Multi-Hazard Mitigation Plan Update

TOWN OF LOWELL, VERMONT

DRAFT JULY 2016

Multi-Hazard Mitigation Plan Update

Town of Lowell, Vermont

Town of Lowell
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ACKNOWLEDGEMENTS

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RECORD OF CHANGES

This Multi-Hazard Mitigation Plan Update, including Appendices, will be reviewed and approved on an annual basis by the Hazard Mitigation Committee and following any major disasters. All updates and revisions to the plan will be tracked and recorded in the following table. This process will ensure the most recent version of the plan is disseminated and implemented by the Town.

Date of Change	Entered By	Summary of Changes

CERTIFICATE OF LOCAL ADOPTION

CERTIFICATE OF ADOPTION

TOWN OF LOWELL, VERMONT SELECT BOARD
A RESOLUTION ADOPTING THE TOWN OF LOWELL, VERMONT 2016 LOCAL HAZARD MITIGATION PLAN UPDATE

WHEREAS, the Town of Lowell has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of the hazards profiled in the **2016 LOCAL HAZARD MITIGATION PLAN UPDATE,** which result in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Town of Lowell has developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for its **2016 LOCAL HAZARD MITIGATION PLAN UPDATE (Plan)** under the requirements of 44 CFR 201.6; and

WHEREAS, the **Plan** specifically addresses hazard mitigation strategies, and Plan maintenance procedures for the Town of Lowell; and

WHEREAS, the **Plan** recommends several hazard mitigation actions (projects) that will provide mitigation for specific natural hazards that impact the Town of Lowell with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this **Plan** will make the Town of Lowell eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by Town of Lowell Select Board:

1. The **2016 LOCAL HAZARD MITIGATION PLAN UPDATE** is hereby adopted as an official plan of the Town of Lowell;

2. The respective officials identified in the mitigation action plan of the **Plan** are hereby directed to pursue implementation of the recommended actions assigned to them;

3. Future revisions and **Plan** maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as part of this resolution for a period of five (5) years from the date of this resolution; and

4. An annual report on the process of the implementation elements of the Plan will be presented to the Select Board by the Emergency Management Director or Coordinator.

IN WITHNESS WHEREOF, the undersigned have affixed their signature and the corporate seal of the Town of Lowell on this ____ day of _____ 2016.

_____

Date

_____

Select Board Chair

_____

Select Board Member

_____

Select Board Member

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INTRODUCTION

CHAPTER 1. INTRODUCTION

The Federal Emergency Management Agency (FEMA) defines mitigation as "the effort to reduce loss of life and property by lessening the impact of disasters. Mitigation is taking actions now – before the next disaster – to reduce human and financial consequences later (analyzing risk, reducing risk, insuring against risk.)"[1]

"The purpose of mitigation planning is to identify policies and actions that can be implemented over the long term to reduce risk and future losses. Mitigation plans form the foundation for a community's long-term strategy to reduce disaster losses and break the cycle of disaster damage, reconstruction, and repeated damage. The planning process is as important as the plan itself. It creates a framework for risk-based decision making to reduce damages to lives, property, and the economy from future disasters."[2]

"DMA 2000 (Public Law 106-390)[3] provides the legal basis for FEMA mitigation planning requirements for State, local and Indian Tribal governments as a condition of mitigation grant assistance. DMA 2000 amended the Robert T. Stafford Disaster Relief and Emergency Assistance Act by repealing the previous mitigation planning provisions and replacing them with a new set of requirements that emphasize the need for State, local, and Indian Tribal entities to closely coordinate mitigation planning and implementation efforts."[4]

The Town of Lowell, Vermont created this plan as part of an ongoing effort to reduce the negative impacts and costs from damages associated with natural hazards, such as nor'easters, floods, and hurricanes. This plan meets the requirements of the Disaster Mitigation Act 2000. More importantly, the plan was created to reduce loss of life, land, and property due to natural hazards that affect the planning area. It is difficult to predict when natural hazards will impact the planning area, but it is accurate to say that they will. By implementing the mitigation actions listed in this plan, the impact of natural hazards will be lessened.

Local Mitigation Plans must be updated at least once every five years in order to continue to be eligible for FEMA hazard mitigation project grant funding. Specifically, the regulation at 44 CFR §201.6(d)(3) reads:

> A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities, and resubmit it for approval within five (5) years in order to continue to be eligible for mitigation project grant funding.

In 2005, the Town of Lowell developed an All-Hazards Mitigation Plan that was approved by FEMA. This plan serves as an update to that plan.

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[1] What is Mitigation? (2014). Federal Emergency Management Agency. Retrieved January 2014 from http://www.fema.gov/what-mitigation

[2] Multi-Hazard Mitigation Planning. (2014). Federal Emergency Management Agency. Retrieved January 2014 from http://www.fema.gov/multi-hazard-mitigation-planning

[3] Disaster Mitigation Act of 2000, Pub. L. 106-390, as amended

[4] Disaster Mitigation Act of 2000. (2014). Federal Emergency Management Agency. Retrieved January 2014 from http://www.fema.gov/media-library/assets/documents/4596?id=1935

NORTHEASTERN VERMONT DEVELOPMENT ASSOCIATION

This Hazard Mitigation Plan was funded by a FEMA Hazard Mitigation Planning Grant, administered by the Vermont Department of Emergency Management and Homeland Security (DEMHS) through the Northeastern Vermont Development Association (NVDA). NVDA serves the 55 municipalities in Caledonia, Essex and Orleans Counties as both the Regional Planning Commission and the Regional Economic Development Corporation.

2016 HAZARD MITIGATION GOALS

The purpose of the Local Hazard Mitigation Plan is to provide the Town of Lowell (known throughout the document as the planning area) with a comprehensive examination of all natural hazards affecting the area and to provide a framework for informed decision-making regarding the selection of cost-effective mitigation actions. These mitigation actions, when implemented, will reduce the region's risk and vulnerability to natural hazards.

This plan is a result of a collaborative effort between the NVDA and the Town of Lowell with support from the public and the surrounding communities. Throughout the development of the plan, the Hazard Mitigation Committee consulted with the public for input regarding the identified goals, mitigation actions, and risk assessment. They also consulted on the mitigation implementation strategy.

The Jamie Caplan Consulting team and the Hazard Mitigation Committee adhered to the following guiding principles in the plan's development.

Guiding Principles for Plan Development[5]:

- Focus on the mitigation strategy. The mitigation strategy is the plan's primary purpose. All other sections contribute to and inform the mitigation strategy and specific hazard mitigation actions
- Process is as important as the plan itself. In mitigation planning, as with most other planning efforts, the plan is only as good as the process and people involved in its development. The plan should also serve as the written record, or documentation, of the planning process
- This is your community's plan. To have value, the plan must represent the current needs and values of the community and be useful for local officials and stakeholders. Develop the mitigation plan in a way that best serves your community's purpose and people

The Hazard Mitigation Committee identified the following list of thirteen hazards to profile, shown in Table 1 in the order of risk identified through the combination of risk analysis and community input.

[5] Local Mitigation Planning Handbook. (2013). Federal Emergency Management Agency. Pg.I-2.

Table 1 Hazards Including in the Plan

Ranking	Hazard Ranking
HIGH HAZARDS	Flood Winter Storms Extreme Cold Severe Thunderstorm (High Wind and Lightning) Hurricane and Tropical Storm (High Wind)
MODERATE HAZARDS	Ice Jams Wildfire Hail Drought
LOW HAZARDS	Tornado Extreme Heat Earthquake Landslide

The hazard mitigation strategy is the culmination of work presented in the planning area profile, risk assessment, and capability assessment. It is also the result of multiple meetings and public outreach. The Hazard Mitigation Committee developed the six goals shown in Figure 1. The goals from the 2005 plan were revised to develop this current list. Information about the goal development process is in Chapter 3 Planning Process. These goals are considered "broad policy-type statements"[6] that represent the long-term vision for mitigating risk to natural hazards in the Town of Lowell.

[6] Local Mitigation Planning Handbook. (2013). Federal Emergency Management Agency. Pg.6.

Figure 1 Mitigation Plan Goals

2016 HAZARD MITIGATION ACTIONS

Mitigation actions have been determined to meet the above goals. The actions are ranked by a number of criteria defined in Chapter 6 Mitigation Strategy. The planning area intends to immediately implement some of the actions and begin seeking funding for others. The Town Administrator will oversee the implementation of the mitigation plan and report regularly to the Hazard Mitigation Committee, this process is detailed in the Implementation Plan chapter.

The following table represents the mitigation actions approved by the Hazard Mitigation Committee for this updated plan. They are listed in order of priority. The Hazard Mitigation Committee recognizes that funding may not come in this order.

Priority	Mitigation Action	Description	Hazards Mitigated	Mitigation Category	Responsible Department	Cost	Potential Funding Source	Timeline
Very High	*Conduct Multiple River Bank Erosion Maintenance Projects in compliance with Act 64 Along Hazen Notch Road to Maintain Water Quality in the Missisquoi River that Drains Into Lake Champlain.	Maintenance on the Missisquoi River to protect the water quality of Lake Champlain. Flooding on Hazen Notch Road strands residents.	Flooding and Erosion, Landslide	Natural Systems Protection	Road Department and Selectboard	High	Better Back Roads Grant, VTrans, Town	July 2016 – June 2021
Very High	Maintain road standards so that watershed health and water quality is maintained in compliance with Act 64.	Encourage water quality and watershed health through the implementation of wooded vegetative buffers along rivers and streams. Lowell is accountable to State and EPA because water drains into Lake Champlain where phosphorous levels are too high.	Flooding and Erosion,	Structure and Infrastructure Projects	Select Board and Road Department	High	Better Back Roads Grant, VTrans	July 2016 - June 2020
Very High	Purchase a permanent generator for the Lowell Graded School.	The generator will allow the school to function as a shelter instantly.	Winter Storms, Flood and Erosion, Extreme Cold, Severe Thunderstorm (High Wind and Lightning), Hurricane (High Wind), Tornado	Structure and Infrastructure Projects	Lowell Graded School	Medium	HMGP	July 2016 – June 2018

Very High	Expand School's Reverse 911 System	Town needs a system to alert all residents to disasters. This action is supported by the LEOP which states, "Alert the public (including special needs or vulnerable populations) of the hazards of the event at the outset and during the event (including protective actions and evacuation information).	All Hazards	Education and Awareness Programs	School and Select Board	Low	HMGP	July 2016 – June 2017
Very High	Maintain Culverts and Roadways to VTrans Standards.	Include culvert survey and replacement, ditching along roadways and cutting vegetation to allow visibility at intersections.	Flooding and Erosion, High Wind Hazards, Ice Jams, Severe Winter Storms, Landslide	Structure and Infrastructure Projects	Road Department	Medium	Town, HMGP. VTrans	July 2016 - June 2021
Very High	Develop a Road Erosion Inventory	Act 64 requires this inventory by 2019.	Flooding and Erosion, Ice Jams, Landslide	Structure and Infrastructure Projects	Road Department	Low	Better Back Roads, VTrans	July 2016 - June 2018
Very High	Update FEMA Flood Maps	Encourage FEMA to update and digitize floodplain maps for the Town.	Flooding and Erosion, Ice Jams, Severe Thunderstorm (High Wind and Lightning)	Local Plans and Regulations	Select Board and NVDA	Low	Town	July 2016 – June 2021
Very High	Designate an Emergency Operation Center	The Fire Department will coordinate with the Hazard Mitigation Committee and the State to designate the Fire House as the EOC.	All Hazards	Local Plans and Regulations	Fire Department	Low	Town	September 2016- August 2017

High	*Retrofit Bridge #10	On Rte. 58 and Hazen Notch Road, maintain access to shelter and allow residents to evacuate.	Flooding and Erosion, High Wind Hazards, Wildfire, Landslide, Earthquake	Structure and Infrastructure Projects	Select Board	High	VTrans	July 2016 – June 2021
High	*Retrofit Bridge #8	On Rte. 58 and Hazen Notch Road, maintain access to shelter and allow residents to evacuate.	Flooding and Erosion, High Wind Hazards, Wildfire, Landslide, Earthquake	Structure and Infrastructure Projects	Select Board	High	VTrans	July 2016 – June 2021
High	Implement Zoning Board plan related to fluvial erosion named in the Town Plan, August 2014 p.36.	The Town Plan includes a list of 5 actions related to property and flood zones. These are also shown below in Figure 1.	Flooding and Erosion	Local Plans and Regulations	Zoning Board	Low	Town	July 2016 – June 2021
High	Four Corner Intersection Maintenance for Safe Winter Travel	The main intersection in Town is dangerous when snow builds up on the road banks.	Severe Winter Storm	Structure and Infrastructure Projects	Road Department, VTrans	Low	Town, VTrans	November 2016 – June 2021
High	Remediate Beaver Dam Issues As They Arise	Prevent flooding caused by beaver dams.	Flooding and Erosion	Natural Systems Protection	Road Department	Low	Town	July 2016 – June 2021
High	Maintain Emergency Access to the General Store.	The General Store is a critical facility and is the only place in Town for gas or groceries. Supported by LEOP which states, “make roads passable and restore emergency access.”	Flooding and Erosion, High Wind Hazards, Wildfire	Structure and Infrastructure Projects	Road Department and VTrans	Low	Town and VTrans	July 16 – June 2021
High	Educate the public about how to shelter-in-place and where to	For a rural community in Vermont, frequently sheltering-in-place is the best solution in a disaster.	All Hazards	Education and Awareness Programs	Hazard Mitigation Committee	Low	Town	September 2016 - April 2017

	access emergency information.	Keeping people off the roads allows the Road Department to clear the roads and first responders to move about.						
High	Elevate transportation corridor at Hazen Notch Road and Route 58 (the lowest point in the Town).	Conduct an engineering study of flooding along Hazen Notch Road and Route 58 to determine appropriate mitigation actions.	Flooding and Erosion, Severe Thunderstorm (High Wind and Lightning)	Education and Awareness Programs	Select Board	High	VTrans, HMGP	March 2017-April 2021
High	NVDA Hazard Mapping Support	Lowell needs assistance redrawing zoning maps for the asbestos area. They would like a clear zoning map so the Zoning Bylaws may be updated. They also would like to overlay an updated floodplain map with the zoning map.	Flooding and Erosion, Ice Jams, Landslide, Wildfire	Local Plans and Regulations	Town Administrator	Low	NVDA	June 2016 – June 2021
High	Build a sand and salt shed	Sand and salt used on the roads in the winter is kept outside and at risk to freezing. Access is limited during incidents of severe winter storms and ice storms.	Extreme Temperatures, Ice Storms, Severe Winter Storms	Structure and Infrastructure Projects	Road Department	Medium	HMGP	April 2016 – June 2017
High	Collaborate with VEC for tree clearing	Road obstruction and downed power lines are two of the biggest concerns in Lowell. Collaborating with the Vermont Electric Company to keep trees trimmed and roads clear is essential to keep the roads free of debris and the power on.	High Wind Hazards and Severe Winter Storms	Structure and Infrastructure Projects	Road Department	High	HMGP	September 2016 – June 2021

