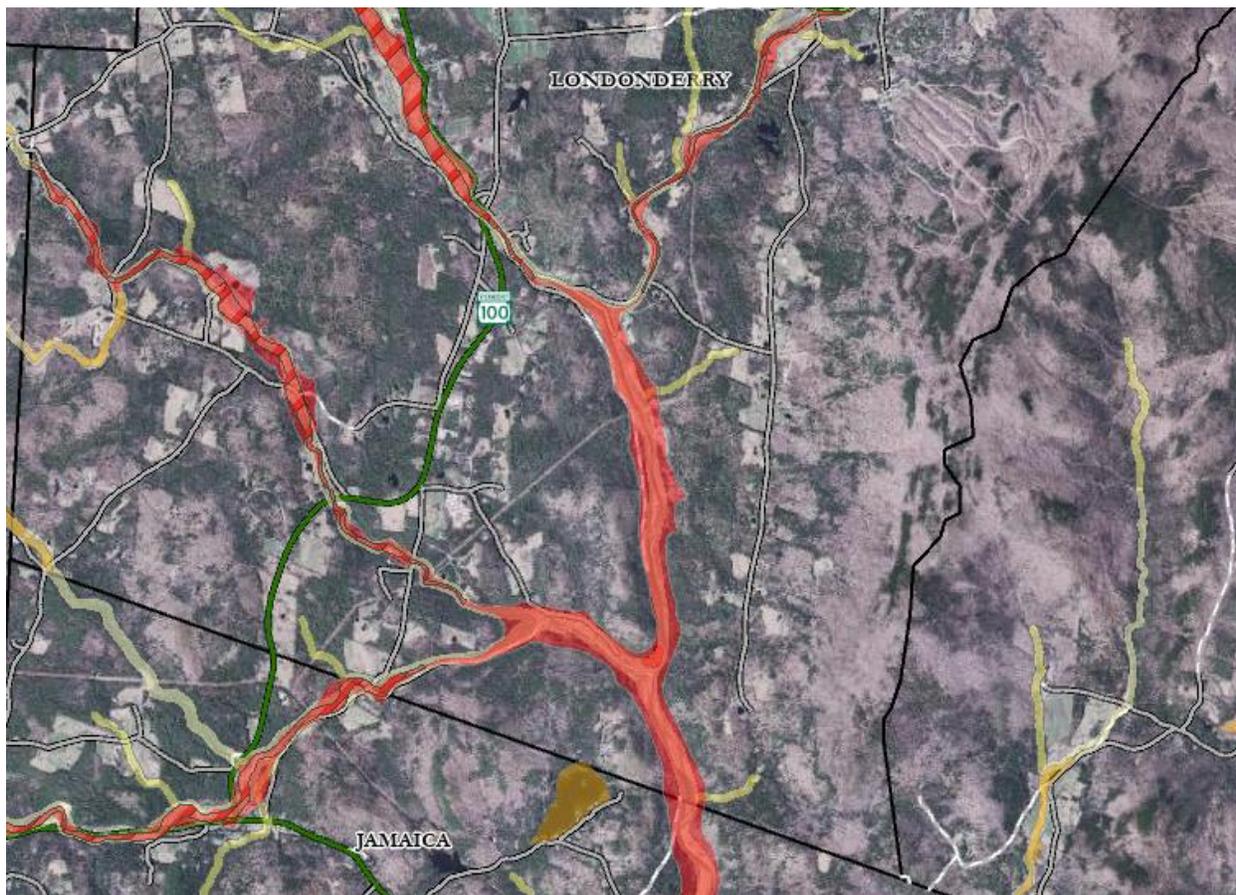
floodproofing, but existing vulnerable development remains. While revered by many, the Williams Dam, rated by the State of Vermont as being in 'very poor condition,' should continue to be monitored for its efficiency and potential impacts during high water events.

¹⁴ 2017 Londonderry Town Plan, pg 18.



This zoomed in map to the left is the South Londonderry Village area. The red hatch shows that floodway lies along most of the developed Main Street and the cream color shows that most of the structures are also within the River Corridor. Overall this area is extremely vulnerable to flooding and flood damages.

The below map shows the SFHAs and mapped River Corridor in the southern half of Londonderry. SFHAs in this area lie along Route 100, which is also the Main Street in the South Village. The floodplain and River Corridor of Cook Brook overlaps, crosses and runs along Spring Hill Road in numerous sections, leaving that Road and intersecting roads nearby vulnerable to flooding and washouts. The Town Office, which also serves as the EOC is vulnerable to being cut off by flooding and flood damages to Route 100/Main Street, even the Office itself is outside of the floodplain.



Extent

The extent of a flood event can vary from a minor event due to a typical rain event or could be a major event as a result of rapid snow melt in spring, rain on frozen ground, or as a result of a tropical depression or storm. It's important to note that this report is looking at flooding data for this section in the light that flooding is the cause of fluvial erosion. There were two flood events in 1973 and 1976 that were worse than TS Irene. There were several businesses damaged in the North Village, there were 5 home buyouts resulting from damages, and several other private structures were damaged. The dam worsened the flooding in the North Village, according to the EMD. The dam is being studied by ANR and a private consultant as of the writing of this plan. The dam is a topic of concern and question in the Town right now.

The highest recorded measurement on the West River at the nearest stream gauge, which is in nearby Jamaica, was 14.87 feet, which was measured on December 31, 1948.¹⁵

Extent for thunderstorms/heavy rain events: The tables below shows the top 10 rain events at three nearby USGS weather monitoring stations¹⁶. Multiple stations are shown as the period of record differs for each, and only the Peru station is currently operational. Most stations take their observations in the morning (7 and 8am are the most common times), so the precipitation would have fallen between 7am on the previous date to 7 am on the date listed in the table.

Of note is that the recent disaster declaration for rain on 7/29-30/2021 is not ranked for the Peru station. TS Irene is a ranking even for the Townshend Dam station, though not the Peru station, and not the largest event for Townshend Dam. One can see in comparing the results that there is variation in rainfall between places locally.

Maximum 1-Day Total Precipitation PERU, VT		
Rank	Value	Ending Date
1	7.45	1984-05-31
2	4.76	1999-09-17
3	4.71	1987-06-23
4	4.43	1990-08-07
5	4.25	1948-12-31
6	3.66	1951-10-08
7	3.50	1995-08-04
8	3.43	1966-08-12
9	3.42	1976-07-12
10	3.39	2005-10-09
Period of record: 1940-11-01 to 2022-01-12		

Maximum 1-Day Total Precipitation for Townshend Dam		
Rank	Value	Ending Date
1	5.60	1973-06-30
2	4.90	2011-08-29
3	4.36	1999-09-17
4	3.97	2005-10-09
5	3.32	1987-06-23
6	3.30	1975-08-08
7	3.21	2003-08-02
8	3.14	1988-04-29
9	3.07	2010-10-01
10	3.02	2000-12-18
Period of record: 1969-05-01 to 2016-06-19		

¹⁵ USGS Stream gauge 01155500 West River at Jamaica, VT (66 years of record)
<http://waterwatch.usgs.gov/index.php>.

¹⁶ Data provided by the Northeast Regional Climate Center at Cornell University, 09/16/2021.

Maximum 1-Day Total Precipitation For South Londonderry		
Rank	Value	Ending Date
1	6.44	1973-06-30
2	3.50	1976-08-10
3	3.48	1948-12-31
4	3.11	1970-04-03
5	3.10	1960-09-13
6	3.07	1969-04-23
-	3.07	1952-06-02
8	3.05	1955-10-17
9	2.97	1955-08-14
10	2.96	1943-11-09
Period of record: 1930-05-01 to 1984-03-31		

To give additional context to this precipitation data, the “Precipitation Frequency Estimates” table below allows one to determine the event frequency based on the rainfall amount. This table puts Tropical Storm Irene at between a 25 and 50-year event specifically for Londonderry. It is important to remember that precipitation levels vary throughout the region.

The table below is specific for Londonderry, and has the values associated with the size of an event in order to determine the storm frequency¹⁷. This is for reference. Londonderry should consider what size event is reasonable to set standards to build to, for both infrastructure and buildings. Some experts advise that towns should be using the 10-year one hour or two-hour frequency estimates to reflect the monsoon type storms that are seen in the region. Infrastructure built for 24 hour events often can't keep up with high intensity storms leading to erosion and street flooding. This should be a consideration in the future.

PRECIPITATION FREQUENCY ESTIMATES (in inches)										
by duration for ARI (years):	1	2	5	10	25	50	100	200	500	1000
5-min:	0.274	0.324	0.405	0.472	0.565	0.636	0.709	0.786	0.893	0.976
10-min:	0.388	0.459	0.574	0.67	0.801	0.901	1	1.11	1.26	1.38
15-min:	0.457	0.54	0.675	0.787	0.942	1.06	1.18	1.31	1.49	1.63
30-min:	0.643	0.758	0.946	1.1	1.32	1.48	1.65	1.83	2.07	2.27
60-min:	0.829	0.976	1.22	1.42	1.69	1.9	2.11	2.34	2.66	2.91
2-hr:	1.1	1.27	1.56	1.8	2.13	2.38	2.64	2.9	3.27	3.55
3-hr:	1.27	1.47	1.8	2.07	2.44	2.72	3.01	3.31	3.72	4.04
6-hr:	1.61	1.87	2.28	2.62	3.1	3.46	3.83	4.22	4.77	5.2
12-hr:	1.99	2.32	2.87	3.32	3.94	4.41	4.89	5.43	6.2	6.82
24-hr:	2.39	2.81	3.49	4.06	4.83	5.42	6.03	6.71	7.68	8.47
2-day:	2.83	3.32	4.11	4.77	5.68	6.37	7.08	7.86	8.96	9.84
3-day:	3.13	3.65	4.51	5.23	6.21	6.96	7.73	8.57	9.75	10.7
4-day:	3.38	3.94	4.84	5.59	6.63	7.42	8.23	9.11	10.4	11.3
7-day:	4.06	4.67	5.67	6.5	7.63	8.5	9.39	10.3	11.7	12.7
10-day:	4.73	5.37	6.43	7.31	8.52	9.44	10.4	11.4	12.7	13.8

¹⁷ NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: Jamaica, VT
https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=vt accessed 1/13/20.

20-day:	6.77	7.51	8.71	9.71	11.1	12.2	13.2	14.3	15.6	16.6
30-day:	8.47	9.28	10.6	11.7	13.2	14.4	15.5	16.5	17.9	18.8
45-day:	10.6	11.5	12.9	14.1	15.7	17	18.3	19.4	20.7	21.5
60-day:	12.3	13.3	14.8	16.1	17.9	19.3	20.6	21.7	23	23.8

Extent for fluvial erosion: The biggest area of fluvial erosion is along the Winhall River and measures 25 feet high by 20 feet wide. There is very limited fluvial erosion on the West River in Londonderry because it's relatively flat topography. There aren't unstable banks. There is some instability near the landfill, but this is banks slides on the scale of 6 feet high by 200 feet wide in several locations near there. The town hasn't addressed the situation in any way.

Probability

Planning participants in this planning process deemed flooding and fluvial erosion as highly likely hazards in Londonderry.

Past Occurrences

There have been 19 Presidential Disaster Declarations in Windham County since 1953, with 3 of those occurring since the last Plan update. Of these, 7 were severe storms, 5 were floods, 3 hurricanes, 1 snow event, 1 severe ice storm, and 2 are biological events (both relate to Covid-19 pandemic).¹⁸

Disaster Declarations for Windham County, VT						
Disaster Number	Incident Begin Date	Incident End Date	Declaration Date	Incident Type	Title	Disaster Close Out Date
3567	8/22/2021		8/22/2021	Hurricane	Tropical Storm Henri	
4532/ 3437	01/20/2020		04/08/2020	Biological	Covid-19 Pandemic	
4356	10/29/2017	10/30/2017	01/02/2018	Severe Storm and Flooding	SEVERE STORMS AND FLOODING	
4043	5/20/2011	5/20/2011	11/8/2011	Severe Storm(s)	SEVERE STORMS AND FLOODING	1/14/2020
4022	8/27/2011	9/2/2011	9/1/2011	Hurricane	TROPICAL STORM IRENE	
3338	8/26/2011	9/2/2011	8/29/2011	Hurricane	HURRICANE IRENE	3/10/2014
1816	12/11/2008	12/18/2008	1/14/2009	Severe Ice Storm	SEVERE WINTER STORM	10/15/2014
1698	4/15/2007	4/21/2007	5/4/2007	Severe Storm(s)	SEVERE STORMS AND FLOODING	3/13/2013
1559	8/12/2004	9/12/2004	9/23/2004	Severe Storm(s)	SEVERE STORMS AND FLOODING	1/4/2011
1488	7/21/2003	8/18/2003	9/12/2003	Severe Storm(s)	SEVERE STORMS AND FLOODING	1/4/2011
3167	3/5/2001	3/7/2001	4/10/2001	Snow	SNOW	2/28/2005
1336	7/14/2000	7/18/2000	7/27/2000	Severe Storm(s)	SEVERE STORMS AND FLOODING	6/30/2008
1307	9/16/1999	9/21/1999	11/10/1999	Severe Storm(s)	TROPICAL STORM FLOYD	6/30/2008

¹⁸ FEMA tool: Data Visualization: Disaster Declarations for States and Counties: Windham County, VT <http://www.fema.gov/data-visualization-disaster-declarations-states-and-counties> Accessed 9/15/2021

1124	6/12/1996	6/14/1996	6/27/1996	Flood	EXTREME RAINFALL AND FLOODING	2/23/2005
1101	1/19/1996	2/2/1996	2/13/1996	Flood	ICE JAMS AND FLOODING	2/17/2005
518	8/5/1976	8/5/1976	8/5/1976	Flood	SEVERE STORMS, HIGH WINDS & FLOODING	4/16/1981
397	7/6/1973	7/6/1973	7/6/1973	Flood	SEVERE STORMS, FLOODING, & LANDSLIDES	11/12/1976
277	8/30/1969	8/30/1969	8/30/1969	Flood	SEVERE STORMS & FLOODING	5/26/1972

Detail on Specific Flooding Events that have Affected Londonderry and Windham County:

Since 1996, when National Climatic Data Center detailed records start, there have been 45 flood events in Windham County, Vermont. Londonderry experiences routine spring flooding, but this is not always documented. There have been 10 events added to the detailed records since the last plan update in 2015, with several notable events discussed below¹⁹.

July 29, 2021 rains - - Night rain starting about 9:30 pm produced about 4 inches of rain in as many hours. There were 13 roads that were initially closed. River Road South being the highest cost impacted road with the longest closure. Total of approximately \$3-5 thousand in town wide public infrastructure damages, so the town did not qualify for federal assistance. Two spots under Mountain Road that were plugged and taken out, but this was part of a project underway that was already funded.

December 25, 2020 - An area of low pressure tracking from the Great Lakes to Hudson Bay advected in an unseasonably warm air mass into the region from Thursday, December 24 to Friday, December 25, 2020. Rain gradually overspread the region from west to east during the day on December 24 with the steadiest, heaviest rainfall during the overnight hours and early morning hours of December 25. Rain showers continued through the day on December 25 and changed to snow showers during the evening and overnight hours of December 25-26 as colder air returned. The region still dealt with nearly the entire snowpack from the blockbuster winter storm from December 16-17 which dropped 9 inches of snow. While the snow compacted over time, very little water was lost from the snow. Observations concluded that between 1.50 to 3.00 inches of water was in the snowpack prior to this event and most if not all of this snow melted. Rainfall totals in Putney were measured at 2.39 inches (Anderson) to 2.54 inches (Mary Quinn) from local spotters. These amounts do not include the additional 1.50 to 3.00 inches of water that melted from the snowpack. The combination of warm air, rainfall and melting snowpack led to areas flooding across the region. Roads were closed across portions of southern Vermont as a result of flooding with one road being washed out. A tree was also downed onto Interstate 91 in eastern Windham County. Key Impacts: road closures, tree damage, damage to structures.

April 15, 2019 – A low pressure system and warm front brought heavy rainfall to the region during the morning hours of Monday, April 15th, 2019. This resulted in a few reports of flooding with some dirt roads washed out. A major disaster was declared by the President of the United States in Bennington County to assist in repairing the damaged roads. Vermont Route 11 was partially closed due to flooding between Route 100 and Derrywoods Road.

¹⁹ NCDC data provided on 8/18/2021 by NOAA's National Centers for Environmental Information (NCEI) Center for Weather & Climate (CWC).

January 24, 2019 - Following a heavy snowfall event on January 19-20 over southern Vermont, a strong low pressure system tracking through southern Canada ushered in an unseasonably warm and moist air mass on January 24th. Temperatures surged into the 40s to mid-50s. Steady rainfall occurred during much of the 24th as a secondary low pressure system developed over the Mid-Atlantic and tracked into southern New England. One four inches of rain was recorded over southern Vermont. The combination of the rainfall along with the mild temperatures melting some of the snow resulted in a real flooding over portions of the region along with minor to moderate river flooding on the Walloomsac River. Some flooding due to ice jams also occurred. Several roads were closed due to flooding, there was a mudslide on Route 7A near Manchester, and trailer parks were evacuated in Brattleboro and Pownal. An unoccupied car was stranded in sixteen inches of water on Route 100 at Evergreen Road. The road was closed.

August 3, 2018 - A slow-moving cold front brought several rounds of heavy rainfall and thunderstorms to eastern New York and western New England. After passing through eastern New York, a severe thunderstorm knocked down trees and caused localized flash flooding in the towns of Putney and West Wardsboro, Vermont.

January 12, 2018 - After a frigid end of December and beginning of January, an unseasonably warm air-mass was pumped into western New England on January 12th on southerly winds. The temperatures reached the 50s and 60s during the day. Showers also developed in the warm air-mass ahead of a cold front and were heavy at times, with some locations receiving one to two inches of rainfall. The combination of warm temperatures and heavy rainfall caused river ice to dislodge and resulted in ice jams in spots.

October 29-30, 2017 rain storm – A low pressure system developed off the southeast coast and rapidly intensified as it tracked northward tapping into tropical moisture. The powerful low moved across eastern New York and western New England Sunday night into early Monday morning bringing damaging winds, power outages, heavy rainfall and flooding to the region. As the system departed, strong winds ensued and caused thousands of power outages and trees down across southern Vermont. Total rainfall amounts reported across southern Vermont ranged from 1.07 inches in Bennington to 7.01 inches near Wilmington.

July 28, 2014 - As a strong area of low pressure moved across upstate New York on Monday, July 28th, repeated rounds of thunderstorms occurred during the afternoon and evening hours. This led to flash flooding across northern Windham County, as small streams and creeks rapidly overspread their banks. In addition, the Williams River reached flood stage due to the rapid surge in water. Although the worst of the flooding remained north of Windham County in Windsor County, many residents reported this flooding to be the worst seen in the area since Tropical Storm Irene in 2011. Heavy rain from thunderstorms led to flash flooding in Windham. The access road to the Tater Hill Golf Course was washed out as a result of the flooding.

July 7, 2014 - A warm and humid air mass was in place across southern Vermont on the afternoon of Monday, July 7th. A cluster of showers and thunderstorms moved from upstate New York into southern Vermont during the mid-afternoon hours. These thunderstorms had previously weakened, but were still associated with very strong winds aloft. As these thunderstorms interacted with the high terrain of the southern Green Mountains, they produced gusty winds. These winds caused damage to trees and power lines near Readsboro. The thunderstorm continued eastward towards the Connecticut River Valley, but did not produce any additional severe weather before exiting the state to the east.

September 12, 2013 - A series of cold fronts moved towards the region on Thursday, September 12th. Despite some periods of cloudiness, a warm and humid air mass ahead of the approaching boundaries allowed for moderate amounts of instability to be in place. Along and ahead of the boundaries, several lines of showers and thunderstorms developed and moved across the region during the afternoon and early evening hours. In addition to a large amount of cloud to ground lightning, a few of the thunderstorms became severe, with damaging wind gusts. Several trees were downed across the region. Some areas that received repeated showers and thunderstorms experienced flash flooding as well, with roads washed out and/or closed as a result. The hardest hit areas were within the Town of Brattleboro. Two to four inches of rain in a short period of time was reported in the areas that experienced flash flooding.

September 1, 2013 - A moist and humid air mass was in place across the region on Sunday, September 1st. A surface frontal boundary was situated across eastern New York into southern New England during the morning hours. During the day, the frontal boundary slowly lifted northward. With enough instability in place due to daytime heating, some showers and thunderstorms developed along this frontal boundary. The showers and thunderstorms tracked over the same locations during the afternoon hours across southern Vermont.

July 10, 2013 - Warm moist air over the northeast provided the ingredients for heavy rainfall, and saturated ground from record May and June rainfall made the region vulnerable to flooding. Showers and thunderstorms developed during the afternoon and evening of July 2 2013, producing heavy rainfall moved repeatedly across southeast Vermont, with isolated flash flooding.