Medium	Retrofit Kempton Hill Bridge	The bridge is high up and the concern is safety and resident evacuation.	Flooding and Erosion, High Wind Hazards, Wildfire, Landslide, Earthquake	Structure and Infrastructure Projects	Select Board	High	VTrans	July 2018 – June 2021
Medium	Pave Mink Farm Road	Class 2 road that needs repaving.	Flooding and Erosion, Severe Winter Storm	Structure and Infrastructure Projects	Road Department	Medium	VTrans, Town	July 2016 – June 2019
Medium	Pave Mines Road	Class 2 road that needs repaving.	Flooding and Erosion, Severe Winter Storm	Structure and Infrastructure Projects	Road Department	High	VTrans, Town	July 2016 – June 2019
Medium	Get a generator for Town Garage	To maintain power in the building especially during evening disasters.	Flooding and Erosion, High Wind Hazards, Severe Winter Storms, Ice Jams, Extreme Temperatures	Structure and Infrastructure Projects	Road Department	Low	HMGP	September 2019 – August 2020
Medium	Educate homeowners about floods and other natural hazards.	The Hazard Mitigation Committee has prioritized education as one of the best methods to mitigate risks in Lowell.	All Hazards	Education and Awareness Programs	Hazard Mitigation Committee	Low	Town	July 2016 – June 2017
Medium	Educate home owners about safe building practices for snow load, flooding, high	Bring in an outside consultant/engineer who knows about safe building practices.	Flooding and Erosion, High Winds Hazards,	Education and Awareness Programs	Hazard Mitigation Committee, Road Department	Low	Town, HMGP	October 2017-December 2019

	winds, and bank erosion.		Hail, Landslide, Earthquake		and Fire Department			
Medium	Maintain data on cost to Town related to flooding and other hazards.	Document costs incurred by Town departments responding to flooding and other hazards.	All Hazards	Local Plans and Regulations	Town Treasurer	Low	Town	July 2016 - June 2021
Medium	American Red Cross Shelter Training for all shelters.	Train representatives from the school and two churches how to run a shelter.	All Hazards	Education and Awareness Programs	Town Administrator	Low	Town and American Red Cross	July 2018 – June 2020
Low	Amend zoning ordinance to include asbestos mine	Development on or near the asbestos mine is prohibited.	Technological Hazard	Local Plans and Regulations	Zoning Board and Select Board	Low	Town	July 2016- June 2017
Low	Participate in the Community Rating System	Participate in the NFIP CRS program if a regional body shares the responsibility of participation.	Flooding and Erosion, Severe Thunderstorms (High Wind and Lightning), Severe Winter Storms	Education and Awareness Programs	Town Clerk and NVDA	Low	HMGP	August 2018 – June 2021
Low	Educate residents about the risk insects present and how they may breed in standing water	Specifically related to mosquito borne illnesses.	Infectious Disease	Education and Awareness Programs	Town Clerk Office	Low	Town	March 2018 - June 2021

AUTHORITY AND ASSURANCES

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

The Hazard Mitigation Committee recognizes FEMA's Local Mitigation Planning Handbook (March 2013) and the Local Mitigation Plan Review Guide (October 2011) as references for this plan.

PLAN ADOPTION

E1. Does the Plan include documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval? 44 CFR 201.6(c)(5)

The Town of Lowell will adopt the plan when it has received "pending adoption" approval from the Federal Emergency Management Agency. The Certificate of Adoption is included on page 5.

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PLANNING AREA PROFILE

CHAPTER 2. PLANNING AREA PROFILE

The Town of Lowell is located in north central Vermont, in Orleans County. It was chartered February 7, 1791 and is 56.38 square miles. It is a rural community with a population of 879 people in 2010[7] that is an average of sixteen people per square mile. Mountain ridges flank the west, south and east side of town. Most of the land used for agricultural purposes is located adjacent to Route 58 and Route 100 with few scattered among the side roads.[8] Residential use is the main use of developed land in Lowell. A good number of residences are located in the village area near the intersection of Routes 58 and 100, providing a cluster of homes. Other residences are scattered throughout the community. Adjacent to the Town of Lowell are seven towns, Albany, Eden, Irasburg, Montgomery, Newport Center, Troy and Westfield. The climate in Lowell is typical for Vermont, and includes long cold winters and short warm summers.

D1. Was the plan revised to reflect changes in development? (Requirement §201.6(d)(3))

This plan has been updated to reflect changes in the Town. However, there have not been many changes in terms of development or population. The Fire Department expanded the Fire House and the Wind Farm has grown. Changes are detailed where appropriate throughout the plan. Despite the limited number of changes, the entire plan has been redone and the risk assessment is new. In terms of this chapter, the previous plan included a list of Lowell characteristics related to demographics and a page about history. This chapter expands the information given previously with sections related to transportation, utilities, Town Resources, economy, schools and churches, historical facilities and critical facilities.

TRANSPORTATION

Transportation in the Town of Lowell centers around roads and bridges and residents move through the town by way of personal vehicles. The following paragraphs taken from the Town Plan describe the roadway system.[9]

> Within the Town of Lowell there are two State highways. Route 100 is a north/south highway providing access to Newport City to the north; Morrisville, Stowe, and Interstate 89 to the South. Route 58 is the east/west highway and it provides access to Barton and Interstate 91 to the east; Montgomery and other points to the west. Route 58 to the west of Route 100, however, is a town road with a gravel surface. This portion of Route 58 passes through Hazen's Notch and is closed during the winter months.
>
> Route 100, classified as a rural minor arterial, passes through the Missisquoi River valley and is generally in good repair, it has paved shoulders that are two feet wide, and has relatively few problems. The problems that do exist include an unsafe segment between mile markers 5.6 and 5.9, poor pedestrian access to the Lowell Graded School, and a dangerous intersection with Route 58. To the north of the Village is a segment of Route 100 (between mile markers 5.6 and 5.9) with

[7] Town Plan (2014). Town of Lowell. Pg.20
[8] Town Plan (2014). Town of Lowell. Pg.22
[9] Town Plan (2014). Town of Lowell. Pg.58

an "S" curve that makes it difficult for northbound drivers to see the farm and cattle crossing to the north (this farm is not currently in operation and therefore not a hazard at this time).

Route 58 to the east of Route 100, which is classified as a major collector, passes over the ridge that forms the northern end of the Lowell Mountains and therefore provides many scenic vistas to the west and north. This highway needs to be repaved but it has not yet been included in the State's repaving program. That portion of Route 58 west of Route 100 is an unpaved Class 2 town road that is eligible for State and/or Federal funds for maintenance.

The planning commission encourages the Select Board and road commissioner to monitor and maintain the current storm drains to provide a level of drainage that will prevent damage due to storm runoff. [10]

Two airports are close to the town according to the Town Plan.[11]

The Newport State Airport located in Coventry and the Morrisville-Stowe State Airport. The Newport State Airport, located in Coventry, was constructed in 1941 and has two paved runways that are 4,000 feet long. The runways are designed for aircraft weighing less than 12,500 pounds and with wingspans less than 79 feet. Visual and navigational aids are available which allow for non-precision approaches for aircraft equipped with electronic navigational instruments.

The Morrisville-Stowe State Airport, located in Morristown, was also constructed in the 1940's and has one paved runway that is 3,700 feet long. The design specifications for this runway are similar to those of the Newport State Airport. Visual and navigational aids are available which allow for non-precision approaches for aircraft equipped with electronic navigational instruments.

UTILITIES

There are no municipal services such as public water or sewer in town. All water and septic are on–site systems. Electric power is provided by Vermont Electric Coop (VEC). The Lowell Planning Commission would like to encourage the VEC to take the necessary steps to upgrade their substation to insure that the town's electrical needs are adequately met in the future.

ELECTRIC INFRASTRUCTURE AND SERVICES[12]

Power is supplied to the Town by the Vermont Electric Co-op (VEC). With the installation of the new wind towers, Green Mountain Power maintains a transmission station on Rte. 100 in and all of the transmission lines and distribution are facilitated through the VEC.

VEC's distribution system line lengths have not changed significantly from the 45 miles reported in 2009, however all of the distribution assets along Rte. 100 in Lowell were rebuilt with the KCW project. These upgrades have greatly improved reliability.

[10] Town Plan (2014). Town of Lowell.
[11] Town Plan (2014). Town of Lowell. Pg.60
[12] Town Plan (2014). Town of Lowell. Pg.51

The Lowell substation was upgraded from 2,500 kilo-volt amperes to 7,500 kilo-volt amperes when the VEC rebuilt the station in 2012. The station is now fed from the VEC 46 kilo-volt transmission system in the north which is connected to the VELCO 115 kilo-volt system. The old connection to the south is now used as a redundant source. Having dual sources from the north and one from the south has greatly improved operating flexibility and reliability.

The 46 kilo-volt transmission line between Jay and Lowell was rebuilt in 2012 as part of the KCW project. It has a capacity of 75 mega-watts which serves Lowell as well as serves as the connection for the KCW wind farm to the VELCO bulk transmission system in Jay. This transmission line which is all to the north of the Lowell substation is jointly owned by GMP and VEC, with VEC being the operating authority and charged with maintenance.

Approximately four miles of new 46 kilo-volt line was built from the south of the Lowell substation to connect to the wind farm. This line is rated at 75 mega-watts as well and is only used to transport the wind farm output. This line is solely owned by GMP which they operate and maintain.

WATER - WASTEWATER/SEWAGE DISPOSAL[13]

The Town of Lowell does not have a municipal sewage disposal system or water supply system. All sewage disposal is handled by individual on-site systems. Water is supplied by drilled wells or on-site natural water springs. At this time, it is not feasible to build a municipal water supply or sewage disposal system. However, the Lowell Zoning Board is concerned about on-site sewage disposal and therefore recommends that before a site is developed it be carefully examined and tested before a septic system is installed. The Zoning Board fully advocates the Vermont Health Regulations and promotes the proper channels through the State regulatory boards to any residents looking to install septic systems. All systems must be in full compliance and must have proper permits in place before any construction is authorized to begin.

STORM DRAINAGE

The Town of Lowell has very little in the way of storm drainage, all of which can be found in the village area along Route 58 west of Route 100. At this time these drains function properly with no known problems. The Zoning Board encourages the Lowell Select board and Road Commissioner to monitor and maintain the current storm drains to provide a level of drainage that will prevent damage due to storm runoff.

HOUSEHOLD REFUSE DISPOSAL[14]

Solid waste in Lowell is picked up by private contractors and hauled to the Waste USA land fill in Coventry. The cost for pick up is paid for on an individual basis by the Town's residents. As with water and sewer services the town does not feel at this time that a municipal service is needed nor is the cost warranted.

[13] Town Plan (2014). Town of Lowell. Pg.50
[14] Town Plan (2014). Town of Lowell. Pg.51

TOWN RESOURCES

TOWN GOVERNMENT[15]

The administration of the Town is the responsibility of a Town Clerk and Treasurer and an Assistant Clerk working closely with the Select Board. The clerk's office oversees the financial management of the town, maintains land records and associated documents, and provides management and administration for a variety of town projects. A three-member Board of Listers maintain the Town's grand list with the assistance of the Town Clerk. With the passage of Act 60, the Board was provided with computer equipment intended to help standardize property assessments in the State. Property Tax maps are available at the Town Clerks office and copies can be obtained by residents when needed. This greatly assists the Zoning Board when reviewing plans for development as they can assess the property plots, location and possible hazards on surrounding land.

LIBRARY[16]

The Lowell Library was founded in 1864 in a private home and later moved to the old Town Hall on Route 58 in the village. At one time the library had an annual budget of only $100 and was very dependent upon private donations for its operation. In addition, the library was open only during the hours the Town Clerk's office was open. It was during those hours that the heat was on and at other times the library was too cold to be used comfortably. With the completion of the new town office building, the library has been moved from the old town hall into the new building.

VOLUNTEER FIRE DEPARTMENT

Lowell has a volunteer fire department comprised of approximately sixteen people. The Lowell Fire Station is located at 2534 Route 100. The fire department owns equipment including a pumper truck, a tanker, a rescue van, a four-wheeler and a generator. The fire department has access to five dry hydrants, they are located on Irish Hill Road, Buck Hill Road, Route 58, Carter Road and Route 100.[17] They maintain a Memorandum of Understanding (MOU) with the Town of Troy who responds if additional resources are needed. The Fire House was expanded to include an additional bay shown in the picture below.

[15] Town Plan (2014). Town of Lowell. Pg.41
[16] Town Plan (2014). Town of Lowell. Pg.48
[17] Town Plan (2014). Town of Lowell. Pg.54

Figure 2 Lowell Fire Department

POLICE PROTECTION

The Town of Lowell relies solely on State Police for patrol and support. The Town had a police department previously but residents in a town meeting voted to disband the department due to cost.

MEDICAL CARE

The closest hospital is the North Country Hospital in Newport. Ambulance service is provided by the Missisquoi Ambulance Service, a cooperative service owned by the towns of Jay, Lowell, Troy and Westfield. The ambulance is staffed by volunteers and housed at the Jay Town Garage but will be relocated to Troy. The Newport Ambulance covers for the Missisquoi Ambulance Service when needed. The town has identified two shelters in town: St. Ignatius Parish Hall and the Lowell Congregational Church. The town has a pre-agreement with the Vermont Red Cross.

ECONOMY

The largest industry in Lowell is the Kingdom Community Wind Farm operated by Green Mountain Power. In addition to the Wind Farm, six commercial businesses, many home-based businesses and four active dairy farms contribute to the economy in Lowell.

SCHOOLS AND CHURCHES

Lowell has one school called the Lowell Graded School for children in preschool through eighth grade. Lowell has two churches, the Catholic Church and the Congregational Church. They previously had a Baptist church but it burned down.

HISTORIC FACILITIES

The Town of Lowell does not have any buildings listed in the National Register of Historic Places.[18]

CRITICAL FACILITIES

The Planning Team identified nine critical facilities which are detailed in the table below. The Natural Hazard Preparedness Survey asked respondents to rank the importance of the critical facilities. The results are Lowell Town Garage, Lowell Fire Department, Lowell Graded School, Town Clerks Office, Post Office, Lowell Congregational Church, Catholic Church, Parish Hall and Wind Tower. This critical facility was updated for purposes of this plan from the previous plan. The risk to each of these facilities is detailed in Chapter 4.

Table 1 Critical Facilities

Building Name	Address	Appraised Value	Notes
Lowell General Store	3042 VT-100	$259.800	Added as a critical facility in 2016.
Post Office	296 Hazen Notch Road	$49,700	This facility is no longer owned by the Town but is still considered critical.
Catholic Church	151 Hazen Notch Road	$130,200	
Saint Ignatius Parish Hall	157 Hazen Notch Road	$172,100	Back-up Shelter
Lowell Graded School	52 Gelo Park Road	$1,256,500	Shelter Added mitigation actions that include purchasing a permanent generator, conducting American Red Cross Shelter training, and restructuring the reverse 911 system for use by the Town in an emergency.
Town Clerks Office / Historical Society / Library	2170 VT Route 100	$321,100	Considered the primary Emergency Operation Center.
Lowell Congregational Church	2506 VT Route 100	$126,900	Back-up Shelter
Lowell Fire Department	2534 VT Route 100	$93,300	Generator Have access to several portable generators.
Lowell Town Garage	2069 VT Route 100	$107,700	A mitigation action has been added that includes purchasing a generator for this facility.
Wind Tower Control Building and Land	1300 Edward Drive	$1,176,800	This land and the building are privately owned. They are considered critical facilities because of the tremendous revenue the Town receives from Green Mountain Power. Critical facilities are chosen because of their contribution to the Town

[18] National Register of Historic Places. (2013). U.S. Department of the Interior - National Park Service. Retrieved February 9, 2016 from http://focus.nps.gov/nrhp/SearchResults/7674df8123d249d38d4292c1d34cfcc5?page=1&view=list

Building Name	Address	Appraised Value	Notes
			in terms of life safety and economic viability.

Working together with Vermont Electric Coop, Green Mountain Power has built 21 wind turbines along the ridgeline of the Lowell Mountain Range. This location offers both a reliable source of wind, and also the infrastructure necessary to bring the project online.[19] The project began generating electricity at the end of 2012. While the Town of Lowell has little or no influence over the operation of the privately owned hydroelectric generating plants in Lowell, the Zoning Board does encourage the continued operation and maintenance of these sites as they are seen as a benefit to the Town of Lowell.

The wind turbines at Kingdom Community Wind are 3 MW VESTAS V112, some of the newest technology on the market. When fully operational, the plant is expected to produce approximately 186,000 MWH annually or the equivalent of enough electricity to power more than 24,000 homes each year. Every kilowatt hour of electricity will be used by Green Mountain Power and Vermont Electric Cooperative customers. Figure 2 shows some of the wind turbines along the mountain ridge.

Figure 3 Wind Turbines along Mountain Ridge

The land leased for the project has been an active logging operation for decades. Of the thousands of acres that comprise Lowell Mountain a total of 135 acres was used for the wind plant. Direct impact to bear habitat totaled 20 acres, impact to wetlands totaled half an acre, and for high level wetlands the impact was one-tenth of an acre. To mitigate these impacts and the habitat fragmentation caused by the road, GMP procured conservation easements on over 2,800 acres. The conserved area includes over 1,100 acres on Lowell Mountain, and over 1,600 acres in Eden connecting important wildlife corridors between Green River Reservoir and the Lowell wildlife habitat area. More information about the Kingdom Community Wind project is included in Appendix E.

[19] About Wind Power. (2016). Green Mountain Power. Retrieved http://www.greenmountainpower.com/innovative/wind/ February 9, 2016

In addition to the nine critical facilities the old asbestos mine on Mines Road near the Lowell/Eden town line is worth noting. At the height of mining in the 1950's-1960's 240 people were employed at the mine. The mine was closed in 1966. The entrance to the mine is blocked to walkers and vehicles. The property is still owned by the Vermont Asbestos Group, who pays taxes to the town and monitors the property. Town members voted during a town meeting not to turn the old mine into a superfund site. It is known that the watershed is impacted by the site since rain water from the mine seeps through the ground and nearby wetlands. The Natural Preparedness Survey distributed as part of the planning process for this plan asked, "how concerned are you about the abandoned asbestos mine?" Responses could range from Concerned to Neutral to I'm not worried. Seventy-one percent of respondents reported to be not worried or neutral. The Asbestos Mine is in Figure 3

Figure 4 Closed Asbestos Mine

3

PLANNING PROCESS

CHAPTER 3. PLANNING PROCESS

The planning process was developed in full compliance with the current planning requirements of the Federal Emergency Management Agency (FEMA) per the following rules and regulations:

- Robert T. Stafford Disaster Relief and Emergency Assistance Act (Public Law 93-288), as amended by the Disaster Mitigation Act of 2000
- Code of Federal Regulations – Title 44, Chapter 1, Part 201 (§201.6: Local Mitigation Plans)
- Federal Emergency Management Agency (FEMA) Local Mitigation Plan Review Guide (dated October 1, 2011)

In addition, the plan was prepared in a manner that maximizes credit points under the National Flood Insurance Program's Community Rating System (CRS). The Planning Team utilized FEMA's *CRS Coordinator's Manual* and its own internal planning crosswalk to ensure that the plan is consistent with CRS requirements for floodplain management planning (Activity 510).

A1. Does the Plan document the planning process, including how it was prepared and who was involved in the process for each jurisdiction? 44 CFR 201.6(c)(1) (a-e)

The purpose of the hazard mitigation planning process is to create a current Town of Lowell 2016 Hazard Mitigation Plan Update that meets all the requirements under both Vermont Division of Emergency Management and Homeland Security (DEMHS) and FEMA. These requirements include an updated risk analysis containing best available data and an updated mitigation strategy.

PLANNING TEAM

The Northeaster Vermont Development Association (NVDA) contracted with Jamie Caplan Consulting LLC to complete an update to the Town of Lowell 2016 Hazard Mitigation Plan Update. Jamie Caplan subcontracted with Stantec for assistance with the risk assessment portion of the plan.

A Planning Team was formed that included Frank Maloney, NVDA; Jamie Caplan, Jamie Caplan Consulting; and Amanda Carlson, Town Administrator. This core group held regular meetings to ensure the project progressed efficiently (Appendix A includes Planning Team Meeting summaries from each of these meetings).

The project was divided into nine steps as illustrated by the Work Plan (shown in Appendix A) and the Work Plan Timeline shown in Figure 1. Jamie Caplan Consulting developed the Work Plan with assistance from the Planning Team.

Table 2 Work Plan Timeline

Steps	Description	Jan 2016	Feb	Mar	Apr	May	Jun	Jul - Aug	Aug - Sep
1	Planning Process and Outreach Strategy	X	X	X	X	X	X	X	X
2	Develop Work Plan	X							
3	Hazard Data Review		X	X					
4	Review Hazard Data in Public Meeting #1		X	X					
5	Complete Vulnerability Assessment		X	X	X				
6	Identify Viable Mitigation Actions			X	X	X			
7	Review Mitigation Strategies Public Meeting #2				X	X	X		
8	Submit Plan to NVDA, Town of Lowell and DEMHS							X	
9	Submit Plan to FEMA for Review								X
Meetings									
Kick-off Meeting		X							
Planning Team Calls		X	X	X	X	X	X	X	X
Stakeholder Meetings			X	X			X		
Public Meetings				X			X		

UPDATES MADE TO 2006 PLAN

This 2016 Multi-Hazard Mitigation Plan is a complete revision from the 2005 Plan. Table indicates some basic changes made to the chapter structure of the plan. Each chapter includes details about how they were updated. The most significant update occurred in the risk assessment and revised mitigation actions.

Table 2 Comparisons between 2005 and 2016 Plans

2005 Mitigation Plan Chapters	2016 Plan Revisions
1. Planning Process	Chapter 1. Introduction Chapter 2. Town Profile Chapter 3. Planning Process
2. Risk Assessment	Chapter 4. Hazard Risk Assessment
3. Mitigation Strategy	Chapter 5. Capability Assessment Chapter 6. Mitigation Strategy
4. Plan Maintenance Process	Chapter 7. Plan Implementation
5. Maps	Chapter 8. Appendices

HAZARD MITIGATION COMMITTEE

The Planning Team identified twelve individuals to participate in the Hazard Mitigation Committee, shown in the list below. They represent multiple departments in the Town of Lowell as well Frank Maloney from NVDA. Each member of this committee was invited to participate, but not all members attended every meeting. Some of them participated in separate meetings or conversations with the Planning Team.

Hazard Mitigation Committee members:

1. Calvin Allen, Fire Chief and Road Commissioner
2. Amanda Carlson, Town Administrator
3. Anita Gagner, Lowell Graded School Principal
4. Frank Maloney, Planner, NVDA
5. Richard Pion, Select Board Chairman
6. Dwight Richardson, Select Board
7. Alden Warner, Select Board and Fire Department Member (Former Chief)

   Zoning Board Members
8. Charles Boulmetis
9. Keith Christiansen
10. Rolf Koob, Fire Department
11. Gordon Spencer – Zoning Administrator
12. Sam Thurston - Head of the Historical Society

The Hazard Mitigation Committee had two in-person meetings during the Planning Process. Details of these meetings are described below. Supporting materials for these meetings are included in Appendix A, including sign-in sheets.

MARCH 22, 2016

The entire twelve-member Hazard Mitigation Committee was present for the first meeting, held March 22, 2016 at 4:30pm in the Town Offices. The Planning Team led the meeting by first explaining the process of updating a hazard mitigation plan. Frank Maloney detailed how NVDA secured funding and supports the planning process. The PowerPoint presentation was distributed to each member and the meeting had the feel of a workshop with everyone participating.

The presentation included an overview of the planning process, details regarding public outreach and participation, some preliminary hazard identification information and critical facility information. The Planning Team previously updated the critical facility list from the 2005 plan. The 2005 plan maps Town Offices, Elementary School, and Fire Department. The 2005 Plan does not specifically name critical facilities. The Planning Team updated the list of critical facilities and then reviewed the list with the Hazard Mitigation Committee. The Lowell General Store was added to the critical facility list at this meeting. Everyone quickly agreed that since it is the only facility for gas and groceries within a twenty-minute drive it is essential to the well-being of Lowell residents. However, several Committee members expressed concern that including it in the plan would make a privately owned facility eligible for federal mitigation funding. The Planning Team explained that federal funding would not become available to retrofit the facility but rather it would indicate the General Store as a priority for the Town in terms of keeping access to it open from flooding and other hazards.

Discussion during the meeting also included reviewing past mitigation actions and updating capability assessment information. A concern about private property was raised in terms of beaver dams located on private property that if they break would cause flooding to other properties both public and private. Concerns were also raised regarding implementing rules or codes that would require certain building practices or other mitigation measures. The Committee is not interested in dictating how people build or use their property. However, the Committee does agree that educating residents about safe building practices and other hazard mitigation and preparedness measures is necessary. This meeting translated into multiple mitigation actions added to this plan.

MAY 24, 2016

The meeting on May 24, 2016 included nine members of the Hazard Mitigation Committee. The Planning Team became aware that not everyone would make the meetings. So the PowerPoint presentation including a full list of mitigation actions was emailed to each of them prior to the meeting for their review. The meeting lasted 1.5 hours and then extended through the Public Meeting. The Planning Team updated the Hazard Mitigation Committee on the planning process and the project timeline. The project is ahead of schedule nearly a month. They reviewed survey results and had an informal conversation regarding what is included in a mitigation plan and the difference between the four phases of emergency management, preparedness, mitigation, response and recovery.

Ms. Caplan showed the Committee preliminary results of the risk assessment including flood analysis, wildfire analysis, historical tornado tracks and landslide susceptibility. The Committee recognizes that national data sets and tools were used for the wildfire analysis and landslide susceptibility but feel that the analysis overstates the vulnerability in Lowell. Lowell has not experienced significant wildfires or landslides. The climate is very moist and densely forested.

Ms. Caplan explained the Priority Risk Index (PRI) to the Committee and showed them the preliminary results from that analysis as well. Ms. Caplan reiterated that a good risk assessment includes qualitative and quantitative analysis. The PRI is based on the quantitative analysis and the Committee meeting represents the necessary "ground truthing" or qualitative analysis. That being said, the Committee re-organized the hazard ranking table, the results of this discussion are shown below.