Tropical Storm Irene – August 28, 2011 - The Federally Declared Disaster DR-4022, Tropical Storm Irene, tracked northeast across eastern New York and western New England during Sunday, August 28th, producing widespread flooding, fluvial erosion, and damaging winds across the region, including Wilmington. Rainfall amounts generally averaged 4 to 8 inches. Much of the rain which fell occurred within a 12-hour period, beginning early Sunday morning, and ending Sunday evening. This heavy to extreme rainfall resulted in widespread flash flooding and river flooding across southern Vermont.

Locally, a total of approximately 8 inches of rain fell in a timeframe of 12 hours, causing the West River to rise approximately 12-15 feet above the normal flow at river bottom. The flash flood water caused fluvial erosion of the shoreline and specifically trees, boats, propane tanks, dumpsters, 2 U-Haul trucks and one porch that were in the floodway were washed down the river, damaging homes in South Londonderry. Main Street had 6 feet of standing floodwater for 12 hours. A commercial building on Main Street had floodwater measuring 5 feet on the ground floor. Roads and bridges were washed out all over town. FEMA provided funding to buy properties that suffered repetitive flooding in the north and south villages. The Town obtained five properties through buyouts that will provide public use for passive outdoor recreation and floodplain storage along the West River within the villages. Londonderry received \$206,105.92 in damages (90% of total).

March 7, 2011 – A cold front moved gradually southeastward across the region during the day Monday, March 7th, as a wave of low pressure moved northeastward along the boundary. To the south of the boundary, it was mild as the area was in the warm sector of the low pressure system. The storm tapped into both Atlantic and Gulf moisture, resulting in heavy rainfall of 1 1/2 to 3 1/2 inches across southern Vermont Sunday, March 6th, into Monday, March 7th before the precipitation transitioned to a wintry mix then snow early Monday morning. The heavy

rainfall, combined with runoff from snowmelt due to the mild temperatures, resulted in flooding of rivers, streams and creeks, mainly from the formation of ice jams.

August 5, 2008 - The passage of a strong upper level disturbance, combined with a moist and unstable air mass in place, led to the development of numerous thunderstorms across southern Vermont during Thursday afternoon on August 7th, some of which contained large hail. In addition, locally very heavy rainfall led to flash flooding in some areas.

March 8-9, 2008 - A strengthening low pressure system tracked from the central Gulf Coast states on Friday March 7th, into the central Appalachians by Saturday morning on March 8th. The low then tracked into northern New England by Saturday evening. Heavy rainfall occurred across southern Vermont from this storm system.

April 15-21, 2007 - Low pressure developed over the lower Mississippi Valley on Saturday April 14th, and then moved northeast while intensifying, reaching the southern Appalachians by Sunday morning, April 15th, and then just south of western Long Island by Monday morning, April 16th. This low became very intense, with a central barometric pressure falling below 970 millibars upon reaching just south of Long Island Monday morning. The low then headed off the New England coast by Tuesday morning. This intense coastal storm spread heavy precipitation across southern Vermont, starting on Sunday, and persisting into late Monday. Initially, the precipitation fell as a mixture of wet snow, sleet and rain, with snow and sleet more prevalent across the higher elevations. The precipitation then changed to plain rain by late Monday morning. Liquid equivalent precipitation totals from this storm ranged from 3 to 6 inches. Rain and snow caused damage to roads and utility lines across Windham County and Londonderry. Across the State, nearly 3.6 million dollars were obligated as part of the FEMA Public Assistance Program under DR1698, and Londonderry received a total of \$26,668.32 from FEMA for damages (75% of total).

June 29, 2006 - After being nearly stationary while deepening for several days, an upper-level trough from the Great Lakes to the lower Ohio Valley was accelerating eastward at daybreak on June 29. An associated weak low pressure over Lake Erie trailed a cold front through the Ohio Valley. During the day, this system moved rapidly eastward and touched off thunderstorms in the warm, humid air mass over western New England in the early evening. Torrential rainfall produced flash flooding in Windham County.

October 8, 2005 - On October 8 at daybreak, a nearly stationary cold front was over southwestern New England. The air over the northeastern United States was very moist. Low pressure in the vicinity of the eastern Carolina states moved slowly north northeast along the cold front. Heavy rain fell over southern Vermont through the early morning hours of October 9. During this period, there was over 6 inches of rainfall in southern Vermont, triggering widespread flooding. Several evacuations of people from their homes occurred.

The following year, another severe period of flooding and thunderstorms, which lasted from the period of August 12- September 12, 2004 engendered Presidential Disaster Declaration DR – 1559. These two events triggered funding from the FEMA Public Assistance Program which helped to pay for debris removal and overtime hours for emergency response workers. Flash flooding resulted in lots of debris.

August 3, 2003 – A tropical air mass was in place over southern Vermont on August 3. With a strong disturbance over the Great Lakes adding weak lift to a very unstable atmosphere, scattered showers and thunderstorms erupted during the afternoon hours. A slow moving storm

over Windham County produced Doppler radar estimated rainfalls of 3 to 4 inches in about four hours. The torrential rains took a toll, washing out roads in Londonderry. Highway 121 was washed out in the Town of Windham. Massive flooding occurred in the Town of Grafton at the base of Fire Pond and Hinkley Brook roads, where water, debris and mud washed those roads out. The raging debris knocked a house off its foundation and damaged several other ones. This was the same area affected by the infamous Flood of 96 which was even more severe. Nearly constant rain and thunderstorms from the period of July 21 through August 18, 2003 led to FEMA Declaration 1488. Many roads were washed out and culverts needed replacing throughout town. Londonderry received \$12,165.59 from FEMA for damages (75% of total).

July 2000 - A stalled frontal boundary across extreme southern Vermont interacted with a strong upper level disturbance from July 15 into early July 16. Two to four inches of widespread rain fell, with locally higher amounts across the higher terrain of Windham County. Specific amounts included 3.00 inches at Bennington and 5.17 inches at West Wardsboro, in Windham County. This rain produced enough runoff to cause the Deerfield River to rise 6 feet above unofficial flood stage in Wilmington. Several roads were reported under water. The widespread heavy rain event set the stage for more widespread flooding later Sunday. The air remained very moist and unstable in wake of the rainstorm. More thunderstorms erupted late in the day across southern Vermont. These storms moved very slowly, trained over the same region, and were further enhanced by the steep terrain. The thunderstorm rainfall, as well as the earlier rainstorm, dumped in excess of 8 inches locally at Newfane. Since the ground was already saturated, the heavy rains from the thunderstorms produced flooding and flash flooding across the region. In Windham County, a five-mile stretch of State Route 30 was closed due to flooding and residents were evacuated. Street flooding was reported at Brattleboro. This event resulted in FEMA declaration number 1336 for Vermont.

September 17, 1999 - The remnants of Hurricane Floyd moved up the eastern seaboard on September 16 and during the early hours on September 17. The storm brought both high winds and heavy rainfall to Southern Vermont, which included a large swath of 3 to 6 inch amounts. Specific rainfall amounts included 2.91 inches in Bennington, 3.89 inches in Sunderland, 4.54 inches at Peru and 5.70 inches at Brattleboro. The rain produced significant flooding across the region, which proved destructive. Many smaller tributaries reached or exceeded bank full. Water from the Millbrook in Weathersfield washed away a portion of State Route 5. The World's Fair in Tunbridge was cancelled for the first time in many years. Winds from the passage of Floyd were estimated to have gusted to over 60 mph, especially over hill towns. The combination of the wind and very saturated ground, produce widespread downing of trees and power lines across much of Southern Vermont. Some trees fell on vehicles and houses. The rain and wind produced power outages across the region. As many as 2,000 people lost power in Southern Vermont.

June 19, 1998 - Thunderstorms with torrential downpours produced flash floods across parts of Windham County. Shoulders of Routes 100 and 112 were washed out near Jacksonville and Halifax. Flooding also occurred in the Putney area and at Rawsonville. Several mountain roads were washed out throughout the County.

January 19, 1996 - An intense area of low pressure which was located over the Mid-Atlantic region on Friday morning January 19th produced unseasonably warm temperatures, high dewpoints and strong winds. This resulted in rapid melting of one to three feet of snow. In addition to the rapid snowmelt one to three inches of rain fell as the system moved northeast along the coast. Many small streams across the county flooded, including Whetstone Brook, resulting in several road washouts.

During 1976, flooding occurred throughout New England, as result of Hurricane Belle, causing millions of dollars in damage. A very damaging flood according to historical knowledge stated by towns people.

In 1973 there was an extreme rainfall event from June 28-30 that affected all areas of Vermont except the northwest section. Rainfall amounts as much as 6 inches in 24 hours in some locations. This was the largest rain event since the 1927 flood. Highway damage was extensive in the south-central, southeastern, and northeastern areas of the State. Three persons were killed in the 1973 flood, and damage was estimated at \$64 million. Sizable crop loss was reported, and damage to State highways was estimated to be \$10 million. The entire State was declared a disaster area.²⁰ After this event, there was extensive dredging, berming and windrowing in an attempt to control channel location and reduce future flood impacts. This flood is an historically significant event for Londonderry. Both Villages of South Londonderry and Londonderry were flooded out. The water levels were 6-8 feet higher than during TS Irene and didn't recede as fast. Town lost two large culverts on Winhall Hollow Road and lost Cross Road Bridge, all of Thompsonburg Road, which runs along a brook, was washed out.

The Spring Floods of 1938, which had an effect on all of New England, caused \$113 million in damage, killed 24 people and made 77,000 people homeless. During this flood alone, the main street of Hooksett, New Hampshire was 18 to 20 feet underwater. This flood destroyed the West River railroad.

The Vermont Flood of 1927 was the deadliest flooding event in the history of the State; eighty-four people were killed with over \$28 million in property damage. The flood of 1927 destroyed much of the industrial base in Londonderry.

Sources used
Local knowledge of areas of concern and impacts, information in 2014 Londonderry LHMP, National Climatic Data Center reports, 2017

Londonderry Town Plan, Discussions and emails with Londonderry Emergency Management Director, FEMA data provided by Vermont Emergency Management, 3/25/2022.



²⁰ USGS "Vermont Floods and Droughts" information page <http://md.water.usgs.gov/publications/wsp-2375/vt/>. Accessed 4/3/15.

Ice Storm

Description and Impact

The Region has a long history of severe winter storms and blizzards and usually experiences at least one or two Nor'easters each year with varying degrees of severity. There have been 87 winter/ice storm or extreme cold events in Windham County since 1996.²¹ A typical event begins as a low-pressure system that moves up the Atlantic Coast, into the Canadian Maritimes, dumping heavy snow across parts of Vermont. Snowfall accumulations are generally three to six inches in the valleys and 6 to 12 inches in the mountains. Winter storms and ice storms can cause power lines to fail, damage trees and impede access to homes and businesses. Wardsboro is at risk as an entire town, though higher elevation areas usually experience the most severity with winter weather.

Heavy wet snows of early fall and late spring, as well as ice storms, often result in loss of electric power, leaving people without adequate heating capability. The other threat from winter storms is downed trees, resulting in power failures and impassable roads or driveways. An ice storm crossed the region in December of 2008 causing widespread downed trees and power outages in Windham County. The total cost of damages across the region surpassed the one-million-dollar threshold triggering a Presidential Disaster Declaration DR-1816 for Windham County. Damage across the region consisted of roads being blocked for short periods of time due to downed trees and utility lines. Thousands lost power for varying lengths of time and several shelters were opened in Windham County. Compared to neighboring southern New Hampshire communities, Londonderry and Windham County fared relatively well from the damage inflicted by the ice storm. There was a significant storm in 1998 that resulted in tree damage and extensive power outages. Areas that got hit the hardest resulting in 50% tree mortality in the forest land. Northern Vermont was hit harder with that storm than southern Vermont.

The primary concerns with winter weather events is power failure, damage to roofs, trees and power lines, and dangerous or impossible travel conditions.

Power failure is a common event in areas of Londonderry and a condition as a result of high winds and/or heavy snow or ice that can occur anywhere in town. Power failures are typically the result of power lines damaged by storm events. During ice storms the higher elevation locations in town as well as areas of concentrated development are most susceptible to power failures. The power station on Thompsonburg Road is susceptible to damage and this causes disruptions town-wide and outages can result in 1-2 day outages. Power failures may also result from disruptions in the New England or national power grid, as indicated by the widespread power outages in 2003. Dead or dying trees in close proximity to power lines pose a particular threat to power lines when ice loads are added.

Elderly and special needs housing that doesn't have access to generator is a concern for the town during each event. There are a lot of inns and lodges in town that don't have backup generation. There are also a large amount of tourists during the winter months that come up for the resorts. This is another concern for the town.

It is also fairly easy for the town's back road transportation network to get cutoff. Route 11 has a lot of truck accidents due to snow and ice. With skier traffic there is also a lot of traffic incidents in difficult weather on Route 11.

²¹ National Climatic Data Center, 1996-2021 storm events

Extent

The severity or magnitude of winter storm to occur in southeast Vermont can range from moderate to very severe. The southeastern region of VT typically receives over 60 inches of snowfall per year, and most Vermonters are prepared to handle large amounts of snowfall. Londonderry experiences significant snow storms every year but according to the town they are manageable. During the major snowfall of winter 2010-2011, where the region received well over 100 inches of snow, the biggest problem was that snow never melted off during the season, only accumulated, making it difficult to find space to store the mounds of snow. But in the season of 2010-2011, the problem arose with finding locations to deposit huge quantities of snow during the season because there wasn't the typical mid-season melt off. Snow amounts are not necessarily a problem for Vermonters, but heavy, wet snow, or the event of rain on snow or frozen ground, are usually very problematic. Londonderry has been known to get up to 2 feet of snow per storm, with sometimes higher amounts.

Seasonal (Jul 1st – Jun 30th)

Maximum

Minimum

Rank	Snowfall	Year(s)	Rank	Snowfall	Year(s)
1	145.4"	1970-71	1	31.8"	1912-13
2	132.0"	1886-87	2	32.0"	1904-05
3	128.4"	2010-11	3	37.7"	2011-12
4	122.4"	2000-01	4	38.3"	1928-29
5	120.2"	2007-08	5	38.7"	1926-27
6	116.9"	1992-93	6	39.6"	1979-80
7	113.5"	1887-88	7	40.4"	1988-89
8	111.6"	1965-66	8	40.7"	1948-49
9	108.9"	1971-72	9	42.5"	1990-91
10	107.2"	1993-94	10	43.0"	1903-04

Seasonal Snowfall records per the
Burlington, VT Weather Service

Probability

The Hazard Mitigation Planning Committee in Londonderry deems ice storms to be likely in any given year. Every winter there is at least one weather related incident where people in town will lose power for a few days.

Past Occurrences

The Region has a long history of severe winter storms and blizzards and usually experiences at least one or two Nor'easters each year with varying degrees of severity. The planning participants, and climate data, noted no significant ice events between 2008 and 2019. There have been three winter storms in recent history in Windham County that were Disaster Declarations:

- Ice Storm (DR-1201) – January 6-16, 1998
- Snowstorm (EM-1358) – December 16-18, 2001
- Winter Storm (DR-1816) – December 11-18, 2008

The following detail events listed in the National Climatic Data Center for all ice storms on record for Western Windham County for records dating back to 1996:

February 13, 2019 - A winter storm brought widespread wintry precipitation to southern Vermont on Tuesday, February 12th through Wednesday, February 13th, 2019. Precipitation started out as snow but then quickly transitioned to a period of sleet and then freezing rain throughout the event. This mix of wintry precipitation resulted in hundreds of closings and delays. Strong winds followed, especially across the southern Green Mountains, which led to power outages across the region.

March 14, 2017 - A very significant coastal snowstorm impacted the region March 14 through 16, featuring extremely heavy snowfall and blizzard conditions. The bulk of the snowstorm occurred during the day on Tuesday, March 14th. Lower elevations saw around 18 inches of snow, with up to 35 reported at higher elevations. The snow fell at 1 to 4 inches per hour for much of the day. There was a widespread extreme public impact, with many roads severely impacted and schools closed. Much of the train service across the region was cancelled. In addition to the snowfall, gusty winds up to 45 mph resulted in near-zero visibility and blizzard conditions across portions of Bennington County. The winds brought considerable blowing and drifting of snow. Although the most severe impacts from the storm occurred on March 14, periods of light snow and blowing snow continued to affect the region through the early morning hours of March 16.

Feb. 25, 2011 - A storm system produced a widespread swath of heavy wet snow across southern Vermont during the day Friday. Snowfall rates of 1 to 2 inches per hour occurred, beginning during the early morning hours, and persisting until late afternoon. Snowfall amounts of 12 to 17 inches occurred across much of southern Vermont. The heavy wet snow created treacherous travel conditions for both the morning and evening commutes on Friday, and also led to numerous school and business closings.

Jan. 19, 2011 - Snow and sleet accumulations across southern Vermont varied from 3 to 9 inches, with ice accumulations of up to a half of an inch.

Jan. 12, 2011 - Heavy snow fell across southern Vermont with snowfall accumulations ranging from 14 inches up to 3 feet. A mesoscale snow-band set up across the western New England, including southern Vermont, Wednesday morning resulting in snowfall rates of 3 to 6 inches an hour.

January-February 2010 - The snow fall during this time was severe, averaging over 100 inches throughout the region, to include the Town of Londonderry. There were a number of large storms during this timeframe. No reported dollar amount of damage. Trees were down and back roads were cut off.

December 11-12, 2008 - A cold front moved across eastern New York and western New England on Wednesday, December 10th, ushering a cold air-mass into the region. A low pressure system developed over the southeast states Wednesday and Wednesday night. This storm then headed northeast Thursday and Thursday night, December 11th, with precipitation spreading northward well in advance of the low. The low continued to track northeast, passing over the mid-Atlantic region late Thursday night, and over the New York City Metropolitan area and southern New England Friday morning, December 12th. The low then moved to the Canadian Maritimes Friday night. As the storm approached, warmer air moved in aloft, and with a cold air-mass remaining in place at the surface. This set the stage for a significant mixed precipitation event. The precipitation came down heavy at times, especially Thursday night. Hourly precipitation rates of one quarter to one third of an inch were reported for several hours in the form of freezing rain across much of the region. The precipitation changed back to snow before ending early Friday afternoon. Total ice accretion from freezing rain ranged from one half to three quarters of an inch, with the greatest amounts occurring across higher elevations of eastern Bennington and western Windham Counties. Some sleet and snow also were mixed in, with as much as 7 inches reported at Woodford. The ice storm resulted in widespread damage to trees and resultant power outages across southern Vermont, where an estimated 15,000 utility customers lost power. Many schools and businesses were shut down for several days due to the loss of power, and impassable roads from extensive fallen debris, resulting in significant economic and societal impacts. States of emergency were also declared across portions of

southern Vermont. The hardest hit areas were across Bennington and much of Windham Counties. Bitterly cold temperatures followed in the wake of the storm Saturday and Sunday, compounding the power outages across the region. Numerous warming shelters were setup to assist those who were without power and heat.

This storm resulted in widespread downed trees and power outages in the region. The total cost of damages across the region crossed the one-million-dollar threshold which allowed for a Presidential Disaster Declaration DR-1816. Damage across the region mostly consisted of roads being blocked for short periods of time due to downed trees and utility lines. Thousands lost power for varying lengths of time and several shelters were opened in Windham County. Compared to neighboring southern New Hampshire communities, Wardsboro and Windham County fared relatively well from the damage inflicted by the ice storm.

March 18-21, 2008 - A strengthening low pressure system tracked northeast from the Ohio Valley on Tuesday March 18th, to a position along the Maine coast by Thursday morning on March 20th. The low then continued to intensify upon reaching the Canadian Maritimes by Friday morning on March 21st. This storm system initially brought a swath of light to moderate snowfall across southern Vermont from Tuesday into early Wednesday, with accumulations of 1 to 3 inches. The snow then changed to freezing rain across the higher elevations of southern Vermont during Wednesday and lasting into Wednesday night. This produced ice accumulation of one half of an inch, to locally up to an inch. The heavy accumulation of ice led to numerous downed trees and power lines, as well as power outages. The hardest hit areas were mainly confined to the highest elevations within western Windham county. As a cold northwest flow developed in the wake of this storm system, some lake enhanced snow bands developed Thursday night into Friday morning, which produced additional snowfall amounts of 4 to 9 inches, mainly across higher, west facing slopes in Bennington county.

March 4-5, 2008 - A strengthening low pressure system over the lower Ohio Valley on Tuesday March 4th tracked northeast into west central New York State by Wednesday morning on March 5th. The low then tracked northeast into the Canadian Maritimes by Thursday morning on March 6th. This storm system spread a swath of freezing rain and sleet across higher elevations of east central New York and portions of southern Vermont. The freezing rain and sleet developed late Tuesday evening, and continued through early Wednesday afternoon before tapering off. In southern Vermont, significant ice accumulations of one half, to locally up to one inch occurred in the higher elevations of western Windham county. Elsewhere, ice accumulations ranged from one quarter to less than one half of an inch, with the least occurring in lower elevations. The heavy ice accumulations across the higher elevations led to widespread downed tree limbs and wires, as well as power outages. Wilmington in southwest Windham county was particularly hard hit.

March 2, 2007 - A significant mixture of snow, sleet and freezing rain began early Friday morning, and ended Friday evening. Snowfall accumulations of 6 to 10 inches fell during this storm, with 10 inches reported at Athens, and 6 inches at Brattleboro. In addition, ice accretions of up to one half inch occurred from freezing rain, mainly within sheltered valley locales.

January 15-16, 2007 - A low pressure system over the mid-west moved east, reaching south central New York State around midday on Monday, January 15th, and then moved off the southern New England coast by Monday evening. Cold low level air remained in place as precipitation overspread the region early Monday morning, producing a mix of freezing rain and some sleet. Significant icing occurred from the freezing rain during Monday, leading to widespread power outages from downed trees and tree limbs, and from power transformers

which shorted out. Although the freezing rain tapered off Monday evening, strengthening winds in the wake of the storm continued to down tree limbs and exacerbate power outages across the region into Monday night. [This ice storm had a significant impact on travel and economy across the region.

November 22, 1997 - A low pressure system south of Long Island on November 22, 1997 produced heavy wet snow across southern Vermont. Snowfall averaged 4 to 8 inches in Bennington and Windham Counties. The heavy wet snow downed trees and power lines, which produced scattered power outages. The power outages were most widespread in Windham County.

On November 13 and 14, 1997, a winter storm tracked from the southeast coast north to the coast of southern New England and then out to sea. Heavy snow fell across southern Vermont, with an average snowfall of 7 to 10 inches. Some specific snowfall totals included: 9 inches at Townsend and 6 inches at West Dover in Windham County and 8 inches at Manchester Center in Bennington County.

March 31-April 1, 1997 - A classic late season nor'easter tracked from the Chesapeake Bay area northeast to central coastal New Jersey then slowly out to sea. This system produced rain across Bennington and Windham Counties during the morning hours of March 31. The rain changed to heavy wet snow by early afternoon. Snowfall amounts were highly elevation dependent. Some specific snowfall totals included: 12 inches at Shaftsbury and 13 inches at Peru in Bennington County and 23 inches at West Wardsboro and 12 inches at Grafton in Windham County. The wet snow brought down many trees and power lines causing widespread power outages and road closures. Some areas remained without power for several days. Route 9, between Bennington and Brattleboro was closed for much of the night.

Nov. 26, 1996 - On November 26, a low pressure system brought a combination of snow and freezing rain to southern Vermont. Over Bennington and Windham Counties, snow and heavy freezing rain downed trees and power lines and caused numerous accidents. Across southern Vermont approximately 10,000 customers lost power.

March 8, 1996 - Heavy snow fell across Bennington and Windham Counties of southern Vermont with 8 to 10 inches common over the area. Some specific snowfall totals included: 9 inches at Dorset and 7 inches at Pownal in Bennington County, 10.5 inches at West Wardsboro and 9.5 inches at West Dover in Windham County.

Jan. 2, 1996 - A major winter storm developed over the Gulf coast states on January 2nd and tracked northeast along the eastern seaboard during January 3rd. Heavy snow fell across southern Vermont with the average snowfall ranging from 10 to 12 inches.

Great Blizzard of '78 - This storm is more well known for its impact on coastal New England and Long Island, but it still had quite an impact on eastern New York and western New England. The Green Mountains of Vermont were hit hard, with many areas reporting around two feet of snow. East Wallingford, near Rutland had 30". The Catskills also had quite a bit, with Prattsville reporting 25". Wind also caused quite a bit of drifting of the snow. On the coast, Boston received 26.7" of snow, their largest storm total on record. The storm also produced strong winds...Logan Airport reported an 83 mph gust...and there was a report of 92 mph on Cape Cod.

Sources used

Local town knowledge and records, National Climatic Data Center, CRREL Ice Jam Database, FEMA's Presidential Disaster Declarations search page, Burlington, VT Weather Service historic weather events page, Albany National Weather Service – major winter storms page

High Winds

Description and Impact

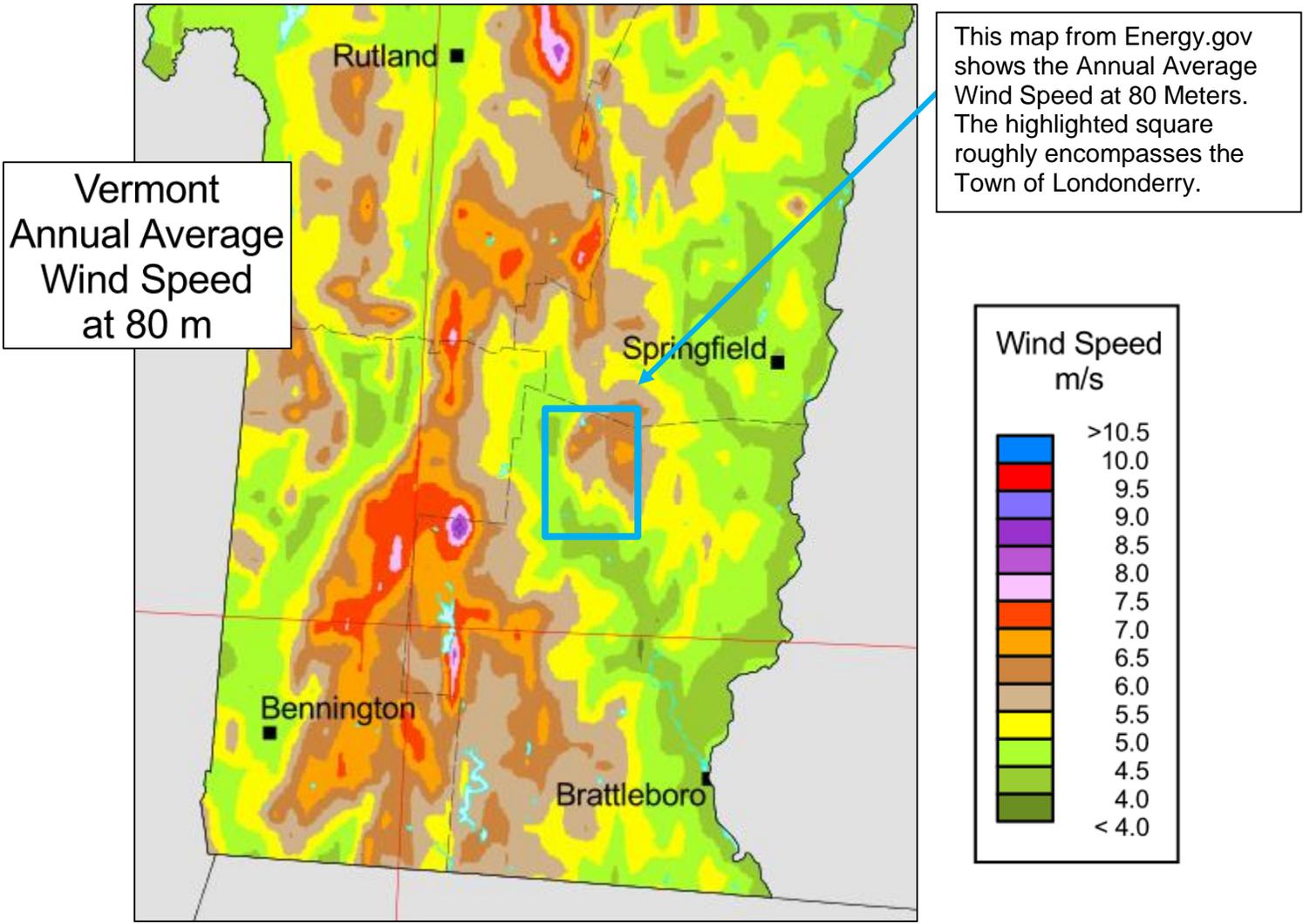
High winds are fairly common in Vermont all across the state. High wind events that are sufficient enough to cause damage to property and taking down trees can occur at any time of year. High wind can damage roofs, uproot trees, break branches from trees and take down power lines anywhere in Town. High winds can be associated with thunderstorms, snowstorms, hurricanes, tropical storms, or just wind storms. High winds tend to sweep through the region after the passage of a weather front. The National Climatic Data Center data indicates that 38 high wind events have occurred in Windham County since 1950, some of which involve thunderstorms²².

Power outage is the risk primarily to do with high winds. Wind causes more trees on wires than ice, although ice does weaken or weigh down trees. Wind after ice causes real damage.

Geographic Area of the Hazard

High wind events are not localized and can affect any part of the Town. Higher elevations are more susceptible. Londonderry has a hilly and mountainous topography, along with valleys where much of the settlement is located. Average wind speeds correspond with the highest elevations, though Plan participants noted that strong gusts do sweep through the valleys, as well. The map on the following page shows annual average wind speeds for southern Vermont south of Rutland. This gives an idea of wind speed in the town in comparison to its surroundings. The purple area to the southwest of the highlighted square is Stratton Mountain, which gets particularly high winds and can serve as a point of reference or comparison to the highlighted square indicating Londonderry.

²² NCDC storm event database provided 8/18/2021.

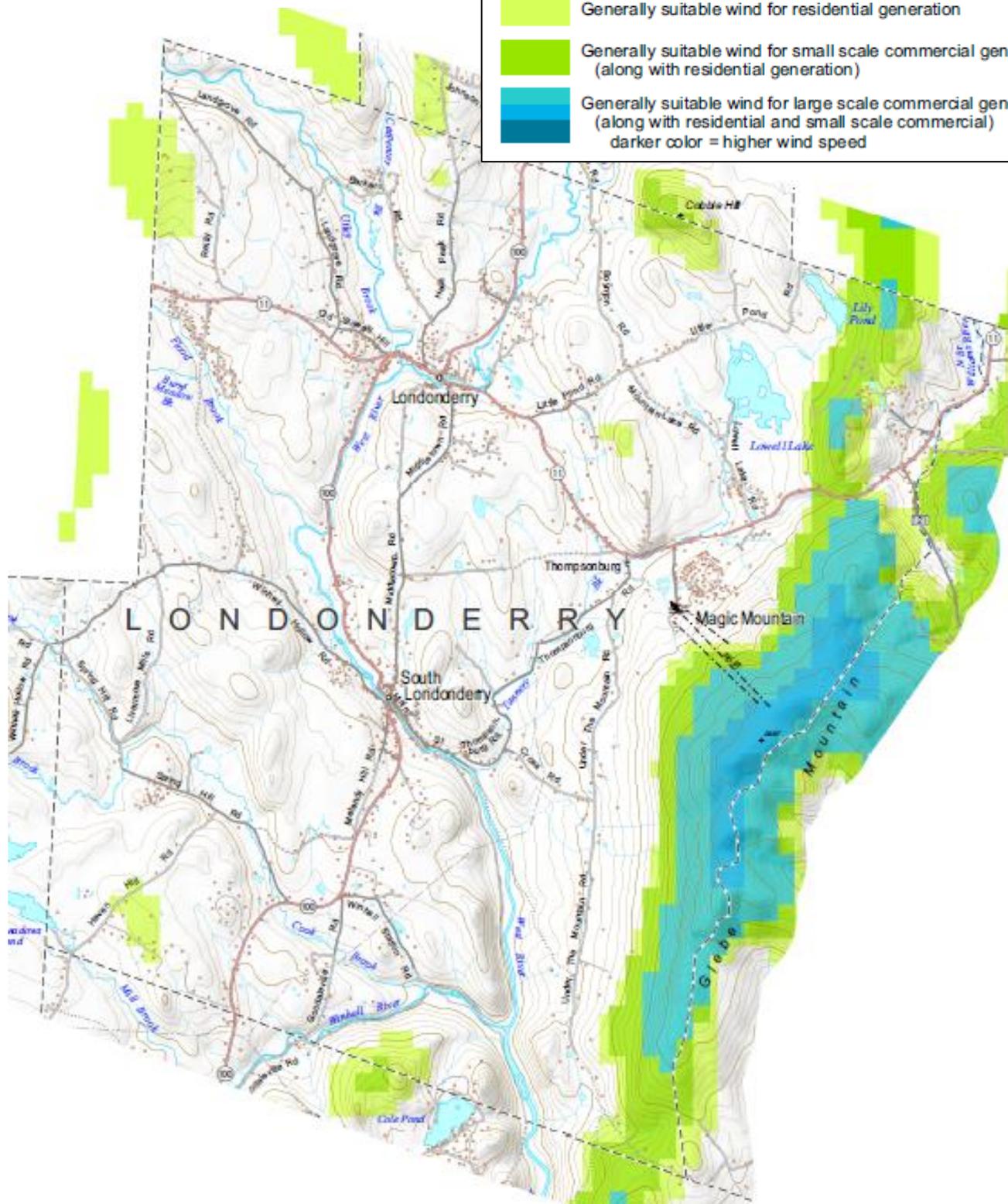


For a more localized look at wind speed, the map on the following page shows wind power opportunity correlated only to wind speed²³. The highest points in town, primarily Glebe Mountain and its surroundings, have the highest wind speeds in the Town.

²³ This map was developed in March 2017 by the Windham Regional Commission for use by the Town and Region in energy planning efforts.

Town of Londonderry Wind Resource

-  Generally suitable wind for residential generation
-  Generally suitable wind for small scale commercial generation (along with residential generation)
-  Generally suitable wind for large scale commercial generation (along with residential and small scale commercial)
darker color = higher wind speed



Extent

Winds are brought into the region mainly due to low pressure systems coming out of the Canadian zone, or high pressures coming off the Gulf Coast.

Extent/magnitudes of Hurricanes and Tropical Storms are ranked using the Saffir-Simpson Scale in the Western Hemisphere, as follows: CAT1=74-95 mph winds, CAT2=96-110 mph winds, CAT3=111-129 mph winds, CAT4=130-156 mph winds, Tropical Storm=39-73 mph winds, Tropical Depression=0-38 mph winds.

Londonderry experiences a variety of wind events, not simply hurricanes, so the Beaufort scale is also included here for reference²⁴:

Force	Speed		Land Conditions
	knots	mph	
0	<1	<1	Calm, smoke rises vertically
1	1-3	1-3	Light air, direction of wind shown by smoke drift only
2	4-6	4-7	Light breeze, wind felt on face, leaves rustle, vanes moved by wind
3	7-10	8-12	Gentle breeze, leaves and small twigs in constant motion, wind extends light flag
4	11-16	13-18	Moderate breeze, raises dust, loose paper, small branches move
5	17-21	19-24	Fresh breeze, small trees in leaf begin to sway
6	22-27	25-31	Strong breeze, large branches in motion, umbrellas used with difficulty
7	28-33	32-38	Near gale, whole trees in motion, inconvenience felt walking against the wind
8	34-40	39-46	Gale, breaks twigs off trees, impedes progress
9	41-47	47-54	Strong gale, slight structural damage occurs
10	48-55	55-63	Storm, trees uprooted, considerable damage occurs
11	56-63	64-73	Violent storm, widespread damage
12	64+	74+	Hurricane, extreme destruction

Probability

The Hazard Mitigation Plan participants ranked wind as being highly likely, or having a 100% probability of occurring within any given year. Wind storms of varying degrees are experienced every year.

There are many trees in close proximity to roads, buildings and power lines throughout the town, however there are no particular areas vulnerable to experiencing trees on wires causing power outages. Under the Mountain Road has a stretch of power line that's off the road that gets outages frequently, and the off the road lines are harder to restore so outages can last longer. There are about 20 residences in that area and most have generators. There are areas where power lines go through the forest, so tree trimming is not practical. That being said, in Londonderry trees on power lines is an issue at times during and after wind events or ice and snow events, meaning power outages are a secondary effect and a hazard to vulnerable populations.

²⁴ NCDC: Beaufort Scale for Land. <https://www.ncdc.noaa.gov/sites/default/files/attachments/Land_Beaufort_Scale.pdf>

Past Occurrences

October 31, 2019 – Intense Halloween wind event left many trees and limbs down, taking down many power lines and snapping a couple of poles. Power outage lasted a couple of days in some places, as restoration efforts were needed region-wide.

August 21, 2019 - The National Weather Service storm survey team confirmed a high-end EF1 tornado in Windham, VT. The team found a swath of almost continuous damage in a 3/4 mile by 350-yard area. There was shingle and siding damage to several homes. Many dozens of trees were violently snapped or uprooted. Outdoor furniture, shingles and siding were tossed hundreds of yards. Based on the degree of damage, the estimated wind speed of 105 to 110 mph was determined, which is a high-end EF1 tornado.

June 18, 2018 - A hot and humid air mass was in place across the region with temperatures in the 90s and dew points in the 60s and 70s. This resulted in heat index values reaching 100 to 110 degrees during the afternoon hours in valley areas. ||This air mass also resulted in an unstable environment for strong to severe thunderstorms to form ahead of a cold front passage during the afternoon and evening hours of June 18th. The storms caused numerous trees and power lines to be knocked down, resulting in over 80,000 customers without power throughout the state of Vermont. Trees and wires were downed in Londonderry.

Jul 1, 2017 - An upper-level disturbance interacted with a very moist atmosphere on July 1, generating thunderstorms across the region. These storms resulted in torrential rainfall in portions of Southern Vermont. The airport at Bennington recorded 3.47 inches of rain in four hours during the evening. This rainfall resulted in river flooding along the Walloomsac. A storm also produced a microburst in Bennington County with maximum wind speeds of 100 mph estimated. The public reported trees down in Londonderry due to thunderstorm winds.

July 19, 2013 – A very warm and humid air mass was in place over southern Vermont on Friday, July 19th. With temperatures into the 90s, the air mass was very unstable. A cold front was upstream of the region across the Great Lakes. Ahead of this front, a complex of thunderstorms developed across Lake Ontario during the evening hours of July 19th. As these thunderstorms moved eastward, they strengthened as they interacted with a lake-breeze boundary over central New York. The thunderstorms raced eastward across eastern New York and reached southern Vermont by the late evening hours. Due to the quick movement of the storms and the very unstable air mass in place, the thunderstorms produced several reports of damaging winds, mainly to trees. The thunderstorms moved east of the region by midnight, ending the threat for severe weather. Trees and wires were reported down in Londonderry as a result of thunderstorm winds.

September 8, 2012 - A warm and moist southerly flow of air moved into the region in advance of a powerful cold front. The combination of partial sunshine, increasing amounts of instability and strong wind dynamics with this system placed the region into a rare Moderate Risk by the Storm Prediction Center. Several supercell thunderstorms developed earlier in the day in advance of the main squall line associated with the cold front with the potential for tornadoes, although none developed across the region. The main hazard was straight line damaging wind gusts from a squall line during the afternoon and early evening hours that resulted in numerous power outages and trees down across the area. The squall line moved east of the area later in the

evening, ending the threat for severe weather. Trees were reported down due to thunderstorm winds approximately 3 miles southeast of North Landgrove.

Aug. 28, 2011 - Tropical Storm Irene tracked north northeast across eastern New York and western New England during Sunday, August 28th, producing widespread flooding, and damaging winds across the region. Strong winds occurred across southern Vermont, with frequent wind gusts of approximately 30 mph in Grafton. The strongest winds occurred from the north to northeast during the morning hours, then from the west to northwest during Sunday evening. The combination of strong winds, and extremely saturated soil led to numerous downed trees and power lines across the region. This also resulted in widespread long duration power outages.

June 8, 2011 - The area was in a warm, humid and very unstable air mass on Wednesday, June 8th. A strong disturbance in the upper levels of the atmosphere moved across the region, tapping the explosive instability and triggering severe thunderstorms across southern Vermont during the evening. Trees were reported down in Londonderry due to strong thunderstorm winds.

May 26, 2010 - A backdoor cold front approached the area from the northeast and provided a focus for thunderstorms during the late evening hours of Wednesday, May 26th. Trees and wires were reported down in Londonderry due to strong thunderstorm winds.

August 1, 2005 - During the latter part of the afternoon, on August 1, thunderstorms moved across southern Vermont. These thunderstorms were triggered by an upper air disturbance moving over a warm, humid and unstable air mass. A couple of thunderstorms produced severe weather. A thunderstorm over Emerald Lake State Park, west of Route 7 near North Dorset, dropped one-inch hail and brought down large limbs and a tree. Severe wind gusts in a second thunderstorm blew down trees near a utility company's Winhall power station, in Windham County.

April 19, 2004 - The same line of thunderstorms that pelted portions of eastern New York, moved into southern Vermont later in the evening on April 19. Though weakening, the line of storms was still strong enough to produce severe weather in Windham County. Strong wind gusts knocked down power lines down in the town of Londonderry.

Mar. 10, 2002 - The pressure gradient between deep low pressure over Ontario, and high pressure off the southeast coast, produced a strong southerly flow across southern Vermont on the evening of March 9. Then, a strong cold front moved across the region shortly after midnight, early on March 10th. A line of showers and embedded thunderstorms accompanied the front. Strong winds ahead of and along the front produced some damage across Windham County. Law enforcement personnel reported a large number of trees and power lines down throughout the county.