Table 3 Hazard Ranking Tables

Hazard Ranking	Based on Priority Risk Index	Based on Hazard Mitigation Committee Discussion
High Hazards	Winter Storms Flood Extreme Cold Severe Thunderstorm (High Wind) Drought	Flood Winter Storms Extreme Cold Severe Thunderstorm (High Wind and Lightning) Hurricane and Tropical Storm (High Wind)
Moderate Hazards	Extreme Heat Wildfire Severe Thunderstorm (Lightning) Tornado Hurricane and Tropical Storm Hail	Ice Jams Wildfire Hail Drought
Low Hazards	Earthquake Landslide Ice Jams	Tornado Extreme Heat Earthquake Landslide

The Committee felt very strongly that Flood be listed above Winter Storms. They said the Town experiences and handles Winter Storms with relatively little incident but that Flooding can wreak havoc and that it can happen quickly and unexpectedly. In that vein, they moved Hurricane up because of the high winds associated with it and the road damage the high winds cause. They moved Drought way down saying it is always wet and chilly in Lowell. They also moved Extreme Heat to the Low category. Ice Jams were moved up because of their likelihood and the potential damage they could cause.

The Planning Team reviewed a re-organized set of goal statements based on the goals in the 2005 Hazard Mitigation Plan. The Committee agreed with the re-organization which is detailed in the Mitigation Strategy Chapter of this Plan.

PUBLIC OUTREACH STRATEGY

A3. Does the Plan document how the public was involved in the planning process during the drafting stage? (Requirement §201.6(b)(1))

Several opportunities were offered throughout the planning process for the public to participate in the mitigation plan. These included:

- Participating in the Public Preparedness Survey
- Attending Town Hall Meetings
- Meetings with Planning Team Members
- Reviewing and commenting on the Draft Mitigation Plan

PUBLIC PREPAREDNESS SURVEY

The Public Preparedness Survey was an integral part of the Public Outreach Strategy. It gave the public an opportunity to comment on their level of interest, knowledge, and readiness toward hazards in the town.

Forty surveys were completed. A copy of the survey is attached in the Appendices. The majority of the surveys were collected at the Town Meeting held on March 1, 2016. The Town Administrator expected a large turnout for this meeting so it was the optimal time and place to distribute the surveys. Surveys were also distributed to the Hazard Mitigation Committee and at public meetings. The following list is a summary of the most compelling results from the survey:

- Only 39% reported being impacted in the past by a natural disaster
- Very few residents are concerned with hazards associated with the old asbestos mine
- Half of the respondents know which facilities in Town are shelters
- The majority of people do not have flood insurance and claim they do not live in a floodplain
- The best way way for people to receive mitigation or disaster preparedness information is through the mail or social media
- Respondents ranked community assets in the following order:
    - Garage
    - Fire House
    - School
    - Town Office
    - Post Office

- Their priority for mitigation planning is to protect emergency services, then protect utilities, to promote cooperation between public and private agencies and to protect private property

The Public Preparedness Survey informed several aspects of the hazard mitigation plan development and is mentioned throughout the Plan.

PUBLIC MEETINGS

The Planning Team, with the support of the Hazard Mitigation Committee, held two Public Meetings during the planning process. These public meetings were each advertised via press release, flyer, and e-mail (copies of these advertisements and attendance sign-in sheets are attached in the Appendix). The press releases appeared in the Front Porch Forum, a free community-building service in Vermont. It also appeared in the May 18, 2016 Chronicle on page sixteen (See Appendix). An example from the Front Porch Forum is illustrated in Figure 2. Ms. Carlson, Town Administrator, invited all of the residents on the Lowell e-mail list by sending them the flyer and personal invitation. Approximately forty people are registered on the list.

Hazard Mitigation Plan - Public Meeting

AMANDA CARLSON, ACARLSON@LOWELLTOWN.ORG, VT RTE 100, LOWELL

EVENT (ALSO ON CALENDAR)
CALENDAR

Event: May 24, 2016, 6:00 PM to 7:00 PM

Public Meeting – Disaster Planning

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

Join the Hazard Mitigation Committee on May 24, 2016 from 6:00 pm – 7:00 pm to share your ideas for reducing risk and becoming less vulnerable to natural hazards such as floods, hurricanes and winter storms. A specific list of projects will be presented along with results from the hazard risk assessment. The meeting will be held at the Town Office Building, 2170 Vermont Rte. 100, Lowell, Vermont.

The purpose of the 2016 Hazard Mitigation Plan Update is to identify and assess the community's natural hazard risks and determine how to best minimize and manage those risks. Upon completion, the plan will be presented to the Town of Lowell for adoption and submitted to Vermont Division of Emergency Management and Homeland Security (DEMHS) and Federal Emergency Management Agency (FEMA) for review and approval. A FEMA approved plan makes the Town of Lowell eligible for federal and state mitigation grant funding.

The Northeastern Vermont Development Association (NVDA) was awarded a grant from the DEMHS to develop the 2016 Hazard Mitigation Plan Update; the previous plan was developed in 2005. The NVDA hired Jamie Caplan Consulting LLC to work with them and the Town to develop the 2016 Hazard Mitigation Plan Update.

If you have any questions regarding the meeting or the survey, or would like to learn about more ways you can participate in the development of the Hazard Mitigation Plan, please contact Frank Maloney, Planner, Northeastern Vermont Development Association at 802-424-1419 or fmaloney@nvda.net. or The Town of Lowell

Amanda Carlson Town Administrator (802) 744 6559 acarlson@lowelltown.org

EMAIL AUTHOR REPLY TO FORUM

Figure 1 Press Release in Front Porch Forum

MARCH 22, 2016 PUBLIC MEETING

Nine people attended the first public meeting which was held directly after the Hazard Mitigation Committee meeting on the same day. Several Hazard Mitigation Committee members and Select Board members were also on hand for this meeting. The Planning Team presented a PowerPoint presentation that emphasized the planning process and the role of the public. The school principal spoke about the school's ability to shelter residents, their need for a generator and their reverse 911 system. This was a follow-up conversation from the Hazard Mitigation Committee meeting. These issues did become mitigation actions in this plan.

MAY 24, 2016 PUBLIC MEETING

Despite multiple outreach efforts the public meeting was not well attended. A factor that may have contributed to low attendance was the school trip to Washington, DC overlapped with the meeting. The trip brought the school principal and several other leaders in the community out of town. The majority of the Hazard Mitigation Committee stayed for the public meeting and conversations regarding mitigation actions continued. Several people expressed an interest in keeping up with the planning process, despite missing the meeting, so Ms. Carlson shared meeting materials with those people.

NEIGHBORING COMMUNITIES AND REGIONAL AGENCIES

A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? (Requirement §201.6(b)(2))

Every effort was made to involve the eight communities neighboring Lowell (Westfield, Albany, Montgomery, Eden, Troy, Newport, Irasburg, and Newport Center) in the public meetings and the mitigation planning process. Amanda Carlson, Town Administrator, sent the outreach flyers and meeting invitations to the town clerks and requested that they post it on their notice boards and e-mail it to their Zoning and Planning Boards and/or Select Boards. The Towns of Montgomery, Troy, and Westfield responded to Ms. Carson that they had spread the word about the Lowell Public Meetings.

Frank Mahoney, NVDA met with Karen Bates, Watershed Coordinator, VT Department of Environmental Conservation to discuss the Update to Lowell's mitigation plan. They discussed ways to manage erosion along the Missisquoi River. A couple of the bridges in Town may be undersized which increases rates of erosion and may cause water or ice to back up and lead to flooding.

The Town of Lowell Road Commissioner participates in Road Foreman meetings organized by Doug Morton the Transportation Planner at NVDA. This gives the Town a chance to collaborate with other Towns and an opportunity to learn about road permitting issues.

REVIEWING AND COMMENTING ON THE DRAFT MITIGATION PLAN

Multiple opportunities were provided for the Hazard Mitigation Committee and the public to review the Multi-Hazard Mitigation Plan Update draft. The Planning Team sent a copy of the draft plan to each Hazard Mitigation Committee member for his or her review prior to making the plan available for public review. The plan was

available for public review for over two-weeks on the Town's website (http://www.townoflowell.org) and to the NVDA website (http://www.nvda.net).

The Planning Team then incorporated changes received and posted an updated draft to the Town's website (http://www.townoflowell.org) and to the NVDA website (http://www.nvda.net) for public review. Comments and changes to the plan were sent to Frank Maloney at NVDA for compiling. These changes were then reviewed and incorporated into the plan.

4

RISK ASSESSMENT

CHAPTER 4. RISK ASSESSMENT

INTRODUCTION

In order to gain an understanding of the natural disaster risks that the people of Town of Lowell are up against, it is necessary to develop a comprehensive natural hazard risk and vulnerability assessment. This risk assessment examines the vulnerability of current and future populations, and structures (including critical facilities and infrastructure) to various natural hazards. The risk assessment provides a compilation of available information and data sets to the Town for comprehensive planning purposes. The risk assessment answers questions regarding hazard history, probability, frequency, and impact. These answers are then used to inform mitigation actions for the town. The ultimate purpose of this plan is to save lives and reduce property losses in future disasters.

The risk assessment is formatted to meet the Federal Emergency Management Agency's local-level hazard mitigation planning regulations as found in C.F.R. 44 201.6 (*Local Mitigation Plans*) in addition to state requirements. FEMA requires the Town to include all possible natural hazard events, to assess vulnerability, and to estimate potential losses. Each hazard must be profiled to include a description of the hazard, historical occurrences, extent (or magnitude), location, and vulnerability. The identified hazards and hazard profile details are described in this chapter.

Extensive information regarding the Town of Lowell's historic, economic, and population make up can be found in Chapter 2. It is advisable to review Chapter 2 prior to reading the Risk Assessment to best understand the geography and characteristics of the town. A Base Map of the Town of Lowell can be found in Figure 1 below.

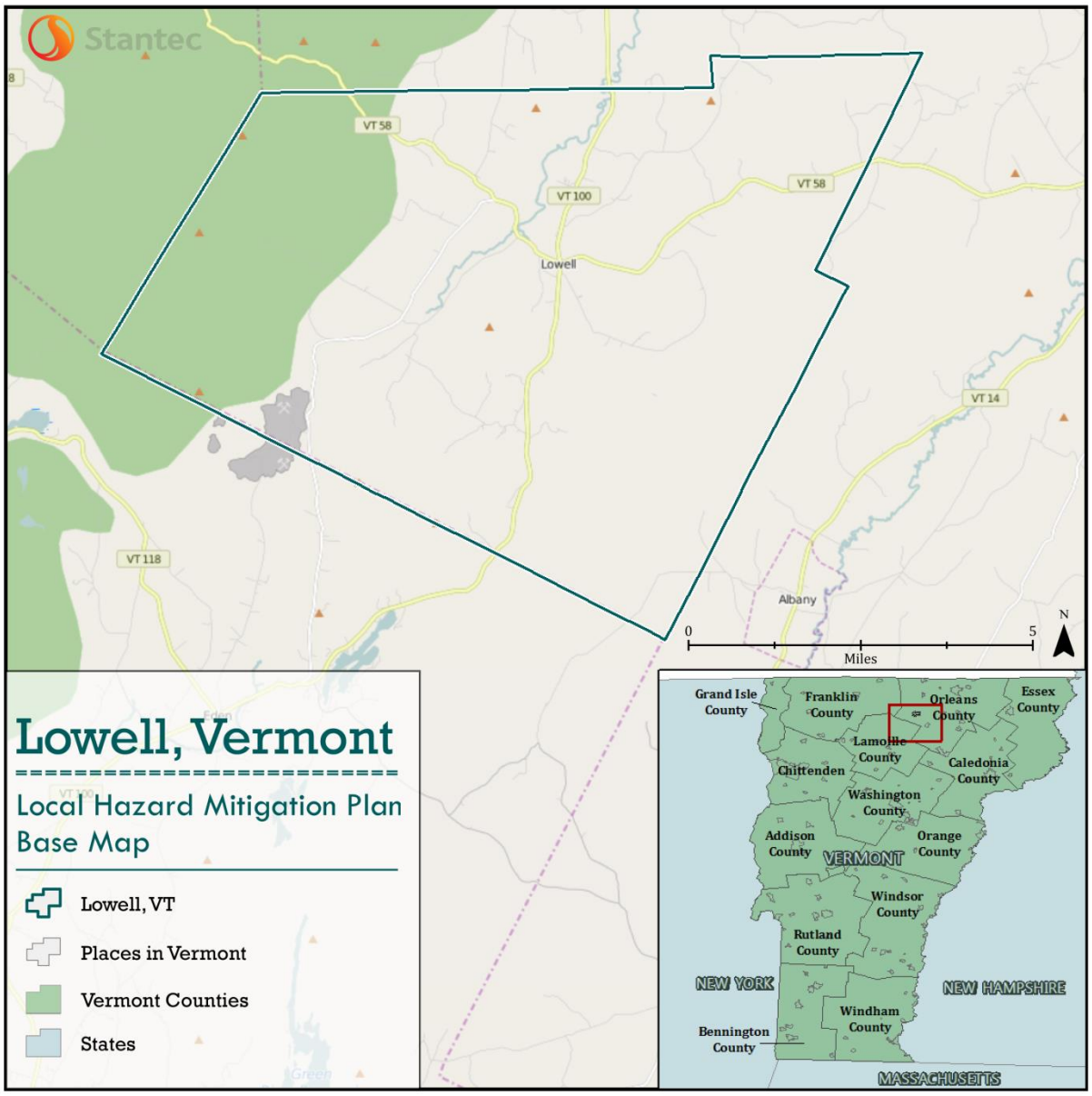

Figure 1 Town of Lowell Base Map

CRITICAL FACILITIES

The following buildings have been deemed critical by Town of Lowell officials. Critical facilities are considered structures or institutions necessary for the Town in terms of emergency response and recovery. These facilities must continue to operate during and following a disaster to reduce the severity of impacts and accelerate recovery.[20] Critical facilities typically include airports, emergency operation centers (EOCs), fire stations, hospitals, police stations, schools, government buildings, and railroad stations. Table 1 lists the Town's critical facilities and reasons why they are considered critical facilities. Figure 2 shows the location of each critical facility.