August 9, 2001 - A supercell, that evolved over New York State during the late afternoon of August 9, weakened somewhat as it moved into Vermont but still produced scattered severe weather across southern Vermont. In Bennington County, trees were blown down in the city of Bennington as well as Arlington. In Londonderry, Windham County, trees and wires were also blown down.

December 12, 2000 - An area of low pressure developed across the Tennessee Valley late on December 11th. The storm then rapidly deepened as it moved northeast into the Ohio Valley,

Saint Lawrence Valley and eventually across the Canadian Maritimes on December 12th. The pressure difference between this intensifying storm and a large arctic high pressure building over the Southeast, produce a high wind event across southern Vermont on December 12th. The strongest winds with the storm came after the passage of the cold front, during the midday hours. A strong westerly wind brought down large limbs, trees and power lines across Bennington county. Large limbs were blown down at Stratton Mountain in Windham County.

September 16, 1999 - The remnants of Hurricane Floyd moved up the eastern seaboard on September 16 and during the early hours on September 17. The storm brought both high winds and heavy rainfall to Southern Vermont. Winds from the passage of Floyd were estimated to have gusted to over 60 mph, especially over hill towns. The combination of the wind and very saturated ground, produce widespread downing of trees and power lines across much of Southern Vermont. A woman was injured on Tavern Hill in Putney, Windham County when a tree came crashing down on her Volvo, destroying the vehicle. Some trees fell on vehicles and houses. The rain and wind produced power outages across the region. As many as 2,000 people lost power in Southern Vermont. Over \$175,000 in damages countywide.

September 7, 1998 - A derecho ahead of a strong cold front, which had moved east from southern Ontario across New York, weakened considerably as it moved into southern Vermont during the predawn hours on the 7th. The derecho still had wind strong enough to down trees in the town of Woodford in Bennington County as well as the town of Londonderry in Windham county. \$3000 in damages in Londonderry.

Nov. 27, 1997 - The passage of a cold front produced strong winds across southern Vermont during the early morning hours of November 27. Winds gusting to 40-50 miles an hour downed trees and power lines in Bennington and Windham Counties. Approximately 1,500 customers lost power for a six- to eight-hour period.

Jul 20, 1996 - An unusually intense low pressure system tracked across the northern Great Lakes to Quebec, Canada during July 19 and 20. The system generated strong northwest winds, which downed trees and power lines over parts of Windham County in southern Vermont.

Feb. 24, 1996 - A rapidly deepening low pressure system moved from southern New Jersey northeast to northern Maine by the morning of February 25. This system brought damaging winds to southern Vermont including Bennington and Windham counties, which downed many trees across the area and produced scattered power outages.

Jan 19, 1996 - An intense area of low pressure located over the Mid-Atlantic Region on Friday morning January 19th produced damaging winds across southern Vermont. This storm was associated with a strong southerly flow which resulted in scattered reports of downed trees, limbs and power lines.

July 18, 1997 - On July 18, a cold front crossed southern Vermont during the afternoon. With a hot and very humid air mass in place the front initiated a few severe thunderstorms. Thunderstorm winds downed trees at Manchester and Dorset in Bennington County and at Londonderry in Windham County. About \$2,000 in damages in Londonderry.

Sept. 21, 1938 - Hurricane Igor hit the region of Southeast Vermont to include the Town of Jamaica, paralyzing the region and the state for weeks. As it was coming, packing winds over 100 miles an hour, authorities were unaware of the magnitude so no evacuation procedures

were instituted and very few precautions were taken. As a result, over 600 people lost their lives and tens of thousands were left homeless. Wind, rain and flash flooding wiped out trees, church steeples and buildings, leaving behind nearly \$400 million in damage statewide.

Invasive Species: Plants and Insects



Invasive plant species are a region-wide hazard; however, each location will be confronted with a distinct mix of invasive species that thrive under the particular ecological conditions of that place. Each invasive species has a different potential to spread to other areas based on the rate at which it spreads and the ecological suitability of the ecosystem that it is expanding into.

An invasive species can be defined as **an exotic species whose introduction into an ecosystem in which the species is not native and causes or is likely to cause environmental or economic harm or harm to human health**²⁵. Another definition is **an exotic species that colonizes both disturbed and undisturbed habitats**²⁶. For an example of the second definition not being met, Coltsfoot (*Tussilago farfara*) is usually only found in disturbed areas, mainly on the edges of unpaved roads. Thus, it is not considered invasive here, since it is rare in undisturbed woods.

In contrast, Burningbush (*Euonymus alatus*), an invasive shrub often planted in local yards, has its seeds carried by birds to nearby woods, where they grow well in those undisturbed areas, crowding out native plants. The homeowner with them in their yard may not realize this spread is happening. (See photo)

Keep in mind that “exotic” may be hard to define. For example, Black locust (*Robinia pseudoacacia*) is native to the US, mainly in and near the Ohio River Valley, but it is not native to Vermont. It was brought here by settlers who planted it mainly to use for fence posts. It spreads rapidly to undisturbed woods, so it is considered invasive in Vermont.

²⁵ (USDA) https://www.nrcs.usda.gov/wps/portal/nrcs/detail/ct/technical/ecoscience/invasive/?cid=nrcs142p2_011124

²⁶ CT Invasive Plant Working Group, <https://cipwg.uconn.edu/criteria-for-listing/>

Invasive Plant Species

In the absence or near absence of natural predators or controls, invasive non-native plants are able to spread quickly and out-compete native plants. Invasive plant species can create monocultures, which often provide poor habitat for native animals that have not evolved with the non-native species, resulting in degraded habitat value and increased vulnerability. The invasive plant issue really escalated in the early 1990's. Invasive plants tend to thrive in disturbed areas. Within the Windham region, they are more prolific in the towns along the



Black Swallowwort carpets a bank to the exclusion of almost everything else. It even twines up a utility pole guy wire. Note the abundant seed pods. (Photo courtesy of John Anderson, Dummerston)

Connecticut River than they are to the west, because the eastern towns are more populated, contain major transportation routes such as I-91 and the rail corridor, which serve as vectors for their expansion, and tend to have significant land disturbance. Some of these plants were originally planted because of their positive aspects such as their ability to grow in difficult growing conditions, long growing season length, their large seed production and their ornamental value. These same reasons are a big part of why they have become invasive.

Aquatic invasive species are spread by overland transport of watercraft, trailers, and fishing and recreational equipment. Londonderry has particular concern, and pays particular attention to aquatic invasive species in Lowell Lake. Since public access to Lowell Lake is a Vermont State Park, Londonderry relies on the State of Vermont for monitoring and education concerning aquatic invasive species. The Lake is a popular tourist and recreational destinations for boating and swimming. The most effective way to prevent spread is through education and equipment inspections designed to catch invasive species "hitching a ride" from one waterbody to another. Preventing the spread of aquatic invasive species is far more effective and economically sensible than eradicating invasive species once they are established. With support from Vermont DEC, Public Access Greeters educate lake visitors about invasive species, provide courtesy watercraft inspections and STOP introductions²⁷. The most common invasive found by the greeter program is Eurasian milfoil, which is also a top invasive concern in Londonderry.

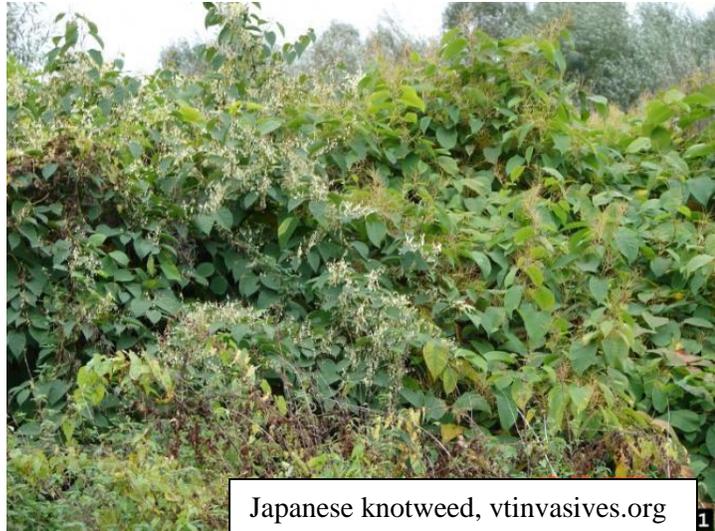
²⁷ <https://dec.vermont.gov/watershed/lakes-ponds/aquatic-invasives/spread-prevention/greeters>

Heavy travel corridors like VT Routes 30, 11 and 100 are also highways for the spread of invasives. Waterways and riparian areas are also corridors that invasives can overtake and spread along.

Particular invasive plant concerns for Londonderry are listed in two groups based on their estimated threats to natural and hard infrastructure. All (except spindle tree) are quarantined, Class B Noxious Weeds in Vermont²⁸.

Group A—Higher threats to infrastructure

1. There are heavy infestations of Japanese Knotweed (*Fallopia japonica*) along the West river bank, as well as the lower reaches of several brooks. It leaves shorelines susceptible to erosion because there is no other vegetation stabilizing the stream bank (Basin 11 Management Plan, Preliminary Draft 2007). TS Irene both (1) eroded stream and river banks, removing many riparian trees, and (2) moved fragments of knotweed to new areas, thus allowing knotweed to flourish on the bare soil left in its wake.
2. Asiatic (Oriental) bittersweet (*Celastrus orbiculatus*), an aggressive climbing vine that can smother trees, utility poles, and buildings. Not a high prevalence in Londonderry
3. Amur, Morrow's, Tartarian, and Bell's honeysuckle (*Lonicera mackii*, *morrowii*, *tatarica*, *x bella*)
4. Japanese & Common barberry (*Berberis thunbergii* & *B. vulgaris*), which promote Lyme disease by harboring high populations of deer mice, one of the intermediate hosts of deer ticks.
5. common and glossy (European) buckthorn (*Rhamnus cathartica* & *R. frangula*), which slow forest regrowth.
6. Burningbush (*Euonymus alatus*)—still a common ornamental in yards, spreading to woods via birds that eat the low-value fruit, little wildlife value, should be excavated.
7. Water chestnut (*Trapa natans*)—Displaces native aquatic plants, can block boat traffic.



Group B—Lesser threats to infrastructure

8. Mile-a-minute vine (*Persicaria perfoliate*), on Federal invasives list that is included in state list. Considered a "watch list" species in VT, but can cover other plants as well as

²⁸ Vtinvasives.org is the primary website for information. This list was developed by Peter Bergstrom of the Rockingham Conservation Commission. Email dated 8/21/2021.

hard infrastructure.

9. Garlic mustard (*Alliaria petiolate*) is common along roads and in fields and riparian areas in Londonderry, and can invade forests.
10. European spindle tree (*Euonymus europaeus*)-locally problematic, not on VT invasives list; suggested for addition to it. Very hard to control. You can buy seeds on eBay.
11. Goutweed (*Aegopodium podagraria*)—Highly invasive, has solid green leaves, or variegated green & white leaves. Very hard to control.
12. Norway maple (*Acer platanoides*)— inhibits growth of nearby plants spread widely by seeds to nearby woods, little food or habitat value to wildlife. Should not plant any new ones. Provides good breeding habitat for Asian long-horned beetles (ALB).
13. Common reed (*Phragmites australis*)—more in wetlands than riparian areas.
14. Purple loosestrife (*Lythrum salicaria*)
15. Yellow flag iris (*Iris pseudacorus*)—wetland plant, not sure how much we have.
16. Amur maple (*Acer ginnala*)-- not sure how much we have.
17. Tree-of-heaven - not sure how much we have. Looks very similar to sumac and walnuts (black and butternut) but has smelly leaves when crushed, and smooth leaf margins except at the base.
18. Wild Chervil (*Anthriscus sylvestris*) - This invasive plant can be seen starting in May alongside roads, and is notable in our rolling Vermont fields. Often confused for Queen Ann's Lace which blooms later in the summer.

Five groups of invasive plants found in Londonderry, listed below, are thought to pose the highest threat to native and/or hard infrastructure. Barberry is also a human health threat (Lyme disease).

Common name	Latin name	Locations	Threats	Control
Japanese Knotweed	<i>Fallopia japonica</i>	Banks of all rivers and many brooks	Can grow through asphalt, into basements, and block trails; more likely to wash out than natives	Mowing (endless), repeated cutting & digging (3-10 years), mesh?
common and glossy (European) buckthorn	<i>Rhamnus cathartica</i> & <i>R. frangula</i>	Clearcuts, woodland edges	Prevents regrowth of native trees	Excavation including roots
Japanese & Common barberry	<i>Berberis thunbergii</i> & <i>B. vulgaris</i>	Planted shrub, escapes to woods	Increases deer mice which harbor deer ticks with Lyme disease	Excavation including roots
Burningbush	<i>Euonymus</i>	Planted as ornamental,	Displaces native	Excavation

	<i>alatus</i>	birds spread seeds to woods	shrubs	including roots
Amur, Morrow's, Tartarian, and Bell's honeysuckle	<i>Lonicera mackii, morrowii, tatarica, x bella</i>	Planted as ornamental, birds spread seeds to woods	Displaces native shrubs	Excavation including roots

Elevations generally below 1,500 feet (which includes all of Londonderry except Glebe Mountain) are most susceptible to invasive species, although any land with some sort of major disturbance (from wind, water, logging, or land clearing and development) could potentially host them. Invasives tend to come up early and flower early, allowing them to get established before native plants have the chance. It may be possible to slow down or even halt the spread of these species by identifying and removing plants as soon as they appear. Early detection is the key. This detection can be aided by educating residents about the identification of and problems caused by invasive species. Below are some examples of how invasive plants are impacting Londonderry:

Natural infrastructure

1. Japanese knotweed has taken over significant sections of streambank on the West River and its tributaries. It is also becoming more common along roadsides and other disturbed areas. Common & Glossy buckthorn, Morrow's honeysuckle, Japanese barberry, and burning bush are colonizing disturbed forest areas and forest edges, and may be preventing regeneration of other species.
2. Invasive vines such as Oriental bittersweet can cover and eventually kill a tree.
3. Invasive tree pests are killing some of our valuable trees such as ash and hemlock.

Hard (human) infrastructure

1. Any human structures near Japanese knotweed are vulnerable to invasion by its stems. It can spread up to 30 feet underground, and come up through asphalt. Roadside trees killed by invasive insect pests can fall and damage roads, utility lines, and human structures, and cause accidents. Some towns, including Londonderry, are mapping their roadside ash trees and identifying the ones that are highest priority of removal due to these risks.
2. Invasive vines can cover utility poles and make servicing the lines, transformers, and junction boxes on them very difficult.

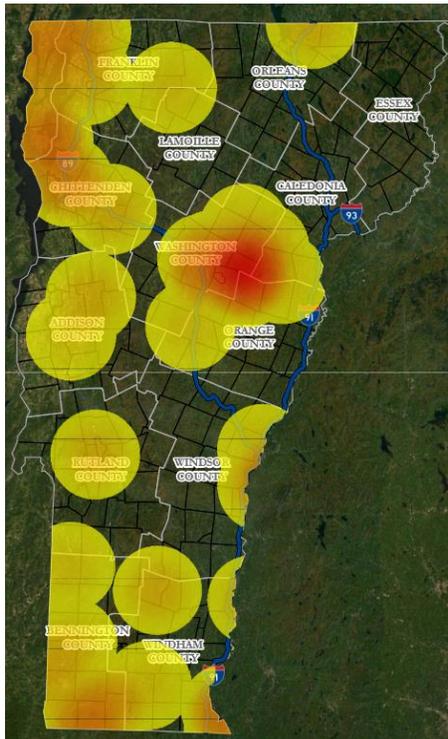
Preventing the spread of invasive plants is something that everyone can assist with. The first step is to not plant non-native plants on your property and to remove invasives that exist. Additionally, it is important that when soil is disturbed, to plant native cover before invasives have a chance to establish themselves. Proper disposal of non-native vegetation is critical to avoid its spread, safely burning the material when possible. Avoid transporting non-native plants, including firewood and garden debris, as this is critical to prevent the spread of non-native seeds and insects. Mowing roadsides from the north to the south can also help prevent the migration of invasive seeds on-site²⁹.

²⁹ Vermont Fish and Wildlife Department: Wildlife Action Plan. Developed 11/22/05. Accessed 3/2/15.
http://www.vtfishandwildlife.com/library/reports_and_documents/vermonts_wildlife_action_plan/_/_report/7_appendix/k_invasive_exotic_and_pest_species.pdf

VTinvasives.org is a great resource for towns interested in engaging in activities around invasives, including using their template to develop a custom invasive species plan for your town. The idea is to continue to create as much awareness as you can so residents know who to call when they see things. The sooner an outbreak is found, the better the chances of containment. Bio-controls are being worked out currently but aren't yet a solution. Insect pests are often found first by concerned citizens, members of the Conservation Commission, arborists and foresters.

Top Invasive Forest Pests and their Impacts

Non-native invasive species cause irreversible impacts on tree health, forest composition, and biodiversity. Three non-native insects which currently threaten Vermont are the emerald ash borer (EAB), Asian longhorned beetle (ALB) and hemlock wooly adelgid (HWA). Hemlock wooly adelgid is currently present throughout the state. Initially discovered in Orange County in February 2018, Emerald ash borer (EAB) has been spread quickly and as of this writing been determined the in orange areas on the map. Asian longhorned beetle are within fifty miles of Vermont's border. Over half of the trees in Vermont are host species of one of these three invasive insects.³⁰



Map provided by VTinvasives.org and current as of 11/19/2021.



Emerald ash borer (shown above)

Emerald ash borer (EAB), *Agrilus planipennis*, is an exotic beetle that was discovered in southeastern Michigan near Detroit in the summer of 2002. The larvae feed in the cambium between the bark and wood, producing S-shaped galleries that girdle and kill branches and trees. Emerald ash borer probably arrived in the United States on solid wood packing material carried in cargo ships or airplanes originating in its native Asia. It first came into Detroit and killed off all the ash trees in the city, which had been planted after the city's elm trees had been killed by Dutch elm disease. The United States Department of Agriculture Animal and Plant Health Inspection Service (APHIS) does inspections at ports and terminals, but only inspects about 7% of materials coming into the US.

Emerald ash borer has spread rapidly in the United States, killing millions of trees. Emerald ash borer was confirmed in Londonderry in 2019. The town is not seeing any tree damage yet, but the town has been planning for Ash tree removal along the roads. GMP has been removing Ash trees along the power lines. From a forestry standpoint, there is an impact on the sale of Ash wood to allow it only to go to USDA approved receiving sawmill facilities and only be transported during the non-flight season of winter. Before that, EAB ash could be moved more

³⁰ vtinvasives.org (accessed 2/20/15)

freely. The town has established a fund for ash tree removal in the near future, currently \$3,000 per year. The town is not actively removing ash yet to see what GMP does first that threaten their utility lines. GMP has been removing trees incrementally since 2019.

EAB has also been confirmed in other towns within the Windham Region. Londonderry is entirely covered under what VTinvasives.org calls the “Slow the Spread Movement”. Carefully planning and managing the movement of infested or potentially infested material will slow the spread and provide greater protection for uninfested forests. EAB is currently present in 33 states (most recently in Maine).

White ash is one of the ten most common tree species in Vermont, so this insect will have a major impact in Vermont. EAB only feeds on Ash trees, but that is 7% of Vermont’s tree species. EAB can travel faster than Asian longhorned beetle. EAB is often moved around on firewood that people transport. Eradicating the insect on wood requires heating it to at least 140 degrees or higher for greater than 60 minutes.

Signs and Symptoms: Symptoms and signs include D-shaped adult exit holes, bark splitting, serpentine frass-filled (sawdust-like waste) feeding galleries, wood pecker feeding, crown dieback, and epicormic shoots (whips growing off the trunk and branches). Many of these symptoms and signs are similar to other insects and diseases of ash.



Blonding with pecked holes on ash trees is a sign of EAB infestation.

EAB essentially girdles the ash trees, killing them. It lives between the inner bark and the wood, so it isn’t that deep. Woodpeckers like feeding on EAB, but the woodpecker population isn’t large enough to significantly impact the EAB population. Also the woodpeckers don’t generally detect the insects in the trees until they have been present for about two years, which is too late to save the tree. One of the best diagnostic methods for detecting EAB is called “blonding”. “Blonding” is a clear symptom of EAB infestation. It occurs when woodpeckers, while foraging for the succulent EAB larvae, flake off outer layers of bark, revealing the lighter or blond-colored inner layers of bark.³¹

A native ground-nesting wasp, *Cerceris fumipennis*, is providing a handy solution to the EAB detection problem. This wasp will prey on the adult emerald ash borers (as well as related native beetles) and carry them, paralyzed, back to its burrow. The paralyzed beetle is then stored underground as food for the wasp’s larva. Purple traps have been placed in Londonderry by the Conservation Commission to catch the EAB for early detection; none have been detected thus far.

Hemlock woolly adelgid

The hemlock woolly adelgid (HWA), *Adelges tsugae*, is a tiny insect from east Asia that attacks forest and ornamental hemlock trees. It feeds on young twigs, causing needles to dry out and drop prematurely. Trees may die in four to six years. Some survive, but with sparse foliage, losing value as shelter for wildlife and their ability to shade streams.

³¹ University of New Hampshire Cooperative Extension – Blonding on Ash trees information sheet. <http://extension.unh.edu/resources/files/Resource004103_Rep5824.pdf> Accessed 3/2/15.

The HWA first arrived in the southeast U.S. and spread to the northeast through the Long Island Sound. Sustained cold leads to kill off of the adelgid insects. Mortality rates of even 91%, however, can still lead to population growth through the warm season because they reproduce asexually so it only takes one for the population to expand. The HWA mortality rate shifts each year based on temperature patterns throughout the year, especially cold winter temperatures cause die off.



HWA is not yet present in Londonderry. It has not been found upstream from Jamaica so far. In the Windham region, it was initially found in Brattleboro and the Guilford area. It is now found in 14-15 Windham Region towns, and has been recently found in Springfield in Windsor County. It has not yet been found in Weston, Winhall, Somerset, Searsburg or Readsboro. HWA is moving south to north in lower elevations first, and is mostly throughout southern Vermont at this point. Dead or dying hemlocks are a sadly regular sight in the region. It was first found at the SIT campus in 2010 and is now found throughout the town of Brattleboro.

Hemlock trees and even whole stands are showing signs of decline, but trees in Vermont have not been reported to have been killed from HWA alone. Foresters have been watching infested trees for eight years, and the trees haven't been killed yet most likely because winter temperatures kill off enough of the HWA to give the tree a temporary reprieve. HWA does weaken the trees to the point that other secondary stresses, such as funguses and disease, may result in their mortality. Another pest, Hemlock elongate scale was found recently for the first time in Guilford, Vernon and Brattleboro.

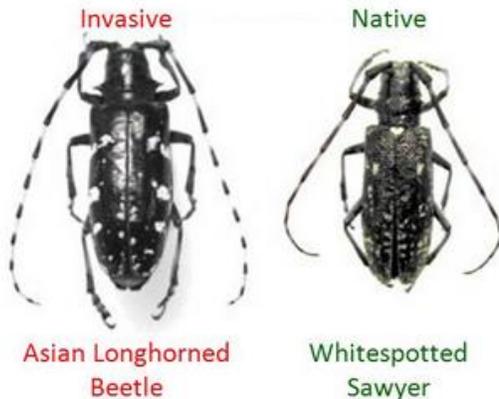
Asian longhorned beetle³²

The Asian longhorned beetle (ALB), *Anoplophora glabripennis*, is an invasive insect that feeds on certain species of hardwood trees, eventually killing them. Also known as the Starry Sky or Sky Beetle, the ALB is native to eastern Japan, and Korea. It was brought to the US, to New York City first, in packing material from Asia. ALB attacks a variety of native hardwood species, including maple, birch, elm, poplar, horse chestnut and willow. ALB prefers maples and does not like trees in the oak family. Upon hatching, the larvae tunnel through the heartwood of a host tree until fully grown. They then burrow out of the trunk as adult beetles. This process weakens the wood, making it prone to breakage, and can cause tree health to decline. Outbreaks of this beetle pose a severe threat to even perfectly healthy trees in both forests and urban and suburban landscapes. The beetle has caused tens of thousands of trees to be destroyed in Illinois, Massachusetts, New Jersey, New York and Ohio. Trees that aren't destroyed by people trying to prevent the spread are usually killed by the pest within a couple years. About half of



³² <http://www.maine.gov/dacf/php/caps/ALB/ALBdamagepics.shtml>

Vermont's trees are susceptible to Asian longhorned beetle. This insect will have a major impact if it becomes established in Vermont.



Signs and Symptoms of Infestation: Oval to round wounds on the bark where the females have chewed out a site to deposit their eggs. Round emergence holes in the trunks and branches of trees. Piles of coarse sawdust at the base of trees.

The closest area to the Windham region that has the pest is Worcester County, Massachusetts in 2008. And they have an active quarantine and public notification campaign about the pest.³³ They are having to destroy every host tree, infected or not, and will be replanting in the oaks.

Boston had a small outbreak which they believe was caught in time. New York and Ohio also have quarantines in affect

in their boundaries to prevent the spread. ALB has not been detected in upstate NY or in NH. It is difficult to spot infected trees from the ground, so inspectors need to climb trees. To treat wood for transport it needs to be heated to at least 160 degrees for longer than 75 minutes.

Impact

The impacts of invasive species have ripple effects that go on and on. Hemlock is a foundation tree species, and when it goes away invasive plant species tend to take over, causing wildlife habitat and water quality to decrease. Deer use hemlock stands to winter over in because of the cover a healthy tree provides, so there could be a detrimental impact to the deer population, and hunting, caused by the loss of hemlock. Hemlocks provide shade to waterways, so their loss could mean warmer streams and lower water quality, potentially impacting aquatic life. The hemlock isn't a comparatively very valuable wood product, but it is used for logging and wood products, so there are economic threats to its loss. The large deer population is causing the loss of new trees to regenerate the forest hardwoods, thereby leaving vulnerability for invasives to come in.

Ash logs are more valuable than hemlock logs, but the bigger concern with the loss of ash is the cascading ecological impacts. There are over 40 arthropod obligate species that are threatened by the loss of ash trees (they depend on ash for their survival), and ripple effects of the loss of these arthropods and the interrelationships aren't even fully known at this point. Ash is a valuable tree for wood products and logging, so the economic impacts could be severe. Not to mention, the cost to towns for removing dead or dying trees, and the aesthetic and community open space impacts caused by their loss. Ash trees are about 12% of the forest cover in Vermont, and there are pockets of lots of ash in Londonderry. Londonderry has not done an ash tree survey to know where vulnerable trees are located. They have also not completed an EAB plan. Interested private citizens can obtain purple traps for assistance with early detection of EAB on their property. Ash is pretty widespread in the highway right of ways townwide. The concern in Londonderry is impacts of hazard trees to roads and power lines.

The loss of maple trees to ALB, could mean a devastation to the maple industry, which is a big industry in Vermont, including in Londonderry. A lot of people sugar, not all commercially, but it is a big activity in town. Economic impacts could be great. Sap can't be used once a maple is treated with insecticide, and the lag time before it can be used again is unknown. Fall foliage

³³ <http://www.worcesterma.gov/city-manager/asian-longhorned-beetles>. Accessed 3/2/15.

tourism is a big draw for visitors to Vermont and this would be big loss of “leaf peepers” who are a big driver of the economy for the area.

Probability

As mentioned earlier in this section, emerald ash borer and hemlock wooly adelgid are currently known to be present in Londonderry. Asian longhorned beetle has been found within fifty miles of Vermont’s border. EAB and HWA has been confirmed in Londonderry and 13-14 other towns in the Windham region. Additionally, certain invasive plant species are present in every town in the region.

Extent

Over half of the trees in Vermont are host species of one of these three main pests, so the potential impact is great. EAB only feeds on Ash trees, which are 7% of Vermont’s tree species and a strong component of beech/birch/maple forest stands. Southeastern Vermont has primarily white ash and green ash, while black ash is less common here, they are found more so to the north. Green ash is common in urban environments because they are good shade trees and do well in an urban setting.

Ash on roadside rights of way have the highest potential for infestation of EAB. There is the potential for hundreds of dead Ash trees along roadways throughout the state and near extinction of Ash trees. The current mortality rate is 99.8% of trees (may be lower for white ash). Cutting dead trees is a very hazardous activity and the potential for a lot of dead trees along road ways is a concern for protecting public safety and infrastructure. Green Mountain Power expects EAB to severely impact their grid over time, so they are proactively removing vulnerable Ash trees near their power lines in confirmed affected areas. Areas that haven’t been confirmed must contract for tree removal for trees they are concerned with.

Being proactive is key for stopping, or at least curtailing, the spread when pests are detected. Inventories of roadside ash trees are a good thing for towns to do now. Training road crews to identify threats and who to alert of outbreaks is also a good idea. The EMD has done an ash tree inventory town wide in right of ways. There are removal plans in place but they have not been acted on yet.

There are EAB insecticides that are registered for use in VT and they are fairly effective at protecting trees, but they have to be applied to each tree individually so this isn’t practical to protect all ash trees in a forest environment, but is a good option for an urban tree canopy. Additionally, trees have to be retreated every one to two years because of the insect’s life cycle. ALB eradication is to cut and chip all the trees that are infested. There is another insecticide that works for ALB, but it is only effective if the tree is treated before the larvae burrow too deeply into the wood beyond the tree’s vascular system. The ALB larvae spend a lot of time in the interior wood, out of the vessel system of the tree so they aren’t exposed to the insecticide.

The worst example of the potential impact of ALB infestation in the U.S. is Worcester County, Massachusetts. This problem has been going on since 2008, although upon detection it was well established, as much as 15 years went by before it was discovered. The Massachusetts ALB Cooperative has confirmed a regulated area of 110 square miles, which has been expanded over time from the original 17 square miles considered infested. This area is under strict regulation by order of the Commonwealth of Massachusetts, no one can cut, move, harvest, carry, transport or ship firewood, green lumber and other material within or outside of the affected area unless authorized. These are significant restrictions, so the impact of ALB detection should be taken very seriously as it affects numerous hardwood species.

ALB can be eradicated when discovered early. It is usually found in industrial settings, because it usually arrives in pallets from an Asian shipment. ALB is now being moved around through human activities, especially through the movement of firewood. It is easier to detect ALB than EAB because the ALB is larger.

Invasive plants are also a threat to the ecology and economy of Londonderry. Invasive plants are present in Londonderry. Long-standing and spreading forest threats in the Windham Region are glossy buckthorn, purple loosestrife, Japanese barberry, Morrow's honeysuckle, multi-flora rose, Japanese knotweed, cow parsley, and garlic mustard, and Asiatic bittersweet. There are more and more invasive plants moving up along roadways and waterways from lowland areas. All threaten forest regeneration, and multi-flora rose and Asiatic bittersweet can destroy mature trees. Smaller invasive plants such as garlic mustard, purple loosestrife, and goutweed present a threat to native herbaceous plants. The health threat posed by Japanese barberry should be noted: According to Jeffrey Ward, Chief Scientist at the Connecticut Agricultural Experiment Station, a forest infested with Japanese barberry harbors an average of 120 black-legged ticks per acre while a forest without barberry harbors an average of only 10 black-legged ticks per acre. Black-legged ticks are known to transmit the causal agents of several diseases, including Lyme disease. TS Irene spread a lot of invasive plants around the region through the transport of seed material from various sources, including flood waters. Logging, and particularly clear cutting, create areas that are particularly susceptible to invasives. Logging is a frequent occurrence in Londonderry as approximately 8,401.64 acres in Londonderry are in the Current Use program, this includes about 83 parcels. Current use qualification requires 25-acres minimum to be enrolled in the forestry program. Many parcels are in the range of a hundred acres or more. Forestry is the dominant enrollment in Londonderry (which allows for up to 20% to be open land in the property). Logging is recognized as an important industry in Londonderry and statewide.

VTinvasives.org is a great resource for towns interested in engaging in activities around invasives, including using their template to develop a custom invasive species plan for your town.³⁴ The idea is to continue to create as much awareness as you can so residents know who to call when they see things. The sooner an outbreak is found, the better the chances of containment. Bio-controls are being worked out currently but aren't yet a solution. Insect pests are often found first by concerned citizens, arborists and foresters.

Sources Used

Review and input from Kevin Beattie (forester in Londonderry) and Irwin Kuperberg, Londonderry Conservation Commission Chair; Invasive plant lists from Peter Bergstrom of the Rockingham Conservation Commission, send 8/21/2021; Email with VT State Forester Jim Esden on 2/21/20 (802-885-8822 or jim.esden@vermont.gov); Email with Windham County Forester Sam Schneski on 2/21/20 (sam.schneski@vermont.gov); Interview with Windham County forester Bill Guenther on 3/2/15 (802-257-7967 or bill.guenther@vermont.gov); Interview with First Detector Jordan Fletcher on 4/29/15; VT Fish and Wildlife website; VTinvasives.org; Cerceris.info webpage; Maine Forest Service webpage³⁵; Images courtesy of Google images and Maine Forest Service

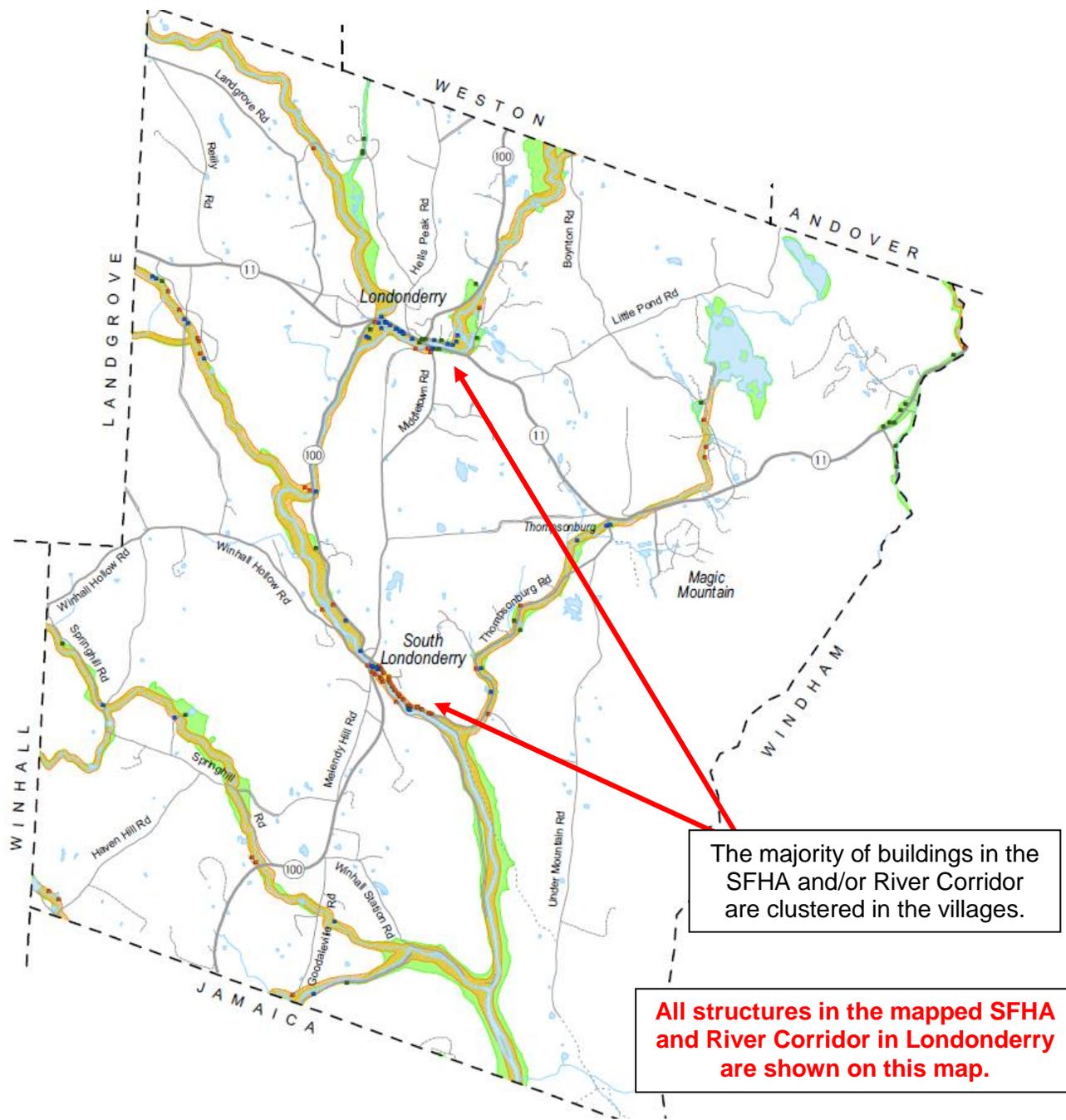
³⁴ < <http://www.vtinvasives.org/tree-pests/community-preparedness> >

³⁵ http://www.maine.gov/dacf/mfs/forest_health/invasive_threats/index.htm

ASSESSING VULNERABILITY

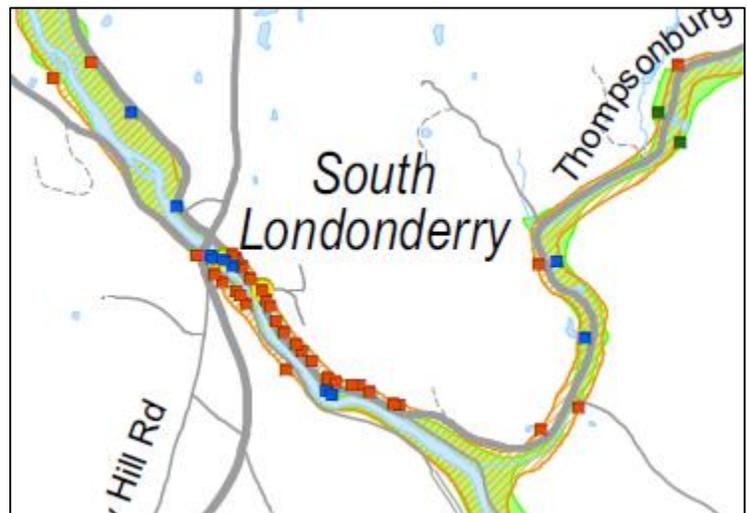
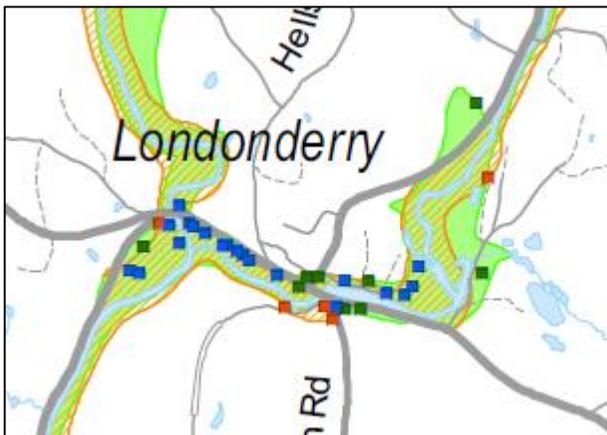
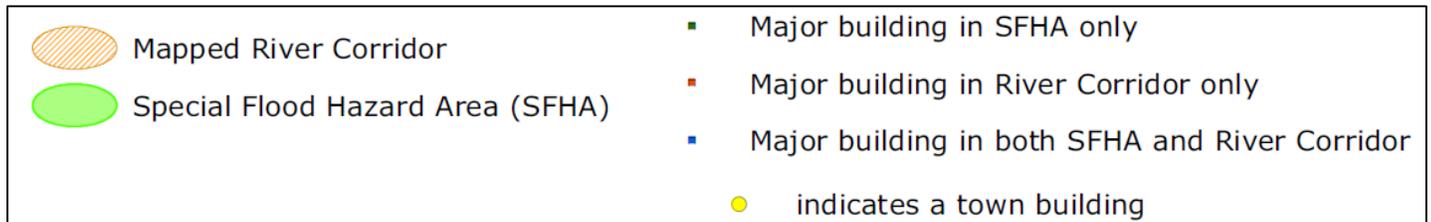
Structures in the SFHA and River Corridor

There are 71 buildings within FEMA-designated Special Flood Hazard Areas (SFHAs).³⁶ Of these, 43 of these are also in the River Corridor, while 28 are only in the SFHA. There are 98 structures in the River Corridor. 43 of these are also in the SFHA, while 55 are only in the River Corridor. The following maps show the location of these structures.



³⁶ GIS mapping analysis performed by WRC, 9/27/2021.

Most of the vulnerable structures are located in the two villages of North and South Londonderry. The inset maps below show that the majority of affected structures in North Londonderry are in both the SFHA and the River Corridor or just the SFHA, while in South Londonderry village the majority of affected structures are in the River Corridor only.



Properties within the SFHA, that have a mortgage, are required to purchase flood insurance. For non-mortgaged properties, coverage is optional. Londonderry's participation in the National Flood Insurance Program (NFIP) gives residents access to discount flood insurance through the National Flood Insurance Program. Flood insurance can still be purchased privately, however, it is more expensive. Development in SFHAs must meet additional construction standards as outlined in Londonderry's floodplain regulations, which is part of their zoning ordinance and was most recently adopted in 2009.

Repetitive Loss Structures

According to information gathered from the State Hazard Mitigation office, there are two NFIP repetitive loss properties in Londonderry – losses in 2011 and 2019. They are both nonresidential businesses.³⁷ A Repetitive loss structure is an NFIP-insured structure that has had at least 2 paid flood losses of more than \$1,000 each in any 10-year period since 1978.³⁸ Severe repetitive loss (SRL) structures are NFIP-insured buildings that, on the basis of paid flood losses since 1978, meet either of the loss criteria described in the SRL section. SRL properties with policy effective dates of January 1, 2007 and later will be afforded coverage (new business or renewal) only through the NFIP Servicing Agent's Special Direct Facility (SDF) so that they can be considered for possible mitigation activities. An SRL property is defined as a residential property that is covered under an NFIP flood insurance policy and:

- That has at least four NFIP claim payments (including building and contents) over \$5,000 each, and the cumulative amount of such claims payments exceeds \$20,000; or
- For which at least two separate claims payments (building payments only) have been made with the cumulative amount of the building portion of such claims exceeding the market value of the building.
- For both (a) and (b) above, at least two of the referenced claims must have occurred within any ten-year period, and must be greater than 10 days apart.