There are no known losses to critical facilities that have occurred in the last ten years (though future losses are possible). Further, no additional data on previous losses were available. These facilities have a combined building exposure value of nearly $3.7 million (as provided by town officials).

Table 3 Lowell Critical Facilities

Critical Facility	Type	Justification for Inclusion
Post Office	Government	Mail services
Catholic Church	House of Worship	These facilities are deemed critical because of their emergency response function.
Parish Hall	Public Gathering	Houses vulnerable populations and identified as critical.
Lowell Grade School	Educational	School/Shelter
Town Clerks Office/Historical Society/Library	Government	Vital documents
Lowell Congressional Church	House of Worship	Community gathering building
Lowell Fire Department	Fire Station	Emergency Response Support; Equipment
Lowell Town Garage	Government	Equipment and Vehicles
Wind Tower Control Building and Land	Wind Facility/Wind Tower	This land and the building are privately owned. They are considered critical facilities because of the tremendous revenue the Town receives from Green Mountain Power.
General Store	General Store	Local convenience store to buy basic household items, food and gas.

[20] Local Mitigation Planning Handbook. (2012). Federal Emergency Management Agency. Available at http://www.fema.gov/hazard-mitigation-planning-resources

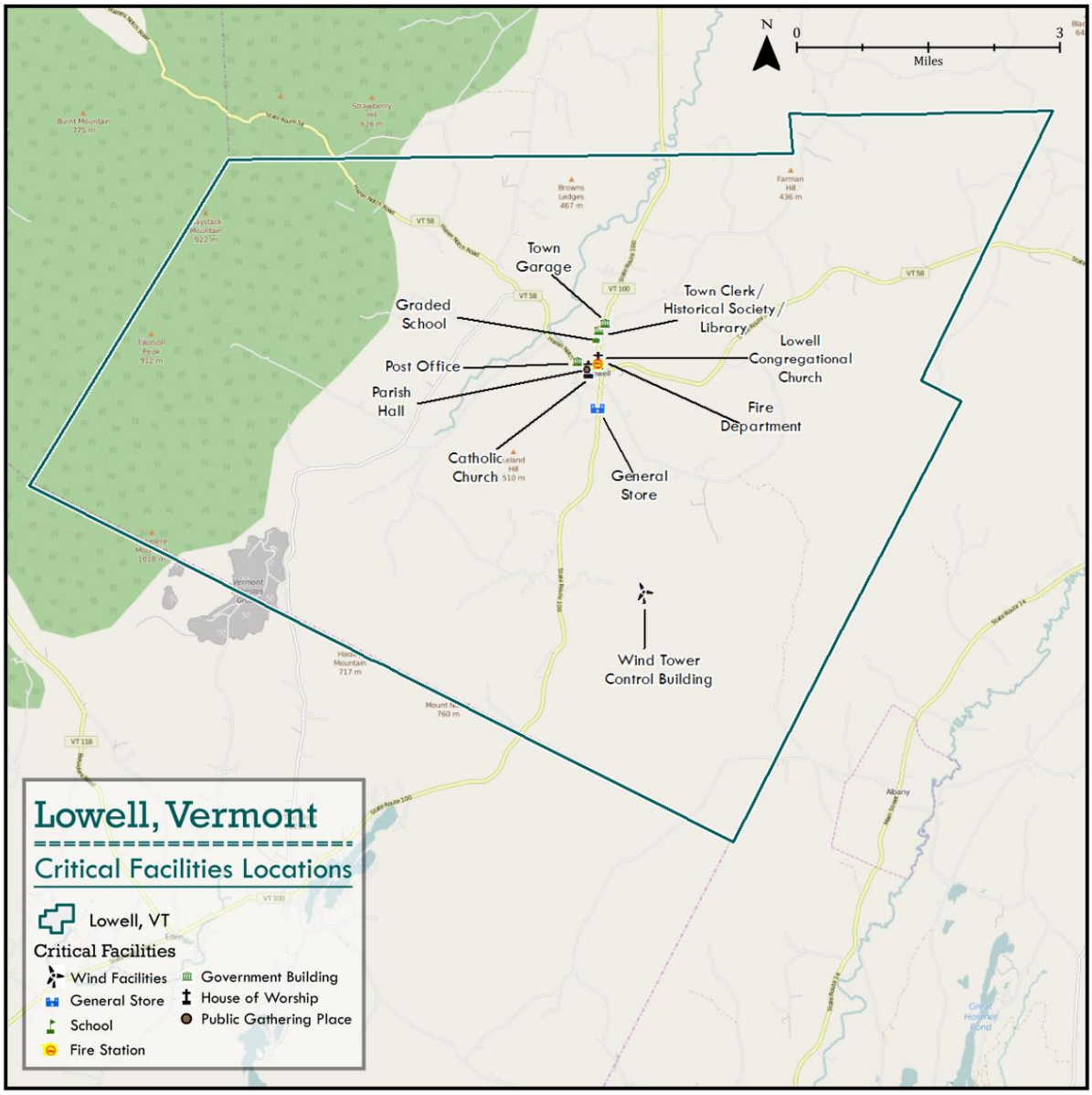

Figure 2 Town of Lowell Critical Facilities

HAZARD IDENTIFICATION

Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction? 44 CFR 201.6(c)(2)(i) and 44 CFR 201.6(c)(2)(iii)

Hazard identification is the process of identifying the types of hazards that can affect the mitigation plan study area; in this instance, the study area is the Town of Lowell, Vermont. While only natural hazards are required, other hazards such as technological or man-made hazards can be included in the plan. The identified hazards include all those hazards listed in the State Hazard Mitigation Plan (SHMP). In addition to the SHMP hazards, a list of major presidential disasters was reviewed to better understand the planning area. These can be found in Table 2 below. The table also highlights the two main types of disaster assistance provided by FEMA: Individual Assistance (IA) and Public Assistance (PA). The IA program provides funds for individuals and households for temporary housing, lodging reimbursement, housing repair, housing replacement, and housing constructions. The IA program also provides assistance for related expenses such as child care, medical care, and essential household items, for example. The PA program provides assistance to state, tribal, and local governments, and some non-profit organizations to help communities quickly recover. There is typical cost share of 75 percent of the eligible cost of the project is covered by the federal government, resulting in a 25 percent non-Federal share. There are several categories of public assistance projects, which highlight the type of projects:

- Category A: Debris removal
- Category B: Emergency protective measures
- Category C: Roads and bridges
- Category D: Water control facilities
- Category E: Public buildings and contents
- Category F: Public utilities
- Category G: Parks, recreational, and other facilities

Table 4 Presidential Disasters Declared in Orleans County, VT (1965-2016)

Date	Disaster Name (Date of Event)	Disaster Number (Type of Assistance)	Assistance
07/09/1973	Severe Storms, Flooding, Landslides	FEMA-397	**IA, PA-ABCDEFG**
08/13/1976	Severe Storms, High Winds, Flooding	FEMA-518	**IA, PA-ABCDEFG**
08/16/1995	Excessive Rainfall, Flooding	FEMA-1063	**IA, PA-ABCDEFG**
02/13/1996	Ice Jams and Flooding	FEMA-1101	**PA-ABCDEFG**
07/25/1997	Excessive Rainfall, High Winds, Flooding	DR-1184	**IA, PA-ABCDEFG**
07/10/1998	Severe Storms and Flooding	DR-1228	**IA, PA-ABCDEFG**
11/10/1999	Tropical Storm Floyd	DR-1307	**PA**
4/10/2001	Snow	EM-3167	**PA**
07/12/2002	Severe Storms and Flooding	DR-1428	**IA, PA-ABCDEFG**
9/23/2004	Severe Storms and Flooding	DR-1559	**PA-ABCDEFG**
8/3/2007	Severe Storms and Flooding	DR-1715	**PA-ABCDEFG**
6/15/2011	Severe Storms and Flooding	DR-1995	**IA, PA-ABCDEFG**
8/29/2011	Hurricane Irene	EM-3338	**PA**
9/1/2011	Tropical Storm Irene	DR-4022	**IA, PA-ABCDEFG**
6/22/2012	Severe Storm, Tornado, Flooding	DR-4066	**PA-ABCDEFG**

Date	Disaster Name (Date of Event)	Disaster Number (Type of Assistance)	Assistance
8/2/2013	Severe Storms and Flooding	DR-4140	**PA-ABCDEFG**
1/29/2014	Severe Winter Storm	DR-4163	**PA-ABCDEFG**
6/11/2014	Severe Storms and Flooding	DR-4178	**PA-ABCDEFG**
2/3/2015	Severe Winter Storm	DR-4207	**PA-ABCDEFG**

Informed by local input from the mitigation committee, federal disaster declarations, and the SHMP, Table 3, indicates each hazard studied and the justification for inclusion in the Town of Lowell mitigation plan. This table also illustrates a comparison between the relevant hazards in the SHMP and in Lowell's hazard mitigation plan. The hazard list from previous planning efforts in Lowell was amended during the 2016 planning process to better reflect the Vermont SHMP. In addition, climate change was added as an overall consideration to all hazards. A comparison of hazards found in this version versus the previous 2006 version can be viewed in Table 4.

Table 5 Hazard Identification and Justification for Inclusion

2013 Vermont State Hazard Mitigation Plan	Town of Lowell Relevance and Justification	Included in Town of Lowell HMP
ATMOSPHERIC HAZARDS		
Flooding and Fluvial Erosion	There are several historical floods in the town and presidential disasters linked to flood in the county. Flooding can result in property damage and loss of lives. Erosion, which is a naturally occurring process. Flowing water and floods may erode streambeds or wash out roads. It also includes beaver dams which can result in flooding when breached.	YES
Severe Thunderstorm (including wind and Lightning)	Severe thunderstorms are common during the warmer months. They are capable of producing strong wind, lightning, and hail (discussed separately). There are several major disaster declarations associated with this hazard.	YES
Severe Winter Storms	This hazard includes snow, ice, and blizzard events. There are several major disaster declarations associated with this hazard.	YES
Ice Jams	Ice jams are possible in this area and may result in flooding, although limited incidents have been reported in the planning area. There is a major disaster declaration associated with this hazard.	YES
Tornadoes	Tornadoes pose a risk because buildings in this part of the country are not built to withstand severe wind damage. However, tornadoes are a low probability event. There are federal disaster declarations associated with this hazard.	YES
Hurricanes & Tropical Storms	Lowell is not a coastal community and is several hours from the coast. However, a hurricane may arrive as a tropical storm or tropical storm remnants and is still capable of resulting in wind damage, tornadoes, and flooding. There are two major disaster declarations associated with this hazard.	YES
Hail	Hail is typically associated with thunderstorms and is capable of causing extensive property damage (especially to roofs) and vehicular damage.	YES

2013 Vermont State Hazard Mitigation Plan	Town of Lowell Relevance and Justification	Included in Town of Lowell HMP
Extreme Temperatures	Extreme cold is a risk in Lowell. It can become a hazard, particularly for vulnerable populations, if the power is disrupted or the event lasts several days. It may also result in hypothermia or frostbite due to exposure. Extreme heat threatens the population, particularly for vulnerable populations, if the power is disrupted or the event lasts several days. Heat can result in a variety of health conditions including heat stroke. It can also have impacts on agricultural resources.	YES
Drought	Drought is a risk in Lowell. Drought typically occurs in the summer months and can result in water restrictions and increased wildfire hazard.	YES
Wildfire	Wildfire is a risk in Lowell. There is significant tree cover that could result in wildfire. However wildfires are rare in the planning area, and there have been no major incidences in Vermont since the 1950s.	YES
Landslide/Rockslides	Landslide is a risk in Lowell. This hazard was investigated in accordance with SHMP hazards. Rockcuts for road construction may also result in rocksliding hazards. Steep slopes and mountains within the Town are heavily vegetated and thus have a low probability but are possible.	YES
Earthquakes	Earthquake is a risk in Lowell. Earthquakes are possible in this area and the hazard was included in the state plan. In general, earthquake risk in the planning area is low.	YES
Infectious Disease Outbreak	Infectious Disease is a risk in Lowell and was included in accordance with SHMP. Further, infectious diseases could threaten the economic wellbeing and public health within the Town.	YES
TECHNOLOGICAL HAZARDS		
Dam Failure	There are no nearby dams that would impact the Town of Lowell. Further, technological hazards are not required to be addressed per FEMA regulations for hazard mitigation plans.	NO
Terrorism	While it is recognized that terrorism is possible anywhere, there are no significant sights or threats that deem further assessment in this this plan. Emergency Management Plans typically address this with response and preparation measures. Further, technological hazards are not required to be addressed per FEMA regulations for hazard mitigation plans.	NO
Invasive Species	Technological hazards are not required to be addressed per FEMA regulations for hazard mitigation plans.	NO
Rock Cuts	Human removal of rock (often for road construction) was not addressed as a separate hazard. Any areas of concern will be addressed under the Landslide hazard profile. Further, technological hazards are not required to be addressed per FEMA regulations for hazard mitigation plans.	NO
Nuclear Power Plant Failure	There are no nuclear power plants in the area. The nearest site is over 130 miles away (Vermont Yankee). Further, technological hazards are not required to be addressed per FEMA regulations for hazard mitigation plans.	NO

Non-natural hazards are not required by federal regulations (44 CFR 201) and thus will not be profiled extensively or include a vulnerability assessment.