Participation in and Compliance with the National Flood Insurance Program (NFIP)

The National Flood Insurance Program (NFIP) is a voluntary program organized by FEMA that includes participation from 20,000 communities nationwide and 247 Vermont towns and cities. Combined with floodplain mapping and floodplain management at the municipal level, the NFIP participation makes affordable flood insurance available to all homeowners, renters, and businesses, regardless of whether they are located in a floodplain.

The NFIP was instituted in 1968 to make flood insurance available in those communities agreeing to regulate future floodplain development. As a participant in the NFIP, a community must adopt regulations that: 1) require any new residential construction within the 100-year floodplain to have the lowest floor, including the basement, elevated above the 100-year flood elevation; 2) allow non-residential structures to be elevated or dry flood proofed (the flood proofing must be certified by a registered professional engineer or architect); 3) require anchoring of manufactured homes in flood prone areas. The community must also maintain a record of all lowest floor elevations or the elevations to which buildings in flood hazard areas have been flood proofed.

In return for adopting floodplain management regulations, the federal government makes flood insurance available to the citizens of the community. In 1973, the NFIP was amended to mandate the purchase of flood insurance as a condition of any federally regulated, supervised or insured loan on any construction or building within the 100-year floodplain. In 2012, Congress passed the Biggert-Waters Flood Insurance Reform Act to reduce subsidies for structures built before the NFIP was instituted (called pre-FIRM structures). Over 50 percent of Vermont's NFIP

³⁷ Email from Caroline Massa dated 5/2/2022.

³⁸ <https://www.fema.gov/national-flood-insurance-program/definitions>

policies are pre-FIRM, which means that flood insurance premiums for many will increase over the ensuing years.

While the NFIP floodplain management criteria are administered by states and communities through their floodplain management regulations, FEMA's role is to provide technical assistance and to monitor communities for compliance with the minimum NFIP criteria. Londonderry joined the NFIP on July 1, 1991 and is a member in good standing (CID 500132). The latest floodplain ordinance was adopted in December 2009 and is in the zoning ordinance. The latest Flood Insurance Rate Maps (FIRMs) and Flood Insurance Study (FIS) referred to in the development of this plan have an effective date of September 28, 2007 (portions of the town are undergoing map updates as of this Plan writing). The Zoning Administrator also serves as the Floodplain Administrator and reviews all development to determine if it is located in any floodplain boundaries. If so, the Administrator reviews the application to ensure that all relevant regulations are proposed to be adhered to and does any needed inspections before working with the Development Review Board or issuing a permit. ANR has 30-days to review all applications in floodplain boundaries and may offer comment to the town. ANR review opportunity is required before the town can issue a permit, and serves as a second technical review of applications which can assist the town in deciding whether to issue or deny a permit.

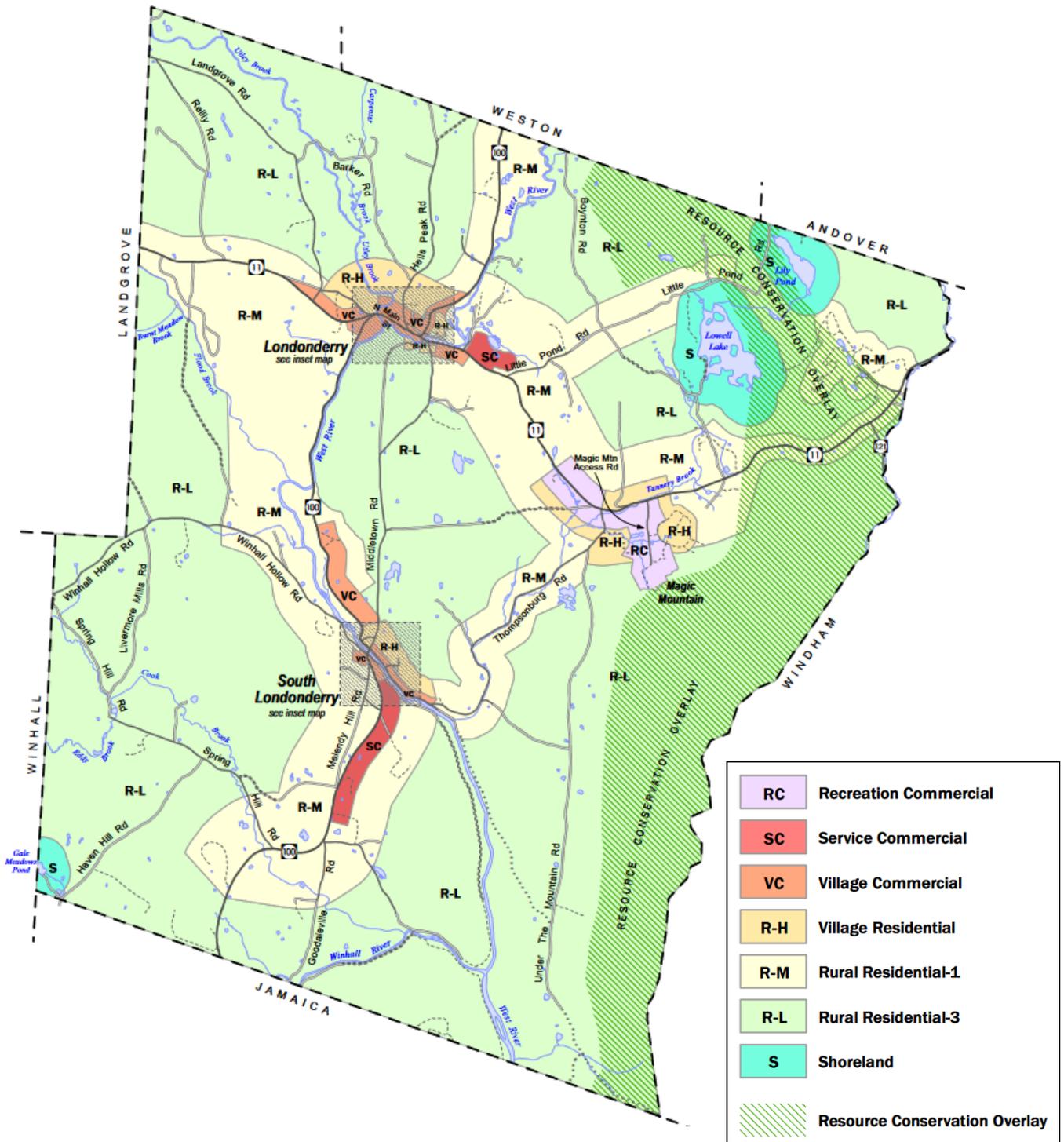
The latest record indicates that there are twenty-three (23) active NFIP policies in Londonderry. These policies have a total value of \$5,570,000. There have been 27 NFIP claims paid in Londonderry since 1978, totaling \$660,104.³⁹ Londonderry may want to do public outreach to encourage the purchase of flood insurance for people in the River Corridor and the FEMA 500-year floodplain (Zone X on the FIRMs). Flood insurance is reasonably priced in these areas, and covers damage from fluvial erosion, as well as inundation flooding. Nearly 20% of flood insurance claims nationally are for flood damage to buildings located outside the SFHA.

The Town works with the elected officials, Windham Regional Commission, the state and FEMA to correct any compliance issues and prevent further NFIP compliance issues through continuous communications, training and education. The NFIP is administered locally by the Zoning Administrator, who also fulfills the role of Floodplain Administrator.

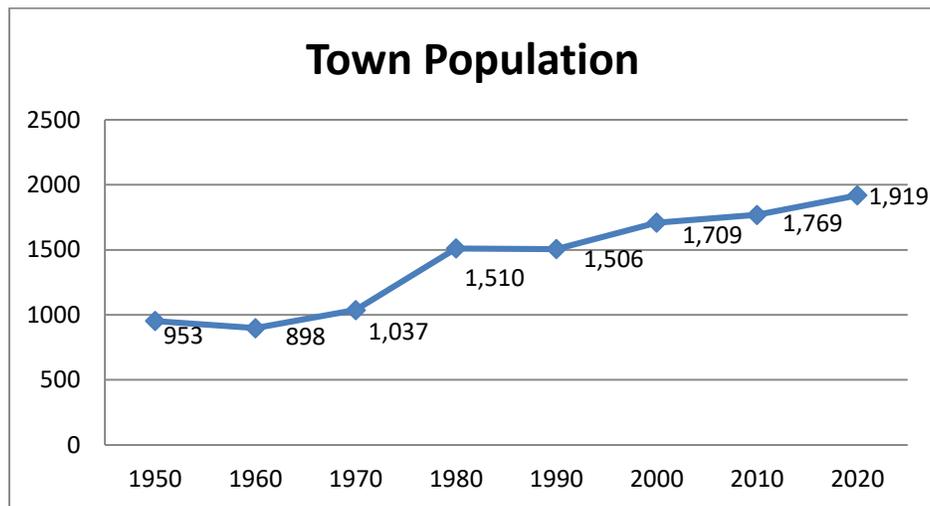
³⁹ FEMA NFIP Insurance Report, Nov 2014

<<http://floodready.vermont.gov/sites/floodready/files/NFIP%20Insurance%20community-report%209.26.14.pdf>>

Prospective Land Use Map from 2017 Londonderry Town Plan



Development Trends



Londonderry's population has been steadily and slowly growing over the past 70 years.

Development is minimal in Londonderry. The impact of the Covid-19 pandemic has brought in a lot of new residents, but not a lot of new development. There hasn't been any large scale new development, just a few new homes each year. The Zoning Administrator processes 50 permit applications per year on average, ranging in size⁴⁰.

Londonderry's active Conservation Commission takes the lead managing the seven Town properties, including the newest 100-acre parcel. The intent of these properties is to contribute to resource and water source protection. One of the seven properties is 23-acres substantially in the West River floodway and a management goal is to provide and maintain stable vegetative cover and access to the floodplain for the West River between the Villages of Londonderry and South Londonderry.

The buyouts along the West River damaged by TS Irene were completed. CDBG mitigation funding paid for the restoration of those properties. The intent of buying out these properties and removing the buildings was to remove vulnerable structures and restore protected floodplain for the West River to access.

MITIGATION STRATEGY

Local Hazard Mitigation Goals for this Plan

The below Hazard Mitigation Goals, which were contained in the prior Londonderry Local Hazard Mitigation Plan, were reviewed by the planning participants as part of the Plan update process. The participants unanimously felt that the overall goals outlined here remain the town's overall hazard mitigation goals. The fourth bullet was slightly updated with the name of the Local Emergency Management Plan replacing the prior name for this plan, and removing "Capital Improvement Plan", which Londonderry does not have. The updates are highlighted below:

⁴⁰ Per email from Will Goodwin, dated 3/16/2022.

- Reduce the loss of life and injury resulting from all hazards.
- Reduce the impact of hazards on the town's water bodies, natural resources, and historic resources.
- Reduce the economic impacts from hazard events.
 - Minimize disruption to the road network and maintain access
 - Mitigate financial losses incurred by municipal, residential, industrial, agricultural and commercial establishments due to disasters.
 - Ensure that community infrastructure is not significantly damaged by a hazard event.
- Encourage hazard mitigation planning to be incorporated into other community planning projects, such as the Town Plan and the **Local Emergency Management Plan**.
- Ensure that members of the general public continue to be part of the hazard mitigation planning process.

Town Plan Policies and Recommendations that Support Mitigation

The 2017 Londonderry Town Plan presents an indirect focus on mitigation, which is highlighted by the number of policies and action items that relate to mitigation. I will mention them here, but not include the entire section that they are a part of:

Land Use

Policy 1.12 Require all land development – excluding outdoor recreation, forest management, and agriculture – to be sited so as to avoid and protect critical resource areas, including wetlands, floodplains, and significant ridgelines including Glebe Mountain.

Economy

Policy 1.6 Maintain high environmental standards for existing and new commercial, governmental, and residential development.

Natural Resources

3.5 Require that water resources be maintained in a natural state.

3.6 Maintain appropriate undisturbed buffers of vegetation along watercourses, lakes, ponds, wetlands, and vernal pools in order to protect shorelines, provide shading to prevent undue increase in stream temperatures, minimize effects of erosion, sedimentation and other sources of pollution, and maintain scenic, recreational, and habitat values.

3.8 Require that any construction project that disturbs five or more acres of soil submit an erosion and sediment control plan.

3.9 Prohibit development, including road and driveway construction, on slopes with gradients greater than 25%.

3.11 Encourage strategies to protect water resources such as conservation easements, purchase of development rights, and land trusts.

Actions

3.1 Develop standards for appropriate buffer zones between rivers, streams, and other surface waters and new development, including roads, driveways, and public and private trails.

7.2 Cooperate with neighboring towns to maintain large tracts of undeveloped land.

Community Resources

Policies

4.2 Encourage the improvement of existing roads and design culverts and bridges to carry a 25-year flood event without damage, to maintain compliance with state standards.

4.3 Encourage the development and improvement of emergency evacuation and sheltering plans, including the protection of pets and livestock.

4.4 Require that the Town participate in the National Flood Insurance Program.

Actions

4.1 Work to identify at-risk populations.

4.2 Work with State and local emergency preparedness organizations.

4.3 Plan for protection of the Town's historic assets from disasters.

4.4 Evaluate flood hazard areas at least every two years.

4.5 Maintain Local Emergency Operations Plans (LEOP) and Hazard Mitigation Plans (HMP).

4.6 Seek funding for mitigating historic flooding problems in the Town.

Flood Resilience

Policies

1.1 Flood emergency preparedness and response planning are encouraged.

1.2 It is the policy of the Town to protect floodplains, river corridors, land adjacent to streams, wetlands, and upland forests through adoption and administration of flood hazard area regulations governing development in designated Special Flood Hazard Areas and River Corridors, in order to reduce the risk of flood damage to infrastructure, improved property, people, and the environment.

1.3 Prohibit development in floodplain areas, except for forestry, agriculture, recreation, and open space.

1.4 Require that any floodplain development conform to Vermont Department of Environmental Conservation (24V.S.A.) and the National Flood Insurance Program (44 C.F.R.) regulations.

Actions

1.1 Train Town Officials in ICS 100 and 402.

1.2 Consider acquisition/buyout of structures that are substantially damaged along the West River.

1.3 Host Community Education and Outreach Program on how to construct a residential safe room with guides on the Town website.

1.4 Acquire EMD Certification Level 1.

1.5 The Town will regulate any new development in identified flood hazard areas, fluvial erosion hazard areas, and/or River Corridors to ensure that development does not exacerbate flooding and fluvial erosion, and extend these provisions to development activities that might increase the amount and/or rate of runoff and soil erosion from upland areas.

1.6 The Town will further pursue a flood resilience management approach by implementing their Local Hazard Mitigation Plan and other strategies for restoring the stream geomorphic equilibrium conditions and enhancing the emergency preparedness that will mitigate the risks to public safety, critical infrastructure, historic structures, and municipal investments.

Policies

2.1 It is the policy of the Town to foster the protection and restoration of river corridors, floodplains, wetlands, and upland forested areas that attenuate and moderate flooding and fluvial erosion.

2.2 New development in identified flood hazard, fluvial erosion, and river corridor protection areas should be avoided. If new development is to be built in such areas, it should not exacerbate flooding and fluvial erosion.

2.3 The protection and restoration of geomorphic equilibrium, floodplains, and upland forested areas that attenuate and moderate flooding and fluvial erosion should be encouraged.

Actions

2.1 Expand Cobble Ridge Road Bridge.

2.2 Stabilize Goodaleville Road embankment (completed 2016 – 17).

2.3 Upgrade Lowell Lake Road (completed 2016) and Derry Woods Road culverts (to be completed 2017).

2.4 The Town will be familiar with Flood Insurance Rate Maps (FIRMs) that delineate areas that could be inundated by water during flooding. (Select Board, Development Review Board, Zoning Administrator)

2.5 The Town will be familiar with ANR River Corridor maps that delineate the land area adjacent to streams and rivers that are required to accommodate a stable channel. (Select Board, Development Review Board, Zoning Administrator)

2.6 The Town will pursue a flood resilience management approach whose essential components are to identify and map flood and fluvial erosion hazard areas based on studies and maps provided by the Vermont ANR Rivers Program, and designate those areas for protection to reduce the risk of flood damage to infrastructure and private property.

2.7 The Town will update the Flood Hazard Areas Regulations to include regulation of river corridors, and include provisions for advance notification of and specific limits on new development activities in identified flood hazard areas, fluvial erosion areas, and/or River Corridors, based on regulatory templates developed by the ANR DEC Rivers Program.

Past and Ongoing Mitigation and Maintenance Efforts

Below is an update on prior identified hazard mitigation projects that were listed in the 2014 Londonderry LHMP. The planning participants reviewed these actions in the summer of 2021 and provided the current status on each item. Current status is listed here in the last column, and prioritization changes are called out where applicable. Overall prioritization changes between plans had to do with actions that have been completed and the remaining needs in the Town after the immediate projects following Tropical Storm Irene. During the past several years, the Town has focused on better understanding the flood hazards in their community and plan for how best to mitigate them. This is an ongoing effort.

	MITIGATION ACTION	RESPONSIBLE PARTY	TIMEFRAME	FUNDING SOURCE	PROJECT PRIORITY	CURRENT STATUS AS OF SUMMER 2021
1	Tree Inventory to determine trees that will affect power lines	Road Foreman	Annually – substantial tree take down in 2012	Highway Dept. Budget	High	Completed annually
2	Checking Culverts and under bridges debris jams	Road Foreman	After every significant wind storm	Highway Department Budget	High	Ongoing
3	***Provide a back-up 3-phase generator for shelter	Selectboard	0-36 mos.	HMGP	High	Completed
4	Acquisition/Buyouts of 5 structures that are substantially damaged along the West River	Town Selectmen	0-24 mos.	HMGP grant	High	Completed
5	Checking Culverts and under bridges for ice and debris jams	Road Foreman	Every winter	Highway Department Budget	High	Ongoing
6	Provide backup power supply for Town Offices – establish Town Office as the EOC	Selectmen, EMD	0-60 mos.	HMGP	High	Completed
7	Training of Town Officials in ICS 100 & 402	Selectmen	1 year	Volunteer time / Training provided by HSU	High	Completed and offered to new town officials
9	Cobble Ridge Road Bridge expansion	Town Selectmen / Road Foreman	0-24 mos.	FEMA Public Assistance	Medium High	Remains a priority action, but no funding yet – hopefully ARPA
10	Goodaleville Road embankment stabilization	Road Foreman	0-12 mos.	VTrans grant/DOT	Medium	Completed

	MITIGATION ACTION	RESPONSIBLE PARTY	TIMEFRAME	FUNDING SOURCE	PROJECT PRIORITY	CURRENT STATUS AS OF SUMMER 2021
11	***Lowell Lake Road Culvert upgrade	Road Foreman	0-12 mos.	VTrans	Medium	Completed
12	***Derry Woods Road Culvert upgrade	Road Foreman	0-12 mos.	VTrans	Medium	Completed
13	Establishment of an Emergency Shelter at Flood Brook Elementary School - with generator	Selectmen / EMD	0-12 mos.	HMGP Generator grant	Medium	Completed
14	Community Education and Outreach Program on how to construct a residential safe room. Guides on Town website.	Town Selectmen, EMD	0-24 mos.	Awaiting Funding	Medium High	This action has been reworked to include adding an Emergency section to the town website. This is listed in the new Mitigation Actions table.
15	EMD Certification Level 1	EMD	1 year	Provided by HSU	Medium	Not completed and the EMD has deemed this is not necessary.
16	Bury power / utility lines into town critical facilities (schools, town office)	Selectmen	0-60 mos.	Town Budget	Low	Not completed. No longer deemed necessary because the Town office, Town garage and Floodbrook School all now have generators.

There are certain ongoing efforts in the town that serve to either mitigate for hazards, assist with readiness of town to deal with a hazard, or both. Those efforts are listed here:

1. Leaf removal, tree trimming and culvert/ditch cleaning are maintenance activities done every spring by the road crew. If ditches are being eroded, the crew may also stone line them.
2. The town manages a local Emergency Operations Center (EOC) during disasters. The Town has also utilized a virtual joint EOC with the surrounding towns of Weston, Peru and Landgrove. This was so successful that they will continue this in the future, as needed.
3. The town maintains one emergency shelter at the Flood Brook Elementary School, and it is capable of being an overnight shelter.
4. Londonderry is a member in good standing of the National Flood Insurance Program. The floodplain ordinance is kept compliant and the town maintains SFHA maps at the town office.
5. A yearly fire protection reminder is sent with funding request from both fire departments to residents.
6. The Rescue Squad does regular trainings and drills.
7. Floodbrook School does drills regularly involving the fire departments and the Londonderry Rescue Squad.