Rock Cuts, Nuclear Power Plant Failure, Terrorism, and Dam Failure were included in the state plan as technological hazards but are not required by federal regulations (44 CFR 201). These hazards were not deemed as a threat to the Town of Lowell, addressed under existing natural hazard profiles, or addressed in other community plans. Thus, they were not included in this plan.

Table 6 Comparison of Hazard Identification from Previous Local Hazard Mitigation Plan

2005 Lowell Hazard Mitigation Plan Identified Hazards	2016 Lowell Hazard Mitigation Plan Identified Hazards *Note: Climate Change included within each hazard as an extenuating circumstance.*
ATMOSPHERIC/NATURAL HAZARDS	
Flood • Flood/Flash Flood • Beaver Dams • Flash Flood	Flood • Flood/Flash Flood • Erosion • Beaver Dams
Forest Fire	Wildfire
Severe Weather – Power Outages	Severe Thunderstorm (including Wind and Lightning)
Not included	Severe Winter Storm
Not included	Ice Jams
Not included	Tornadoes
Not included	Hurricanes and Tropical Storms
Not included	Hail
Not included	Extreme Temperatures
Not included	Drought
Not included	Wildfire
Not included	Landslides/Rockslides
Not included	Earthquakes
TECHNOLOGICAL HAZARDS	
Not included	Infectious Disease Outbreak
Hazardous Materials	Not Included (as a non-natural hazard, it is not subject to FEMA 44 CFR 201 regulations). It was recommended that this hazard continue to be included in other community plans.
Structure Fire	Not Included (as a non-natural hazard, it is not subject to FEMA 44 CFR 201 regulations). It was recommended that this hazard continue to be included in other community plans. Further, potential fire risk to structures due to wildfire, is addressed under the wildfire hazard.
School Safety Issues	School safety was not included in this iteration of the plan. Schools do emergency planning with the fire departments to prepare emergency action plans for a variety of potential incidents ranging from bomb scares to drugs to guns.

PRIORITY RISK INDEX

The prioritization and categorization of identified hazards for the Town of Lowell is based principally on the Priority Risk Index (PRI), a tool used to measure the degree of risk for identified hazards in a particular planning area. The PRI was used to assist the Town of Lowell Hazard Mitigation Committee in gaining consensus on the identification of those hazards that pose the most significant threat to the Town. These hazards were chosen based on a variety of factors including location extent, impact, probability, warning time, and duration.

The PRI results provide a numerical value for each hazard that allows hazards to be ranked against one another (the higher the PRI value, the greater the hazard risk). PRI values are obtained by assigning varying degrees of risk to five categories for each hazard, 1) probability, 2) impact, 3) spatial extent, 4) warning time, and 5) duration). Each degree of risk has been assigned a value from 1 to 4 and an agreed upon weighting factor.

To calculate the PRI value for a given hazard, the assigned risk value for each category is multiplied by the weighting factor. The sum of all five categories equals the final PRI value, as demonstrated in the example equation below:

PRI VALUE = [(PROBABILITY x .30) + (IMPACT x .30) + (SPATIAL EXTENT x .20) + (WARNING TIME x .10) + (DURATION x .10)]

According to the weighting scheme applied, the highest possible PRI value is 4.0. Table 5 shows the weighting schemes for each category. By determining a value for each hazard that can be relatively compared to other hazards threatening the planning area, hazards can be ranked with greater ease.

Many of the PRI categories are described within the hazard profiles. The final PRI results, including the calculated values for each natural hazard in Lowell, are found at the end of this section in the “Summary of Hazard Risk.” It should be recognized that not all hazards pose a serious threat to the Town, and the PRI is helpful in summarizing the potential risk.

Table 7 Priority Risk Index Scoring Criteria

PRI CATEGORY	DEGREE OF RISK			ASSIGNED WEIGHTING FACTOR
	LEVEL	CRITERIA	INDEX VALUE	
Probability	Unlikely	Less than 1% annual probability	1	**30%**
	Possible	Between 1 and 10% annual probability	2	
	Likely	Between 10 and 90% annual probability	3	
	Highly Likely	90%+ annual probability	4	
Impact	Minor	Only minor property damage and minimal disruption to government functions and services. No shutdown of critical facilities.	1	**30%**
	Limited	Minor injuries are possible. More than 10% of buildings damaged or destroyed. Temporary shutdown of critical facilities (less than one week).	2	
	Critical	Multiple deaths/injuries possible. More than 25% of buildings damaged or destroyed. Complete shutdown of critical facilities for more than one week.	3	
	Catastrophic	High number of deaths/injuries possible. More than 50% of buildings damaged or destroyed. Complete shutdown of critical facilities for 30 days or more.	4	
Spatial Extent	Negligible	Limited to one specific area	1	**20%**
	Small	Small areas affected	2	
	Moderate	Large areas	3	
	Large	All areas	4	
Warning Time	More than 24 hours	Self-explanatory	1	**10%**
	12 to 24 hours	Self-explanatory	2	
	6 to 12 hours	Self-explanatory	3	
	Less than 6 hours	Self-explanatory	4	
Duration	Less than 6 hours	Self-explanatory	1	**10%**
	Less than 24 hours	Self-explanatory	2	
	Less than one week	Self-explanatory	3	
	More than one week	Self-explanatory	4	

SOURCES OF INFORMATION

Hazard information collection and assessment was conducted for all hazards under consideration. Information sources used in the risk and vulnerability assessment included hazard mitigation plans, reports and studies, Internet resources, local newspapers, and personal interviews conducted with government officials and representatives, professional experts, and residents of the Town of Lowell. In addition, Hazus-MH was used for data and to conduct the flood analysis. Hazus-MH is FEMA's GIS-based loss estimate modeling tool for flood, hurricane wind, and earthquakes.

Two main datasets were utilized during this plan update – Parcel Data (Town of Lowell), building data (Town of Lowell), and building values (Hazus-MH). No single source of data could be utilized because each was incomplete. However, when used in conjunction with one another, a more robust assessment was developed. The Town provided information on number parcels; however, no additional building information (construction type, building replacement value) was associated with the parcel data. The town also provided E911 building data, which does provide building information such as building use. Of note, the E911 data is a spatial point data and not a building footprint; no building footprints were available. Neither the E911 data nor the parcel data contained building value information. Given a lack of building values, Hazus-MH was used to determine the total exposure within the town and estimate potential dollar losses. Table 6 shows data sources of information while Table 7 shows a breakdown of type of property from the E911 source. (Note that critical facilities are included in the E911 source and explained in the aforementioned Critical Facilities subsection.)

Table 8 Building Data Sources

Data	Value	Source
Number of Parcels	1,166	Town of Lowell
Value of Parcels	N/A	N/A
Emergency Site/911 Layer (number of buildings)	595	Town of Lowell (NVDA)
Number of Buildings	546	FEMA Hazus-MH 2.1
Building Replacement Value (total exposure)	$79,337,500	FEMA Hazus-MH 2.1
Value of Building and Contents	$124,935,000	FEMA Hazus-MH 2.1

Table 9 Building Data (by building type)

Type	Number	Type	Number
Camps	137	**Mobile Home**	86
Cemetery	1	**Multi-Family**	8
Commercial	12	**Other**	11
Development Site	12	**Other Commercial**	12
Fire Station	1	**Other Residential**	9
Gated w/o Building	5	**Public Gather**	2
Government	3	**Public Telephone**	1
Gravel Pit	2	**Seasonal Home**	3
House of Worship	3	**Single Family**	288
Industrial	2	**Wind Facility/Wind Tower**	1
TOTAL	**595**		

HAZARD PROFILES

Does the Plan include a description of the type, location, and extent of all natural hazards that can affect each jurisdiction? 44 CFR 201.6(c)(2)(i) and 44 CFR 201.6(c)(2)(iii)

Does the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction? 44 CFR 201.6(c)(2)(i)

Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? 44 CFR 201.6(c)(2)(ii)

Each hazard mentioned above is profiled separately to describe the hazard and potential impacts on the Town. The profile for each hazard includes:

- Hazard description: A scientific explanation of the hazard including potential magnitude (or severity) and impacts;
- Location: Geographical extent of the hazard;
- Previous occurrences: The number of previous hazard events occurring in the Town (or surrounding area). This section also details previous events including past impacts;
- Extent (or magnitude): The severity of the hazard in the past and potentially severity in the future. Measures may include wind speed, scientific scales, or property damage, for example;
- Probability of future events: The likelihood of future events impacting the Town. Given that an exact probability is often difficult to quantify, this characteristic is categorized into ranges to be used in hazard profiles in accordance with the PRI described above:
    - Unlikely: Less than 1% annual probability
    - Possible: Between 1% and 10% annual probability
    - Likely: Between 10+% and 90% annual probability
    - Highly Likely: Greater than 90% annual probability
- Vulnerability Assessment: The vulnerability assessment will address conditions that may increase or decrease vulnerability such as topography, soil type, land use, and development trends will also be included.
- Potential Losses: Estimated losses will be calculated using available data and resources. Methods utilized include GIS analysis and hazard modeling where tools are available. Information such as number of structures at risk and critical facilities at risk will be analyzed.
- Hazard profiles are presented in alphabetical order.

In addition, each hazard addresses the impacts of climate change. In most cases, this change in meteorological conditions is expected to exacerbate existing hazards.

In alignment with the SHMP, the following text provides hazard profiles for each identified hazards for the Town of Lowell. Hazards are presented in two overarching categories:

- Atmospheric hazards
- Technological Hazards

ATMOSPHERIC HAZARDS

FLOOD

Description

Flooding is a frequent, dangerous, and costly hazard. Globally, it accounts for 40 percent of all natural disasters and results in an average of over 6,500 deaths annually.[21] In the U.S., flooding results in an average of 89 deaths annually.[22] Nearly 90 percent of all presidential disaster declarations result from natural events where flooding was a major component.

Flooding is the most common environmental hazard, due to the widespread geographical distribution of valleys and coastal areas, and the population density in these areas. The severity of a flooding event is typically determined by a combination of several major factors, including: stream and river basin topography and physiography; precipitation and weather patterns; recent soil moisture conditions; and the degree of vegetative clearing and impervious surface. Both of these flooding events can be brought on by severe (heavy) rain. There are several types of flooding which are presented below:

- **Flash Flooding**
  Flash floods occur within a few minutes or hours of heavy amounts of rainfall and is capable of destroying buildings, uproot trees, and scour out new drainage channels. Heavy rains that produce flash floods can also trigger mudslides and landslides. Most flash flooding is caused by slow-moving thunderstorms or repeated thunderstorms in a local area, or by heavy rains from hurricanes and tropical storms. Although flash flooding often occurs in mountainous areas, it is also common in urban centers where much of the ground is covered by impervious surfaces.

- **Sheet Flooding**
  Sheet flooding is a condition where storm water runoff forms a sheet of water to a depth of six inches or more. Sheet flooding and ponding are often found in areas where there are no clearly defined channels and the path of flooding is unpredictable. This type of flooding is more common to occur in flat areas. Most floodplains are adjacent to streams or oceans, although almost any area can flood under the right conditions where water may accumulate.

- **Urban Flooding**
  Urban flooding is usually caused by heavy rain over a short period of time. As land is converted from fields or woodlands to roads and parking lots, it loses its ability to absorb rainfall. Since sidewalks and roads are non-absorbent, water flows down the surface of the streets, and is then dumped directly into sewers. In fact, roads and buildings generate more runoff than tropical forestland. Fixed drainage channels in urban areas may be unable to contain the runoff that is generated by relatively small but intense rainfall events.

[21] Flood Data and Statistics. (2008). Prevention Web. Retrieved December 11, 2014 from http://www.preventionweb.net/english/hazards/statistics/?hid=62
[22] Weather Fatalities. (2014). National Weather Service. Retrieved December 11, 2014 from http://www.nws.noaa.gov/om/hazstats/resources/weather_fatalities.pdf

Urbanization increases runoff two to six times over what would occur on natural terrain. As a consequence, high volume of water can turn parking lots into lakes, flooding basements and businesses, and cause lakes to form in roads where drainage is poor or overwhelmed.

Urban flooding occurs where there has been development within stream floodplains. This is partly a result of the use of waterways for transportation purposes in earlier times. Sites adjacent to rivers and coastal inlets provided convenient places to ship and receive commodities. The price of this accessibility has increased flooding in the ensuing urban areas. Urbanization intensifies the magnitude and frequency of floods by increasing impermeable surfaces, amplifying the speed of drainage collection, reducing the carrying capacity of the land, and occasionally, overwhelming sewer systems.

- **Riverine Flooding**
  Periodic flooding of lands adjacent to non-tidal rivers and streams (known as the floodplain) is a natural and inevitable occurrence. When stream flow exceeds the capacity of the normal watercourse, some of the above-normal stream flows onto adjacent lands within the floodplain. Riverine flooding is a function of precipitation levels and water runoff volumes within the watershed of a stream or river. The recurrence interval of a flood is defined as the average time interval measured in years, expected to take place between the occurrence of a flood of a particular magnitude and an equal or larger flood. Flood magnitude increases with increasing recurrence interval.

Fast warming temperatures in the spring months may also result in flooding due to snowmelt.

In addition to flooding types, there are several types of floodplains. All the flood types described above may occur within a floodplain. However, the flooding may not occur in a designated floodplain.

As noted above, the periodic flooding of lands adjacent to rivers, streams, and shorelines (land known as floodplain) is a natural process that has some chance of occurrence each year. Floodplains are designated by the frequency (and severity) of the flood that is large enough to cover them. For example, the 10-year floodplain will be covered by the 100-year flood and the 100-year floodplain by the 1,000-year flood. Flood frequencies such as the 100-year flood are determined by plotting a graph of the size of all known floods for an area and determining how often floods of a particular size occur. Another way of expressing the flood frequency is the chance of occurrence in a given year, which is the percentage of the probability of flooding each year. For example, the 100-year flood has a 1.0-percent chance of occurring in any given year, and the 500-year flood drops to a 0.2-percent chance of occurring in any given year. Therefore, they are commonly referred to as the 1.0-percent annual chance flood and 0.2-percent annual flood, respectively. It should be noted that flooding is possible every year and even multiple times each year.