8. GMP has a major line upgrade project of a cross country single wire line from a substation in Londonderry going into Weston that has been stalled for years. There is movement on this project in 2022 and plans for it to go forward.

The below actions are listed in the 2017 Londonderry Town Plan as needed transportation improvements:

Road and Bridge Projects

Priority	Site Location	Description	Cost
Critical – High	Derry Woods: Culvert	The existing culvert is 24' long. There are 2 – 3 swamps up stream that contribute to the water flow through this culvert. The road is low enough to be breached when necessary. There's a lot of beaver activity.	\$120,000.00
Critical – Moderate	Goodaleville Road: Ditch Stabilization	North side of the road, bank is slumping and the ditch is not well defined. The ditch ends into the Winhall River at the new bridge.	\$6,215.00
Critical – Moderate	Spring Hill Road: Bank Stabilization	Two separate stream banks need to be stabilized.	\$20,500.00
Critical – Low	Thompsonburg Road: Bridge	Bridge is in OK shape. There is some cracking on the abutments and the guardrails need to be replaced.	\$96,250.00
Critical – Low	Cobble Ridge Road: Bridge	This bridge was replaced, to an extent, after it was washed out by Irene.	\$500,000.00
Total Costs			\$742,500.00

Progress update on the above actions:

- Derry Woods culvert- complete
- Goodaleville Road ditch stabilization – complete
- Spring Hill Road stream bank stabilization – not yet completed and the Town Administrator was unable to recall why this was listed in the Town Plan
- Thompsonburg Road bridge repair and guardrail replacement – completed in 2016
- Cobble Ridge Road bridge – still needed and listed in the mitigation actions of this Plan

Identification of Mitigation Actions

The Londonderry Hazard Mitigation Planning participants identified the following hazard mitigation activities based on an evaluation of hazard event vulnerability not addressed by existing hazard mitigation initiatives and the feasibility of new activities.

Mitigation actions are listed in priority order by hazard. Actions were prioritized by the plan participants. These are new actions so any shifts in prioritization of actions came out through the multi-year plan development process. The following criteria were used in establishing project priorities. The ranking of these criteria is largely based on the best available information and best judgment as many projects are not fully scoped out at this time. Prioritization was done during the meetings for the plan development in discussions among participants and guided by WRC's Emergency Planner. Actions relating to future development were considered, but the plan participants did not find them to be feasible at this time due to lack of political will/community support.

- Does the action reduce damage?
- Does the action contribute to community objectives?
- Does the action meet existing regulations?
- Does the action protect historic structures or structures critical to town operations?
- Can the action be implemented quickly?
- Is the action socially acceptable?
- Is the action technically feasible?
- Is the action administratively possible?
- Is the action politically acceptable?
- Is the action legal?
- Does the action offer reasonable benefits compared to its cost of implementation?
- Is the action environmentally sound?

This table was shared to assist in consideration of action types:

Mitigation Action	Description of Category	Examples of Mitigation Actions
<p style="text-align: center;">1</p> <p>Local Plans and Regulations</p>	<p>These actions include government authorities, policies, or codes that influence the way land and buildings are developed and built.</p>	<ul style="list-style-type: none"> • Comprehensive plans • Land use ordinances • Building codes and enforcement • Capital improvement programs • Open space preservation • Stormwater management regulations and master plans
<p style="text-align: center;">2</p> <p>Structure and Infrastructure Projects</p>	<p>These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure.</p> <p>This type of action also involves projects to construct manmade structures to reduce the impact of hazards.</p>	<ul style="list-style-type: none"> • Acquisitions and elevations of structures in flood prone areas • Utility undergrounding • Structural retrofits. • Floodwalls and retaining walls • Detention and retention structures • Culverts • Safe rooms
<p style="text-align: center;">3</p> <p>Natural Systems Protection</p>	<p>These are actions that minimize damage and losses and also preserve or restore the functions of natural systems.</p>	<ul style="list-style-type: none"> • Sediment and erosion control • Stream corridor restoration • Forest management • Conservation easements
<p style="text-align: center;">4</p> <p>Education and Awareness Programs</p>	<p>These are actions to inform and educate citizens, elected officials, and property owners about hazards and potential ways to mitigate them. A greater understanding and awareness of hazards and risk among local officials, stakeholders, and the public is more likely to lead to direct actions.</p>	<ul style="list-style-type: none"> • Radio or television spots • Websites with maps and information • Real estate disclosure • Mailings to residents in hazard-prone areas. • StormReady • Firewise Communities

Cost-Benefit Analysis

As part of public involvement discussions, there was a rough cost/benefit analysis done for each action listed in the table and those results are shown in the table. The below cost and benefits tables address the priorities for the mitigation strategies that are stated in the Mitigation Actions Table. This was how the mitigation actions were assessed by the Hazard Mitigation Planning participants. Priority was assessed somewhat independently of cost/benefit and was based more on the perceived need of each action and availability of funding, versus what the action costs and benefits.

At the time of applying for FEMA's PDM-C, FMA or HMGP grant programs, each project listed below will undergo full benefit-cost analysis (BCA) methodology, version 5.1 or higher to maximize savings. Whenever possible, Wilmington will utilize 406 mitigation funding.

Cost Estimates

High	= >\$100,000
Medium	= \$25,000 – 100,000
Low	= < \$25,000

Benefit Estimates

High	Public Safety
Medium	Infrastructure/ Functionality
Low	Aesthetics/ General Maintenance

Mitigation Actions Identified by the Hazard Mitigation Planning participants

	HAZARD(S) ADDRESSED	ISSUE DETAIL	ACTION	RESPONSIBLE ENTITY	Start/Complete TIMELINE	POTENTIAL FUNDING	MITIGATION / PREPAREDNESS	PRIORITY	Notes / Status
1	Flooding	Regular maintenance activity that serves to mitigate issues during events.	Checking Culverts and under bridges debris jams	Road Foreman	After every significant wind storm	Highway Department Budget	Preparedness	High	Ongoing
2	Ice jam flooding	Regular maintenance activity that serves to mitigate issues during events.	Checking Culverts and under bridges for ice and debris jams	Road Foreman	Every winter	Highway Department Budget	Preparedness	High	Ongoing
3	Flooding	Cobble Ridge Road Bridge (Bridge 31) is a wooden bridge on steel girders that is paved over to help the wood last. This bridge hasn't been a high priority in the past due to it being a side road, even though it is a big problem when it goes out, cutting off the road. This bridge is critical to a number of homes with no other public access. After TS Irene cut off the bridge, a private road needed to be graveled to create access and un-graveled afterwards. The bridge has not gone out since TS Irene, but it is a bottleneck even during smaller storms. It is over the West River.	Upgrade of Cobble Ridge Road Bridge 31 with a larger bridge.	Road Foreman / Selectboard	The construction phase won't begin in this plan cycle, but there are steps the town will be taking to get ready during this plan cycle (steps 1-3 listed in notes)	potentially ARPA funds	Mitigation	High	Vtrans hydraulic study said the bridge should be 66' wide but is 44'. Since Irene this has been an issue. Have listed it on RPC priority list for several years, no funding yet. Right of way access would be needed. This is a \$1 million project. Process: (1) find funding for this project, (2) get Vtrans to update the hydraulic study and get the project engineered, (3) right of way acquisition, (4) construction can begin.

	HAZARD(S) ADDRESSED	ISSUE DETAIL	ACTION	RESPONSIBLE ENTITY	Start/Complete TIMELINE	POTENTIAL FUNDING	MITIGATION / PREPAREDNESS	PRIORITY	Notes / Status
4	Flooding / Fluvial Erosion	As certain buildings come up for sale in vulnerable locations they are not selling easily due to known flood risk.	Continuing to raise awareness for residents and businesses to consider buyouts, even on a non-emergency basis.	EMD / Planning Commission	Initiative to begin 2022 and as needed	HMGP / ARPA / PDM / FRCF	Mitigation	High	This effort consists of sharing materials on an individual basis with owners of vulnerable properties, and when particular buyout incentives are available.
5	Flooding / Fluvial Erosion	Shared bridge 10 is deteriorating and the condition needs to be assessed.	Route 121 bridge (belongs to both the Town of Windham and the Town of Londonderry) repaired to current standards.	Road Foreman / Selectboard in both Londonderry and Windham	Start discussion with Windham in 2022; complete by 2024	Town funding and Vtrans grants	Mitigation	High	There is agreement with Windham for this bridge.
6	Flooding / Fluvial Erosion	All the drop inlets (3) in South Londonderry are deteriorated old and undersized culverts.	Replace the 3 drop inlets with new upsized culverts.	Road Foreman	2023-2024	Town funding and Vtrans grants	Mitigation	High	When the river comes up high enough these culverts are completely underwater. This fix is more important for smaller events. These culverts drain Main Street.
7	Flooding / Fluvial Erosion	The header of the culvert is rusting out and there is movement with truck traffic. This is a metal culvert that doesn't meet current standards.	Upgrade culvert #12 on Spring Hill Road to a bridge	Road Foreman	2023 or 2024, depending on funding	Vtrans structures grant / ARPA	Mitigation	High	The town is seeking funding now, and will put out RFP once funding is final.
8	Flooding / Fluvial Erosion	Because of the floodplain in the Main Street area, the hope is to have people understand what that means and how to deal with living with a flood hazard and the impacts.	Complete the Main Street Study and Master Plan	Planning Commission with Contractor support	2021 start - finish July 2022	ACCD Municipal Planning Grant	Mitigation	High	This is wrapping up now; plan finalization based on SB choices in April

	HAZARD(S) ADDRESSED	ISSUE DETAIL	ACTION	RESPONSIBLE ENTITY	Start/Complete TIMELINE	POTENTIAL FUNDING	MITIGATION / PREPAREDNESS	PRIORITY	Notes / Status
9	Flooding / Fluvial Erosion	There is an undersized and perched double culvert near the schoolhouse that takes water coming off of Magic Mountain.	Replace this double culvert with a concrete box culvert.	Road Foreman	2022-2024 subject to funding	VTrans grant	Mitigation	Medium	
10	Flooding / Fluvial Erosion	Bridge on Boynton Road was not damaged by TS Irene, but it was damaged to the point of failure by large trucks doing repairs after TS Irene. It was replaced after Irene. This was one of the only ways into and out of town during Irene because of other road outages. Vital secondary access.	Upgrade this bridge with a wider cement bridge.	Road Foreman		VTrans grant	Mitigation	Medium	This is a vital town road when other roads are out, particularly Routes 11 and 100. This is currently a wood plank bridge that is not capable of handling large truck traffic. This is also a high traffic bridge when needed. No one is cut off if this bridge is out, just a loss of secondary access.
11	Flooding	Williams Dam is located in the center of the North Village. It is a community fixture but also presents flooding hazards and has been rated a significant hazard dam by the State Dam Safety Division. Currently the town is undecided what to do with repair or removal, or do nothing and the issue is contentious. Doing nothing is not an option.	Make a decision on the action to take on the Dam. The conditions report and alternatives analysis should be used to guide this decision.	Consultant / Selectboard / Town Administrator	Decision should be made in 2022	Dependent on decision made, CRC and ANR will cover engineering and removal costs; town responsible for costs if replace or repair is chosen	Mitigation	High	Alternatives evaluation completed in March 2022. The alternatives analysis was presented at TMD 2022 but the vote was to pass over the matter to another meeting.
12	Flooding	Williams Dam	Create dam failure emergency action plan and outreach to public.	EMD	Create in 2022	Town funds	Preparedness	Medium	EMD is hoping for inundation map leading to creating this evacuation plan/map.

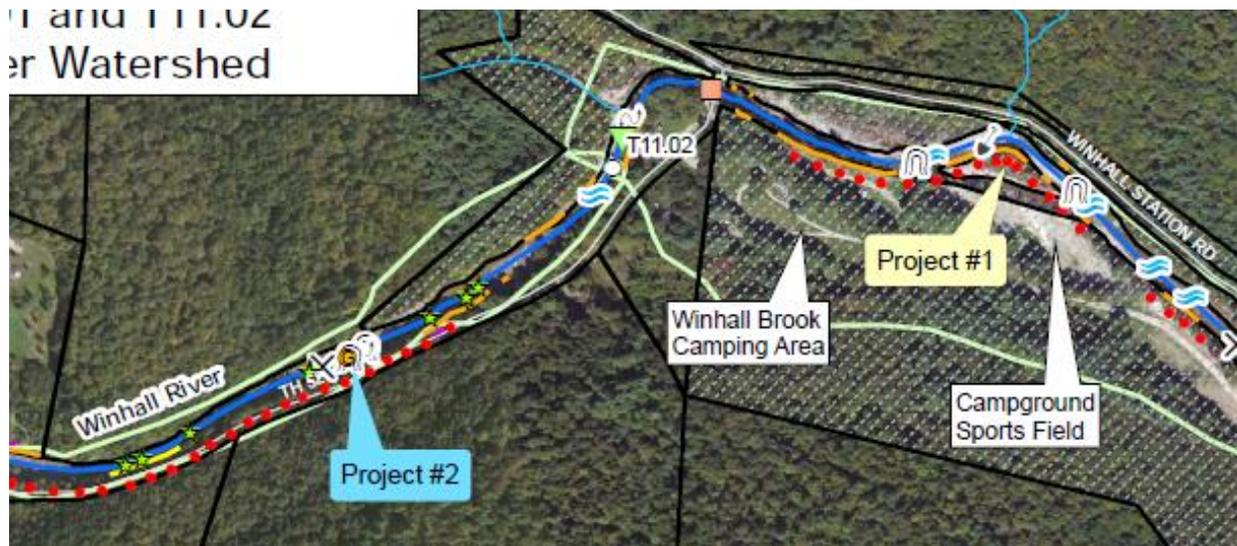
	HAZARD(S) ADDRESSED	ISSUE DETAIL	ACTION	RESPONSIBLE ENTITY	Start/Complete TIMELINE	POTENTIAL FUNDING	MITIGATION / PREPAREDNESS	PRIORITY	Notes / Status
13	Flooding	Williams Dam	Take action for chosen alternative: repair, replace or remove.	Town Administrator / Selectboard / Contractor	Begin , engineering in 2022; complete action in 2023	Removal \$425,000 (ANR and Conn Riv Cons will cover removal cost 100%), or rehab \$767,000-\$900,000 by town bond, or replacement \$1.3 million by town bond	Mitigation, Biggest mitigation benefit for removing the dam	High	The alternatives analysis was presented at TMD 2022. Future engineering study will be needed based on decision.
14	Flooding / Fluvial Erosion	There is an existing Community Resilience Organization (CRO) team in Londonderry that has been looking for an initiative to focus on.	Engage the Community Resilience Organization (CRO) in the Main Street study and revitalization effort	CRO Team and Planning Commission Chair	2021 start - finish July 2022	Town funds and volunteers	Mitigation	Medium	CRO has been helpful in the past on specific efforts, such as sheltering. CRO has been dormant and this could help them become active again.
15	Wind and Ice	At least annually there is outage in Londonderry lasting between a couple of days to a week. Outages in the winter months pose a safety risk. Most people are well equipped for short term outages, but longer term are very concerning. The town usually sets up shelters.	Community Education and Outreach Program on how to prepare for long term power outages, including proper use of a generator.	EMD / Selectboard	Hold every two years starting in 2023	Unknown	Mitigation / Preparedness	Medium	Significant wind events tend to be very localized.

	HAZARD(S) ADDRESSED	ISSUE DETAIL	ACTION	RESPONSIBLE ENTITY	Start/Complete TIMELINE	POTENTIAL FUNDING	MITIGATION / PREPAREDNESS	PRIORITY	Notes / Status
16	Wind	Main streets of each village center is subject to flooding and power outages. Businesses in this area need to remain open.	Bury power lines in the North Village Main Street.	Town Administrator / Selectboard / Planning Commission	2025	Grant funding and town funding	Mitigation	Low	Power substations are not in the villages so this action is questionable if it would work. The planning commission is having very preliminary conversations with GMP.
17	Invasive Species / High Winds	Deteriorating or falling trees can impact power lines and cause power outages. Presence of EAB is concerning for Ash trees near lines.	Tree Inventory to determine trees that will affect power lines	Road Foreman	Annually – substantial tree take down in 2012	Highway Dept. Budget	Preparedness	High	Completed annually
18	Invasive Species	The Conservation Commission did an inventory and came up with roughly 1500 ash trees in the right of ways. GMP has been taking down the trees that threaten their lines, so the town is waiting to see what's left before beginning.	Identify threatening ash trees and remove those trees.	Road Crew with contractor support as needed	10 year project with the most activity in the second 10 years	town funding (Ash borer fund) with the hope for grants; the town has started a reserve fund for this specifically	Mitigation	Medium / High	
19	Invasive Species	There is poison parsnip on the roadsides and Japanese knotweed along the West River. The Town also wants to raise awareness about tick bite prevention.	Include information about invasives and tick bite prevention on the website.	Conservation Commission	2023	Town funds and volunteers	Mitigation	Medium	

	HAZARD(S) ADDRESSED	ISSUE DETAIL	ACTION	RESPONSIBLE ENTITY	Start/Complete TIMELINE	POTENTIAL FUNDING	MITIGATION / PREPAREDNESS	PRIORITY	Notes / Status
20	All hazards	Basic training on ICS is important for ensuring that local officials can effectively participate during town response to emergency events.	ICS-100 & ICS-402 training for new town officials who may be needed to assist in town emergency response activities	Town Officials	As needed	Volunteer time / No cost training	Preparedness	High	Completed and offer to new officials
21	All hazards	Town website does not currently include any emergency information or advice for residents or visitors.	Add a page on the town website with emergency information.	Town Treasurer / Town Administrator / EMD	2022 or 2023, in conjunction with new website being developed	Town funds	Preparedness	High	The Town is planning to do a webpage update.

Actions Identified in the 2014 Winhall River Corridor Plan

The following actions have been identified in the *Winhall River Watershed Corridor Plan*. This *Corridor Plan* was completed in 2014 by the consultant Bear Creek Environmental and this is the only corridor plan that covers Londonderry currently. Hopefully there will be more coverage of the town with future corridor plans. The *Corridor Plan* identifies two projects in Londonderry that would improve the health and stability of the Winhall River. A map showing the project locations and the table of actions is shown here, both of which are in the *Corridor Plan*. The table and graphics shown below were taken directly from the *Corridor Plan*, and thus align with their organizational methodology. The 'Potential Partners/Programs' category speaks to responsible entity and potential funding sources. Londonderry will aim to implement these actions within the next five years.



**Table 1. Winhall River Main Stem
Map 1: T11.01 and T11.02
Site Level Opportunities for Restoration and Protection
Londonderry, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Benefits	Potential Partners/Programs
Project #1 T11.01	Passive Restoration	Buffer is lacking on the south side of the river due to the Winhall Brook Camping Area. There is a recreational field with no buffer at the site.	Streamside Plantings	Low Priority (campground sports field at site)	Improved habitat and water quality	US ACOE TFS
Project #2 T11.02-A	Active Restoration	A gully is present along the south side of the river that is delivering sediment from Cohen Road. There are several locations in this segment where overland flow from the road appears to enter the river.	Stabilize/ Remediate Gully; Improve Stormwater Infrastructure	Moderate Priority	Improved geomorphic stability, water quality, and habitat	WRC, VANR, CRWC, Town of Londonderry



Project #2 – Stabilize/ Remediate Gully; Improve Stormwater Infrastructure

Implementation of Mitigation Actions / Capabilities

Each town has both barriers and capabilities that will affect how they are able to carry out mitigation actions. These have been identified by planning participants as relevant to Londonderry:

Barriers to Implementation:

1. Londonderry does not currently regulate development in the River Corridor through its zoning, which limits control of this hazardous area.
2. Administrative costs for FEMA grants doesn't cover the reality of costs. The town Selectboard and voters are reluctant to take on new grants because of this.
3. Boards and Committees have trouble finding replacements or new members.
4. Two different populations in town between locals and the second homeowners and those moving in from out of the area. There is somewhat of a negative attitude at play and this is apparent on social media. There is friction between new comers and longtime residents.

Capabilities to build upon for implementation:

1. New families are moving into Londonderry and the population is growing.
2. 3 full-time road crew staff is ideal, currently hiring
3. 6 full-time town staff other than road crew
4. Active conservation commission
5. Town staff and volunteers are well trained with ICS and have done a number of drills. The EMD feels that the town can function well in emergencies.
6. Well-functioning fire departments and Rescue Squad. Good number of volunteers on the force (35 between both departments) and on the Rescue Squad (50) compared to many other small towns that struggle to get volunteers.
7. Grant writing staff in-house.
8. Selectboard with lots of local knowledge
9. Well-functioning EOC
10. Long-time EMD with much experience, training and knowledge on emergency response.
11. The Londonderry Fire Departments and the Rescue Squad are able to get volunteers.
12. Windham Regional Commission assistance when needed
13. Floodplain ordinance in place. Town could update floodplain ordinance to include River Corridors and/or more restrictive standards.
14. Development review board
15. Longtime residents are generally the hearty and self-sufficient type.

There are a lot of second homes being sold to full time young families. The town is shifting from a resort town to a family oriented town. There are a lot of new residents from out of state. The new residents seem to have funds and often work remotely.

Recognizing that there is no place that doesn't have barriers to overcome in project implementation, Londonderry should focus on engaging around emergency management at the town level. There are a limited number of committed volunteers and staff who make this town function well. They are invested and plan to remain in the area. The Town has a hard time recruiting new volunteers. Londonderry is not struggling financially, but there has not been much population growth. Londonderry is located along Routes 11 and 100, which are major travel corridors of the region, yet many residents live on back dirt roads that can be difficult to access during certain times of the year. This lends to a "do it yourself" mentality that serves Londonderry positively.

The town looks to and works closely with the Windham Regional Commission. They look to the Regional Plan policies for guidance on land use decisions which influence their town plan policies and goals. The town works closely with VT Department of Environmental Conservation Agency of Natural Resources and the Army Corps of Engineers when mitigating any work in streams or rivers. Additionally, the town adopts the latest VTrans Road Standards for road/culvert/bridge improvement projects. With the support of these agencies and the Commission, Londonderry is capable of carrying out all of the mitigation actions outlined in this plan.

Existing Planning Mechanisms / Integration

The following policies, programs and activities related to hazard mitigation are currently in place and/or being implemented in the Town of Londonderry. The Hazard Mitigation Planning participants analyzed these programs for their effectiveness and noted improvements needed. Londonderry uses all of the tools listed below to help plan for current and future activities with the town. For example: the Local Emergency Management Plan has a contact list that is used for response purposes in the case of a hazard event, and is updated every year after Town Meeting. Town Road and Bridge Standards are followed by the town and Londonderry completed their last culvert inventory in 2013, with partial updates of about 60% done since then. In the development of this plan, the latest 2017 Town Plan was used.

As Londonderry goes through the update process for the planning mechanisms outlined in the table below, they will look to the Hazard Mitigation Plan's Table of Actions and Risk and Vulnerability Assessments to help guide land use district decisions, and guide goals and policies for those districts. They have agreed to this. At the Town Meeting every March, policies and action items in the Town Plan will be reviewed and integrated into hazard mitigation activities as needed. The Local Emergency Management Plan contact list is updated after Town Meeting each year, including updates to vulnerable geographic locations, as well as locations of vulnerable populations. Updates to each of the planning mechanisms outlined in the table below are handled by the identified responsible party identified. There is no timeframe for updating the below referenced plans and regulations to better incorporate hazard mitigation, however, as each document is updated the hazard mitigation plan will be reviewed for incorporation. The goals of this hazard mitigation plan will be incorporated in the upcoming town plan update to ensure that emergency preparedness and mitigation planning efforts are included in the Town Plan, with particular attention to including the projects in the Mitigation Actions Table. This will assist with ensuring that this plan is utilized and project follow-through occurs.

This updated hazard mitigation plan will be considered and incorporated in the next Town Plan update, as appropriate. The LEMP is updated yearly and was updated last in 2021. Other mitigation/emergency planning related documents and their status are outlined in the below table:

Type of Existing Authority / Policy / Program / Action	Description	Effectiveness/Enforcement/Hazard that is addressed	Gaps in Existing Protection/Improvements Needed
Town Plan	Plan for coordinated town-wide planning for land use, municipal facilities, etc.	Flood Resilience is addressed	Current Town Plan incorporates flood resiliency. The Town Plan was last updated by the Planning Commission with assistance from the Windham Regional Commission in 2017.
Town Local Emergency Management Plan	Municipal procedures for emergency response	Incident Command; Hazard Annexes included	LEMP adopted by Town Select board in 2021 and updated yearly; next LEMP should include all of the appendices. LEMP is completed by EMD and Selectboard.
School Emergency Response Protocol	School procedures for emergency response	The school does have an emergency plan in place.	Ensure that the school works with Vermont Emergency Management, local police and local emergency management director to continue to keep the plan relevant. Plans don't include a lot on ICS and how fire departments and law enforcement fit into the plan. This was improved in recent years but should be revisited with new leadership.
Mutual Aid – Emergency Services	Agreement for regional coordinated emergency services. Contracts in place for all except fire.	Local police dispatch; fire dispatch is Keene Mutual Aid; the fire departments handle fire for Londonderry, Phoenix also covers Landgrove, and EMS through Londonderry Rescue is separate and covers 7 towns. State police provide backup	None identified
Mutual Aid – Public Works / Road Crew	This would address sharing of equipment or services between towns.	No formal agreements in place.	It would be beneficial for all towns to have formalized agreements in place before needs arise. Not having this creates unnecessary legwork during and following events.
Road Standards	Design and construction standards for roads and drainage systems	Adopted the latest VTrans Road Standards.	No gaps identified. Road Crew will continue to comply with the most recent Town Road and Bridge standards set by VTrans.
Zoning regulations	Regulates the division of land, standards for site access and utilities	Zoning in place, updated fairly often	Zoning was last updated in 2009. Next zoning update should include River Corridors.
Sewage Regulations	Regulates on-site sewage systems	State Regulations apply	None Identified

Type of Existing Authority / Policy / Program / Action	Description	Effectiveness/Enforcement/Hazard that is addressed	Gaps in Existing Protection/Improvements Needed
Flood Hazard Area Regulations	Regulates development in FEMA identified SFHAs	In zoning bylaw; regulates only to BFE, no freeboard; does not include River Corridors	Revised in 2009 with zoning.
Maintenance Programs	Bridge & Culvert Inventory	Full update in 2013, then about 60% of culverts updated in 2019 and 2020	Complete update should be done soon
Building Code	Regulates building construction standards	No building codes in place	NA
Wetland protection – VT Wetland Rules	Protected by 1990 Vermont Wetland Rules	Protection of environment, water resources, wildlife, biota	None identified

PLAN MAINTENANCE PROCESS

Monitoring and Updating the Plan – Yearly Review

Once the plan is approved and adopted, the Emergency Management Directors (EMD) and the Planning Commission, along with interested and appointed volunteers and stakeholders, will continue to work with the Windham Regional Commission to monitor, evaluate, and update the plan throughout the next 5-year cycle. The plan will be reviewed annually before Town Meeting Day at a Selectboard meeting along with the review of the town's Local Emergency Management Plan (LEMP). This meeting will allow town officials and the public to discuss the town's progress in implementing mitigation actions and determine if the town is interested in applying for grant funding for projects that can help mitigate future hazardous events; e.g., bridge and culvert replacements, road replacements and grading, as well as buying out any repetitive loss structures that may be in the Special Flood Hazard Area, and revise the plan as needed. Windham Regional Commission's emergency planner will assist the EMD in Londonderry with this review, as requested by the Town. Progress on actions will be kept track using a table that WRC will provide to the Town. There will be no changes to the plan, unless deemed necessary by the Town; if so, the post disaster review procedure will be followed.

Plan Maintenance – 5 Year Update and Evaluation Process

The Hazard Mitigation Plan is dynamic. To ensure that the plan remains current and relevant, it is important that it undergo a major update periodically as required in 44 CFR § 201.6(c)(4)(i). This update process will be thorough and occur every five years. This update will include a thorough evaluation of the plan and incorporate any new requirements that FEMA has for Hazard Mitigation Plans. Participants outlined below will work with the Emergency Planner at the Windham Regional Commission (WRC) in accordance with the following procedure:

1. The Londonderry EMD will appoint a team to convene a meeting of the hazard mitigation planning committee. The EMD will chair the committee, and other members should include local officials such as Selectboard members, fire chief, zoning administrator, constable/police chief, road commissioner, Planning Commission members, health officer, Conservation Commission members, interested stakeholders, etc. The EMD will

work with the Windham Regional Commission Emergency Planner and be the point person for the Town.

2. The WRC Emergency Planner will guide the Committee through the update process. This update process will include several advertised public meetings. At these meetings the Committee will use the existing plan and update as appropriate guided by the WRC Emergency Planner to address:
 - Update of hazard events and data gathered since the last plan update.
 - Changes in community and government processes, which are hazard-related and have occurred since the last review.
 - Changes in community growth and development trends and their effect on vulnerability.
 - Progress in implementation of plan initiatives and projects.
 - Incorporation of new mitigation initiatives and projects.
 - Effectiveness of previously implemented initiatives and projects.
 - Evaluation of the plan for its effectiveness at achieving its stated purpose and goals.
 - Evaluation of unanticipated challenges or opportunities that may have occurred between the date of adoption and the date of the report, and their effect on capabilities of the town.
 - Evaluation of hazard-related public policies, initiatives and projects.
 - How mitigation strategy has been incorporated into other planning mechanisms
 - Review and discussion of the effectiveness of public and private sector coordination and cooperation.
 - Impacts of climate change and how the local environment is changing due to climate impacts
3. From the information gathered at these meetings, and other interactions the Emergency Planner has with the Town, along with data collected independently during research for the update, the WRC Emergency Planner will prepare the updated draft in conformance with the latest FEMA Region 1 *Local Hazard Mitigation Plan Review Crosswalk* document.
4. The Planning Commission will review the draft report. Consensus will be reached on changes to the draft. Emphasis in plan updates will be put on critically looking at how the plan can become more effective at achieving its stated purpose and goals.
5. Changes will be incorporated into the Plan by the WRC Emergency Planner.
6. The EMD and town staff will notify the public that the draft is available for public comment. The Town will advertise and make available the draft plan to provide comments both electronically and in hard copy. The draft plan will simultaneously be distributed electronically to adjacent towns for review and comment.
7. Public and adjacent town comments will be incorporated by the WRC Emergency Planner. The final draft will be provided to the individuals that participated in the update, for final review and comment, with review comments provided to the Committee and incorporated into the plan.

8. WRC Emergency Planner will finalize the plan with any remaining comments from the Emergency Management Director and others, and submit electronically to VEM and FEMA.
9. The Plan will be reviewed by the VEM State Hazard Mitigation Officer (SHMO) and FEMA Region 1.
10. SHMO and FEMA comments will be addressed in the plan by the WRC Emergency Planner.
11. The plan will be resubmitted as needed until the plan is approved pending adoption. Once the plan is approved by FEMA, it will be ready for adoption.
12. The Selectboard will adopt the plan and distribute to interested parties.
13. The final adopted plan will be submitted by the WRC Emergency Planner to VEM and FEMA.
14. FEMA will issue final approval of the adopted plan and the five year clock will begin again.

Post-Disaster Review/Update Procedure

Should a declared disaster occur, a special review will occur amongst the Planning Commission, the EMD, the WRC Emergency Planner, and those involved in the five-year update process described above. This review will occur in accordance with the following procedures:

1. Within six months of a declared emergency event, the town will initiate a post disaster review and assessment. Members of the State Hazard Mitigation Committee will be notified that the assessment process has commenced.
2. This post disaster review and assessment will document the facts of the event and assess whether existing Hazard Mitigation projects effectively lowered community vulnerability/damages. New mitigation projects will be discussed, as needed.
3. A draft After Action Report of the review and assessment will be distributed to the hazard mitigation committee.
4. A meeting of the committee will be convened by the Selectboard to make a determination of whether the plan needs to be amended. If the committee determines that NO modification of the plan is needed, then the report is distributed to local communities.
5. If the committee determines that modification of the plan IS needed, then the committee drafts an amended plan based on the recommendations and forwards to the Selectboard for public input.

6. The Selectboard adopts the amended plan after receiving approval-pending-adoption notification from FEMA.

Continued Public Participation

Maintenance of this plan and implementation of the mitigation strategy will require the continued participation of local citizens, agencies, and other organizations. To keep the public aware of and involved in local hazard mitigation efforts, the town will take the following measures:

- Provide hazard mitigation information at Town Meeting
- Schedule and advertise a planning meeting each year, soon after Town Meeting
- Seek participation from key players in addition to general public interest:
 - Selectboard
 - Planning Commission
 - Public Works
 - School
 - Fire & Rescue
 - Police
 - Emergency Management/ 911 Coordinator
- Post the hazard mitigation plan on the town website
- Selectboard will review current hazard mitigation committee members and consider whether new members should be added. Representatives of local businesses, nonprofits, academia, etc. should especially be considered.
- Notify the public of committee meetings through town bulletin board, town website, community forum, town Facebook page, Chester Telegraph, etc.

APPENDIX

1. Adoption Certificate
2. Email sent to adjacent towns for public comment on the draft plan
3. Flyer advertising availability of Draft Hazard Mitigation Plan for public comment
4. Email sent 4/5/2022 to town staff and Hazard Mitigation Planning Committee for review of the draft
5. Town website ad for comment on the draft plan, posted 4/19/22-5/3/22
6. May 19, 2021 and June 2, 2021 public meeting agendas (taken from PowerPoint)
7. Meeting flyer that was posted around town
8. Town website advertisement for the public meetings

**A Resolution Adopting the Local Hazard Mitigation Plan
for the Town of Londonderry, VT**

WHEREAS, the Town of Londonderry, VT has worked with the Windham Regional Commission to identify natural hazards, analyze past and potential future damages due to natural disasters, and identify strategies for mitigating future damages; and

WHEREAS, The Town of Londonderry, VT Local Hazard Mitigation Plan analyzes natural hazards and assesses risks within the community; and

WHEREAS, the Town of Londonderry, VT Local Hazard Mitigation Plan recommends the implementation of action(s) specific to the community to mitigate against damage from natural hazard events; and

WHEREAS, the Town of Londonderry, VT authorizes responsible agencies to execute their responsibilities to implement this plan for the purposes of long term risk reduction and increased community resiliency and;

WHEREAS, the Town of Londonderry, VT will follow the Plan Maintenance Process outlined in this plan to assure that the plan stays up to date and compliant; and

NOW, THEREFORE BE IT RESOLVED that the Town of Londonderry, VT adopts the *Town of Londonderry Local Hazard Mitigation Plan* as well as future revisions and maintenance required by 44 CFR 201.6 and FEMA for a period of five (5) years from the date of this resolution.

Duly adopted this 23rd day of May 2022.
date month, year

Selectboard



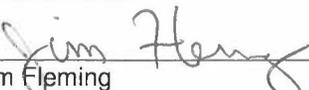
Tom Cavanaugh, Chair

Vincent Annunziata, Vice Chair



Taylor Prouty

Melissa Brown



Jim Fleming

ATTEST



Shane O'Keefe, Town Administrator

2. Email sent to adjacent towns for public comment on the draft plan

Mon 4/18/2022 3:29 PM

 Alyssa Sabetto <asabetto@windhamregional.org>
Londonderry Local Hazard Mitigation Plan for review and comment

To 'Paul Fraser'; 'blzieroff@gmail.com'; 'Greg.meulemans@jamaicavermont.org'; 'derrick.bienken@vermont.gov'; 'ism777oth@yahoo.com'; 'bsgkj@myfairpoint.net'; 'Kord Scott'; 'wpczba@comcast.net'; 'bdunkel1455@gmail.com'; 'mountaindrafting@gmail.com'; 'bill@winhall.org'; 'selectboard@dummerston.org'; 'townadmin@winhall.org'; 'Allison Strohl'; 'Allison Hopkins'; 'clerk@landgrove.vermont.gov'

Cc 'Alyssa Sabetto'; 'Kevin Beattie'; 'townadmin@londonderryvt.org'

 Londonderry_ 2022 Ha...
5 MB

Hello towns/regions adjacent to Londonderry,

Attached please find a draft of the updated Londonderry Local Hazard Mitigation Plan. The Windham Regional Commission has recently worked on updating this plan with the help of the town. It is now being sent to you as an opportunity for review and comment per FEMA requirements. Please share this draft with your town Planning Commission and Selectboard. **Please provide any comments back to the Windham Regional Commission by May 3, 2022.** Please use the contact information in my signature.

I would appreciate you letting me know that you have reviewed the draft, even if you do not have comment. I appreciate your time and assistance in this matter. If you have any questions, please let me know.

Thank you,
Alyssa

Alyssa Sabetto, CFM
Senior Planner
Windham Regional Commission

3. Flyer advertising availability of Draft Hazard Mitigation Plan for public comment

Londonderry Hazard Mitigation Plan

PUBLIC COMMENT PERIOD

The draft Londonderry Hazard Mitigation Plan is now available for public review on the town website: www.londonderryvt.org. A hard copy is available at the Town Office.



The Plan will be available for comment until
May 3, 2022.

Anyone who would like to comment on the plan should contact Alyssa Sabetto at the Windham Regional Commission. She can be reached via phone at 802-257-4547 x113 or email at asabetto@windhamregional.org.

We encourage your review and participation!

4. Email sent 4/5/2022 to town staff and Hazard Mitigation Planning Committee for review of the draft

Tue 4/5/2022 3:18 PM

 Alyssa Sabetto <asabetto@windhamregional.org>
Londonderry Local Hazard Mitigation Plan for internal town comment until April 14

To 'Kevin Beattie'; 'jduda121C1@gmail.com'; 'jhtwitchell@gmail.com'; 'Sharon Crossman'; 'Shane O'Keefe'; 'townderk@londonderryvt.org'; 't.cavanagh@londonderryvt.org'; 'Irwin Kuperberg'; 'JEREMIAH SUND'; 'Will Goodwin'; 'roadforeman@londonderryvt.org'; 't.prouty@londonderryvt.org'

Cc 'Alyssa Sabetto'

 Londonderry_2021 Ha...
5 MB

Hello Londonderry,

Attached is the first draft of the updated Londonderry Local Hazard Mitigation Plan. **This draft is just being passed around at this point for internal town review and is not yet out for public comment. Please review the attached draft and provide comment back to me by April 14th.** I'll incorporate comments and then put the plan out for public comment. If you don't get the chance to comment during this internal opportunity, you can comment during the public opportunity. You can mark up the attached document and scan it back to me, call me with comments or email me back a list of comments. I'm not able to send in a word version, as the file is too large for email.

Please note that the **yellow highlighted** sections of the plan are *not yet completed* for Londonderry and are awaiting further information. They will be customized for Londonderry and un-highlighted as the process moves forward. There are also a few of the appendices that are not yet developed, but will be in the final plan.

Shane and Kevin - If there are any town staff or plan development participants who are not getting this email that should, please forward this on to them.

Thank you,

Alyssa Sabetto, CFM
Senior Planner
Windham Regional Commission

5. Town website ad for comment on the draft plan, posted 4/19/22-5/3/22

www.londonderryvt.org

LOCAL HAZARD MITIGATION PLAN

The draft Londonderry Local Hazard Mitigation Plan is now out for public comment until May 3, 2022. A public notice flyer can be found [HERE](#) and the plan document can be found [HERE](#). Please send any comments to asabetto@windhamregional.org. If you are unable to download or access this electronic version, a hard copy is available at the Town Office during regular business hours.

6. May 19, 2021 and June 2, 2021 public meeting agendas (taken from PowerPoint)

AGENDA FOR TONIGHT'S MEETING

1. Update of the current Londonderry Local Hazard Mitigation Plan

- Purpose
- Process

2. Hazards

- Discuss hazard events that have occurred since the last Plan
- Instructions briefly and then take online survey
- Discuss meeting participant survey results
- Brief review of existing/expired Londonderry Local Hazard Mitigation Plan
- Decide what the updated Plan will address
- Mark up the Atlas with local hazard notes

3. What to think about for the next meeting scheduled for June 2nd

AGENDA FOR JUNE 2ND MEETING

1. Brief review of decisions made on May 19th regarding hazards to address in the updated Plan

2. Mitigation Goals and Actions

- Review/edit Mitigation Goals
- Brief review of the current Mitigation Actions Table that the Town updated
- Create an updated Mitigation Actions Table for the updated Plan
- Identify gaps and capabilities with implementation

3. Other Updates

- Discuss recent mitigation work completed by the town
- Discuss development trends – new developments, upcoming developments
- Overall resiliency concerns or ideas
- Review of other elements and address questions that weren't discussed

4. Next Steps

8. Meeting flyer that was posted around town and online

Update of the Londonderry Local Hazard Mitigation Plan Public Meeting Announcement



2 Meeting Dates: May 19th and June 2nd, 2021

Time: 6:00-8:00 PM

Via Zoom

See Town website for meeting details

Come learn about and help to update
Londonderry's Local Hazard Mitigation Plan!
What hazards does the town face? What actions
can the Town take now to lower vulnerability
before the next natural hazard strikes?

For more information contact
Alyssa Sabetto at 802-257-4547 x113



8. Town website advertisement for the public meetings

Town of Londonderry, VT | Office X +

www.londonderryvt.org

Update of the Londonderry Local Hazard Mitigation Plan Public Meeting Announcement



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Meeting #1 – May 19, 2021 @ 6:00 PM

Join Zoom Meeting via web at <https://us02web.zoom.us/j/82747753352>

Via telephone at (929) 205-6099 (Meeting ID: 827 4775 3352)

Meeting #2 – June 2, 2021 @ 6:00 PM

Join Zoom Meeting via web at <https://us02web.zoom.us/j/82983586842>