The U.S. Army Corp of Engineers and Federal Emergency Management Agency (FEMA) have a role in defining floodplain. The U.S. Army Corps of Engineers calls a 100-year flood an Intermediate Regional Flood, while a Standard Project flood describes a major flood that could be expected to occur from a combination of severe meteorological and hydrologic conditions. Most dam and flood-related structures have been designed to meet 100-year flood conditions.[23] FEMA develops Digital Flood Insurance Rate Maps (DFIRMs) to indicate areas in the U.S. where mandatory flood insurance requirement apply (the 1.0-percent annual chance flood). They are also used for planning purposes to identify hazard areas. DFIRMs are not available for Orleans County. The Town of Lowell has identified this as a mitigation action and is encouraging FEMA to develop DFIRMs for Orleans County. Although an all-inclusive description of FEMA flood zones is not included in this document, brief descriptions of the zones appearing on the FIRMs for the county are as follows:

[23] Flooding. (2003). North Carolina Division of Emergency Management. Retrieved December 11, 2014 from http://www.dem.dcc.state.nc.us/mitigation/flood.htm.

- **Zone A**
  Zone A is the flood insurance rate zone that corresponds to the 1.0-percent annual chance floodplains determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations (BFEs) or depths are shown within this zone. Mandatory flood insurance purchase requirements apply.

- **Zone AE**
  Zones AE is the flood insurance rate zones that correspond to the 100-year floodplains determined in the Flood Insurance Study by detailed methods. In most instances, BFEs derived from the detailed hydraulic analyses are shown at selected intervals within this zone. Mandatory flood insurance purchase requirements apply.

- **0.2-percent-annual-chance (or 500-year) flood**
  This area corresponds to the 0.2-percent annual chance flood areas.

- **Zones B, C, and X**
  Zones B, C, and X are the flood insurance rate zones that correspond to areas outside the 100-year floodplains, areas of 100-year sheet flow flooding where average depths are less than one foot, areas of 100-year stream flooding where the contributing drainage area is less than one square mile, or areas protected from the 100-year flood by levees. No BFEs or depths are shown within this zone. Typically, B and X (shaded) are moderate flood hazard areas, while C or Zone X (unshaded) or minimal flood hazards areas. Note: shade zone X is used in place of Zone B on new maps, and unshaded Zone X is used in place of Zone C on new maps. It should be noted that flooding is possible outside of any defined flood zone. In fact, areas subject to flash flooding are often not captured on the maps. In addition, the flood event may be more severe than the 100-year or 500-year flood zones. In this case, water would go beyond these anticipated areas. Further, development can also alter where water goes in terms of the amount of drainage capability and where water travels. Areas that have not flood historically should not be considered immune from such an event.

Climate change impacts, such as El Niño can also impact flooding through increased or decreased events. El Niño can be generally described as a warmer than normal sea temperatures in the equatorial Pacific. However, its impact can be felt around the globe. Southern Oscillation is defined as a "seesaw of atmospheric pressure between the eastern equatorial Pacific and Indo–Australian areas." The two are closely linked and together called El Niño–Southern Oscillation (ENSO) events.[24] During El Niño is the sea temperature component while Southern Oscillation is the atmospheric pressure component. The systems can impact weather patterns throughout the globe when in effect.

NOAA data suggests increased winter (November through January) precipitation during strong El Niño events and decreased precipitation in weak El Niño events.[25] Beyond these months, trends were for normal to drier conditions during El Niño events.[26]

Erosion and Beaver Dams are also associated with the flood hazard.

[24] ENSO and Drought Forecasting. (2014). National Drought Mitigation Center. Retrieved December 11, 2014 from http://drought.unl.edu/DroughtBasics/ENSOandForecasting.aspx
[25] United States El Nino Impacts. (2014). Climate.gov. Retrieved December 11, 2014 from http://www.climate.gov/news-features/blogs/enso/united-states-el-ni%C3%B1o-impacts-0
[26] ENSO Impacts on the U.S. (2008). National Weather Service: Climate Prediction Center. Retrieved December 11, 2014 from http://www.cpc.ncep.noaa.gov/products/predictions/threats2/enso/elnino/

Erosion is the gradual breakdown and movement of land due to both physical and chemical processes of water, wind, and general meteorological conditions. Natural or geologic erosion has occurred since the Earth's formation, and continues at a very slow and uniform rate each year.

Water erosion can occur over land or in streams and channels. Water erosion, the type of erosion of concern in this plan, may result from raindrops, shallow sheets of water flowing off the land, or shallow surface flow, which becomes concentrated in low spots. Stream channel erosion may occur as the volume and velocity of water flow increases enough to cause movement of the streambed and bank soils. Fluvial erosion is the process of natural stream channel adjustments. Fluvial erosion causes erosion of sediment in some areas, while causing aggradation of sediment in other areas.

Fluvial erosion processes occur more quickly and severely during flood events. Steeper sloped areas and smaller streams are most prone to fluvial erosion. Fluvial erosion can also undercut river or stream bank, creating a risk of collapse. This creates a hazard for those walking along the bank or structures near the bank. Areas of fluvial erosion are also prone to landsliding.

Beavers dams are beaver-built dam built on nearly any type of water source as a form of protection from predators. It is formed by tree branches, mud and rocks that beavers scavenge. By flooding the area behind the dam, beavers can easily swim to obtain food (bark and aquatic vegetation) and has a safe habitat to eat, sleep, and bore kits within the beaver lodge. Beavers typically select spots where there is a large flat area to flood with plenty of trees nearby.[27] While this is natural process for beavers, it can often have dramatic consequences on the landscape.

Beavers have the ability to impact the flow of water and cause flooding by cutting down trees and creating dams. In fact, beavers have posed a problem in many areas within the state. Figure 3

Figure 5 A beaver dam in Vermont (Vermont State Parks)[28]

27 Beaver Biology. (2014). Beaver Solution. Retrieved on December 11, 2014 from http://www.beaversolutions.com/about_beaver_biology.asp

28 Vermont State Parks. Department of Forests, Parks, and Recreation. Retrieved May 6, 2016 from VTstateparks.com/htm/nature_wildlife.htm.

Location

Lowell is located at the headwaters of the East Branch of the Missisquoi River including the Burgess Branch and McAllister Pond. FEMA DFIRMS are typically used to indicate flood location visually; however, they are not available for this area. Paper FIRMs and associated Flood Information Study can be found on the FEMA Map Service Center at https://msc.fema.gov/portal.

Hazus-MH was used to model flood location but is not a replacement for regulatory floodplain boundaries. Figure 4 shows flooding can occur outside of these locations, particularly due to flash floods and over capacity storm water management systems.

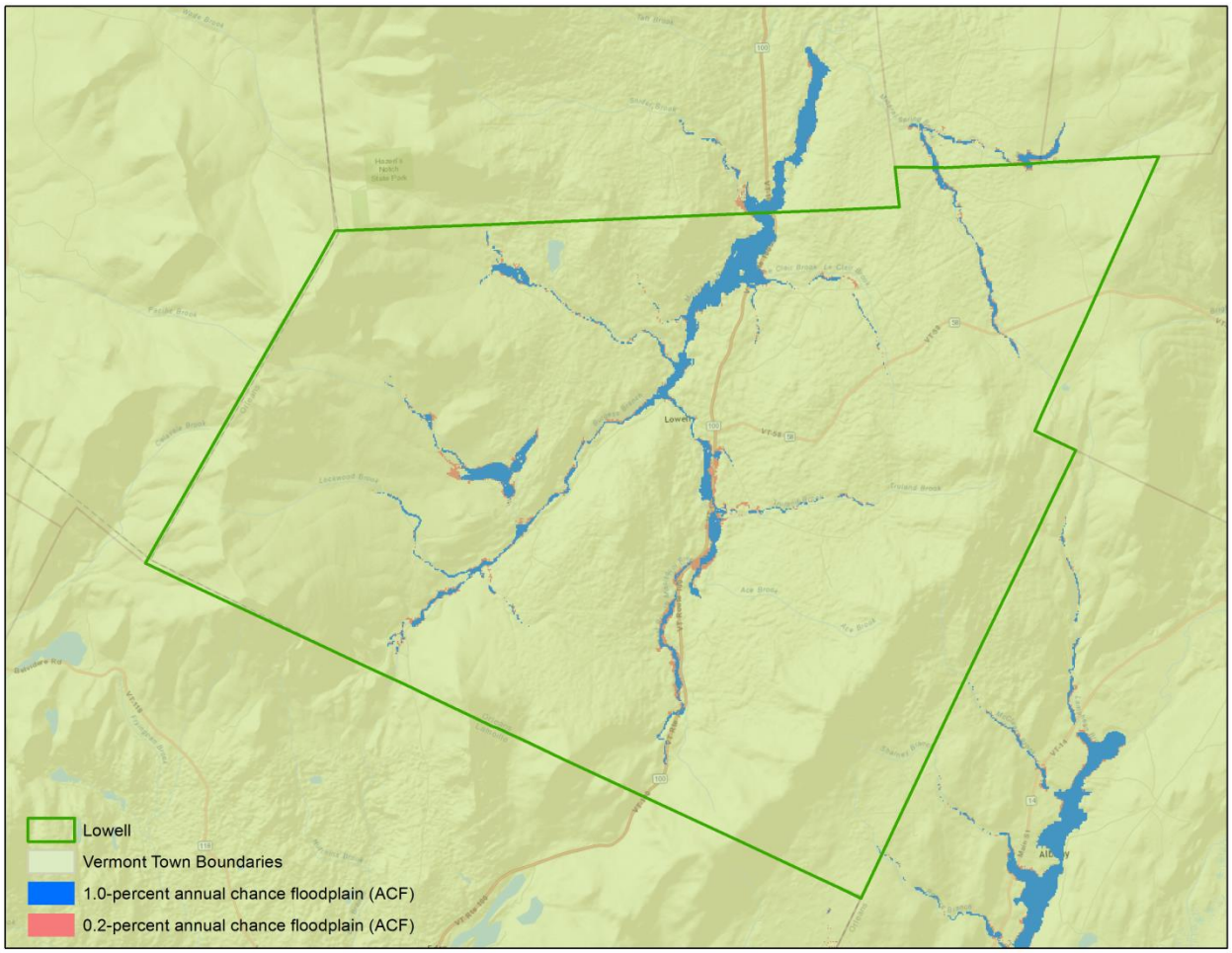

Figure 4 Hazus-MH Modeled Flood Hazard

In addition, there are several rivers, streams and brooks in the planning area as shown in Figure 5. Additional information about these potential flood sources follows the map.

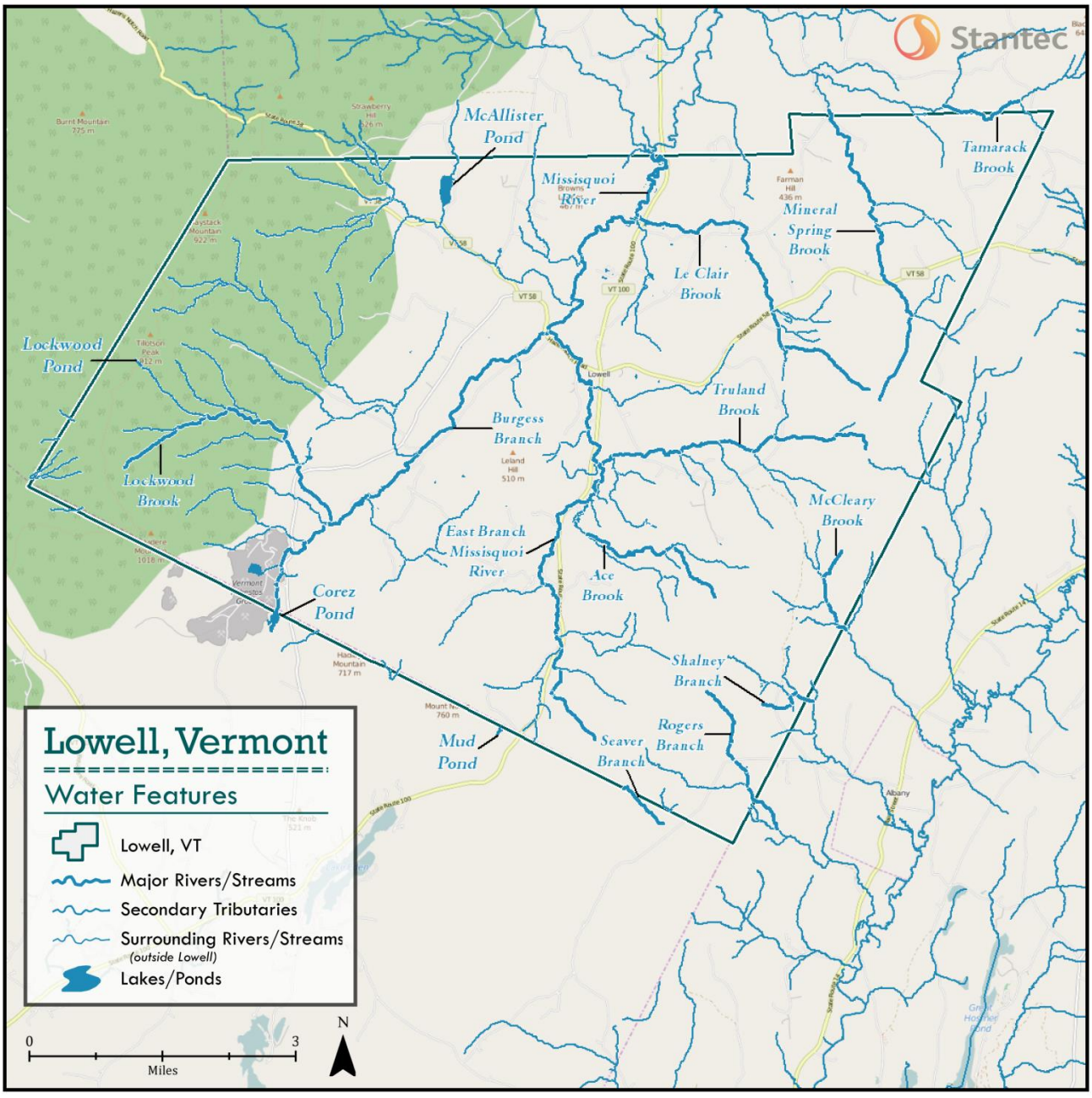

Figure 5 Lowell Streams and Rivers

Erosion may occur along any shoreline or steep embankment such as rivers, brooks, and streams within the planning area. Appendix A of the Town Plan lists areas erosion concern, indicating over 60 structures potentially at risk. Areas where there are clusters of areas of erosion concern include:

- Intersection of Hazen Notch Road and Bousquet Road
- North Irish Hill Road
- Vermont Route 100 and Fiddles Elbow Road (near East Brach Missisquoi River)
- Mink Farm Road and Pierce Road (near East Brach Missisquoi River)

Beaver dams are typically located in slow flowing currents where the water is relatively shallow, but deep enough to provide habitat under winter ice. In Lowell, beaver dams have previously blocked underground drains causing up to 4 feet of standing water on some streets. In 2014, three homes were flooded on Wentworth Avenue due to beaver dams blocking underground drains.[29] In addition, the Hazard Mitigation Committee also noted that large beaver dams may exist on private property, and, if they were to breach, would cause flooding and debris downstream.

Previous Occurrences

The 2006 Town of Lowell All Hazards Mitigation Plan noted a history of flooding, including one event in 1997 that involved four bridge replacements, some roads and culverts. Previous occurrences of flood events were retrieved from the National Centers for Environmental Information's Storm Events Database. There have been a total of 44 riverine and flash flooding events reported for Orleans County, 8 of which occurred in in Lowell and the surrounding area. The data did not show any deaths or injuries from flood events; however, it is possible deaths and/or injuries have occurred and were unreported. It is also possible additional flood events have happened but were unreported. Damages from flood events in Lowell total approximately $5.3 million dollars. Table 8 references the previous flood events reported in NOAA's National Centers for Environmental Information (NCEI).[30]

Table 10 Reported Flood Events in Lowell, VT (NCEI; FEMA Disaster Declarations)

Location	Date	Hazard Type	Property Damage (2016 dollars)	Crop Damage (2016 dollars)	Death/ Injuries	Event Description
West Portion of county (where Lowell is located)	07/15/1997	Flash Flood	$3,437,758	$0	0/0	Cold front across the state lead to heavy rains. Extensive flooding with multiple road washouts.
West Portion of county (where Lowell is located)	08/11/1998	Flash Flood	$846,258	$0	0/0	Cold front moved across region causing thunderstorms and heavy rains. Small streams and brooks rose quickly to banks and higher.

29 Tempera, J. (2014, March 31). Relentless rain floods roads, opens up sinkholes. *Boston Glove.* Retrieved from https://www.bostonglobe.com/metro/2014/03/31/relentless-rain-floods-roads-opens-sinkholes-ties-traffic/y9TWL94tjlnAIGcAAGKs9N/story.html

30 National Centers for Environmental Information. (2015) Storm Events Database – Orleans County, Iowa; Floods, Flood Events. National Oceanic Atmospheric Administration. Retrieved from https://www.ncdc.noaa.gov/stormevents/

Lowell	07/12/2002	Flooding	$16,778	-	-	Received funding for culvert repair projects under Federal Declaration 1428
Lowell	08/08/2003	Flash Flood	$7,343	$0	0/0	Very heavy rainfall accompanied the thunderstorms. In and around the town of Lowell, road flooding was reported.
Troy/ Lowell	07/24/2008	Flood	$31,669	$0	0/0	Flash flooding along East Branch and Burgess Branch caused damage along Mink Farm Road, Route 100, and Route 58 in Lowell. Several parked cars were moved around by the water. Portions of Mink Farm Road and Route 100 were washed out by flood waters.
Lowell	06/15/2011	Flood	$31,821	-	-	Received funding for road/bridge projects under Federal Declaration 1995
Lowell	05/29/2012	Flash Flood	$562,754	$0	0/0	Flooding from heavy rain and snowmelt caused damage to roadways across much of Orleans County. The Missisquoi River flooded portions of Route 100 in Lowell and Troy. The Missisquoi at North Troy exceeded its flood stage of 9 feet on 14 April at 4:24 pm EST, crested at 11.95 feet at 10:15 pm EST on 15 April 2014, and fell below flood stage at 9:51 am EST on 16 April 2014.
Lowell	06/22/2012	Flood	$403,897	-	-	Received funding for road/bridge projects under Federal Declaration 4006
Total	**8**		**$5,338,278**	**$0**	**0/0**	

Flood events, specifically flash flooding, are a major concern for Lowell in the spring months due to snow melt and the town's location in the mountain valley. The town becomes surrounded by water and ingress and egress become a challenge. Many previous events have resulted in road washouts/infrastructure damage. An online search of previous road washouts resulted in the discovery of the following event in April 2013.

> A quick rainstorm caused a flash flood with fast rising waters. This flash flood caused the washout of a 35 foot divide across Mines Road. Cars on the divide during the collapse dropped 5 feet. Luckily the passengers were able to climb to safety; however, the cars then dropped another 25 feet and stones 2 feet in diameter began bouncing over the cars. Washouts have been known to occur frequently during flash flood due to the many gravel/unpaved roads throughout the town.

In 2011, it was reported that 146 segments of the state road system in Vermont washed out, along with over 200

bridges, causing $175 -$200 million dollars in damage.[31]

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Extent

Flood
It is often thought the 0.2-percent annual chance flood is the greatest extent (or severity of flooding). However, flooding may exceed the boundaries and anticipated depth of this hazard.

The USGS stream gage data for Missisquoi River at North Troy (number 04293000) provided mean daily discharge information and peak streamflow between January 1, 1996 and May 15, 2016.[32] The highest mean discharge reported at the site was 8,330 cubic feet per second on June 12, 2002. Peak streamflow was reported at 11,500 cubic feet per second with a historic gage height of 14.55 feet on June 12, 2002. Although this stream gage is located in North Troy, flood stages greater than 8 feet can indicate flooding in/around Lowell.[33] Twelve feet or more is considered major flood on this river, and the record flood crest on this river occurred on June 12, 2002 at 14.55 feet, 2.5 feet over the major flood stage.

Beaver dams
Historically, beaver dams have resulted in 4 feet of rising water in the planning area. However, more extensive events are possible.

Erosion
Several areas of concern were reference but no information on erosion magnitude was reported. Erosion can impact stream and river banks. Higher erosion rates are typically correlated to higher intensity (discharge) events, though it can also be a slowly, naturally occurring hazard.

Climate Change
According to National Climate Assessment, the effects of climate change could potentially alter or increase the extent of flooding in Lowell. There have been two extreme events, Hurricane Irene and Hurricane Sandy, in the last five years which contrast the existing extent and vulnerability from flooding in northern Vermont. The rainfall from Irene led to hydrological extremes, including flooding, in the area of 2 to 3 inches of rainfall per hour and totals over 25 inches in the region.[34]

Probability of Future Events

Flood
There have been approximately 8 events based on previous reports and associated disaster declarations since 1996 (40% estimated annual chance). However, it is likely that less severe event also impact the planning area more frequently. Therefore, the probability is higher for these events. An estimated probability of likely was assigned.

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[31] Swartz, H. G., Meyer, M. (2014). *Climate Change Impacts in the United States: The Third National Climate Assessment* – Ch. 5 Transportation. U.S. Global Change Research Program. Pg.418-440. doi:10.7930/J0J1012N.
32 USGS 04293000 Missisquoi River Near North Troy, VT. (2016) *United States Geological Survey Water Resources.* Retrieved from http://waterdata.usgs.gov/vt/nwis/inventory/?site_no=04293000
[33] Advanced Hydrological Prediction Service. (2016). National Weather Service. Retrieved from http://water.weather.gov/ahps2/hydrograph.php?gage=ntyv1&wfo=btv
[34] Horton, R. & Yohe, G. (2014). *Climate Change Impacts in the United States: The Third National Climate Assessment* [Ch. 5 Transportation]. U.S. Global Change Research Program.

Erosion
Given the natural process of erosion an ongoing flood impacts, some occurrence is inevitable. Therefore, a probability of possible was assigned.

Beaver dams
While the exact number of beavers in Lowell is unknown, the population is sizable enough to cause continued impacts. While no major events were reported, articles citing these occurrences suggest a regular event in the area. Given the tenacity and industrious nature of beavers, it is likely that beavers dams are occurring annually though may not require annual attention. Regular maintenance is needed to prevent significant damage, such as flooding, from occurring. A PRI probability of possible was assigned.

NFIP Information

Does the Plan address NFIP insured structures within each jurisdiction that have been repetitively damaged by floods? 44 CFR 201.6(c)(2)(ii)

- Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? 44 CFR 201.6(c)(3)(ii)

The Town of Lowell is a member of the National Flood Insurance Program (NFIP) but does not participate in the Community Rating System program. There are four NFIP policies in force in the town, and there have been three paid losses totaling approximately $42,000.

The State Hazard Mitigation Officer (Lauren Oates) was contacted to determine the number and type of Repetitive Loss structures in the Town of Lowell. There are eight repetitive loss properties in the State of Vermont including two severe repetitive loss properties. However, neither is located in the Town of Lowell.

Vulnerability Assessment and Estimated Losses

Flood
While flood does have some designated areas, flash floods and urban flooding put all current and future buildings and populations at risk. Impacts of flood include business interruption, mold issues, and damaged contents and equipment, to name a few. Just a few inches of water in a building could cause damage to flooring and foundation structure that cost thousands of dollars to repair. If the water rises more than a few inches in a structure, electrical systems and appliances could be compromised.

Erosion
Erosion can compromise the stability of a structure's foundation. Appendix A of the Town Plan indicated over 50 structures potentially at risk to erosion. Any or future structures and populations residing near a shoreline or steep embankments are potentially at risk. Erosion can also undercut streambeds and pose a risk to those walking along the bank.

Beaver dams
When a beaver dam is breached, it results in flooding. Any current or future structures or population near at beaver dam are potentially at risk. In Lowell, beaver dams are of particular concern near bridges. Many of the bridges are narrow and historic in nature. This means excess hydrostatic forces from flooding or beaver dam breaches could wash out a bridge. However, impacts are generally mitigated through proper management (beaver removal and dam deconstruction).

There are no known critical facilities known to be specifically at risk to erosion, beaver dams or flooding.

Flood vulnerability was investigated further using FEMA's Hazus-MH software as described below.

Hazus-MH 3.0 Flood Analysis

Given no property values from the existing local data, an analysis using FEMA's Hazus-MH software was employed to estimate losses. As noted above, Hazus is a GIS-based hazard loss estimation tool. A level 1 analysis was conducted for the Town of Lowell, meaning that the model's default inventory was utilized and no additional data updates were employed.

Building exposure and potential flood losses were estimated using the latest version of the Hazus-MH 3.0 software. This flood scenario was completed for the Town of Lowell, Vermont. Within Hazus, dasymetric mapping is used, where census blocks are reduced by removing undeveloped areas. This allows for a more accurate distribution of 2010 U.S. Census Bureau data and a more accurate estimation of losses.

A stream network was created using a 1 square mile drainage basin, deviating from the default 10 square mile drainage basin. This was done to capture all streams which are a flood hazard to the Town of Lowell. Hydrology and hydraulics were run within the Hazus software, developing flood depth grids and delineating floodplains for both the 1.0-percent annual chance floodplain (100-year or 1.0% ACF) and the 0.2-percent annual chance floodplain (500 year, 0.2% ACF) return periods. U.S. Geological Survey National Elevation Dataset digital elevation models (1/3 arc second) and default Manning's n-values for land cover were used during this process.

Flood hazard analysis results were generated for the Town of Lowell. These results include general building stock damage and losses, yielding results for building and content damage, inventory, income, rental income and wage loss, as well as relocation costs.

Table 9 highlights the total exposure in the Town (total replacement value of all buildings as reported in the Hazus-MH inventory). Table 10 includes potential losses to buildings and total losses as a result of flood. Lastly, Table 11 shows losses as a percentage of total exposure.

It should be noted that the Hazus-MH calculated floodplain does not reflect (or supersede) the regulatory FEMA FIRM data. Further, the Town of Lowell is a very small area. However, the model does present a general picture of losses due to various flood scenarios. As noted in the Sources of Information subsection, the number Hazus dataset is different from the town-provided dataset. For example, Hazus noted 3 education buildings, 4 religious buildings, and 2 government buildings. The town data indicated 1 education building, 3 religious buildings, and 3 government buildings. It is recognized that there is inherent discrepancies amongst the datasets, but the Hazus-MH results can be used as a planning tool to understand concentrations of risk and potential mitigation actions. Such discrepancies could be remedied by employing a Level 2 Hazus-MH analysis where Hazus-MH datasets would be updated to reflect on the ground conditions. A level 2 analysis was outside of the scope of this plan update but may be considered in future plan updates. Forgoing the Hazus-MH would mean not estimation of building exposure for the town's risk assessment.

Table 11 Hazus-MH 2.1 Building Exposure

	Number of Buildings	Building (only) Exposure	Contents Exposure	Total Exposure
Residential	508	$67,259,000	$33,652,000	$100,911,000
Commercial	23	$6,397,000	$6,397,000	$12,794,000
Industrial	6	$1,728,000	$1,991,000	$3,719,000
Agricultural	2	$450,000	$759,000	$1,209,000
Religious	4	$1,732,000	$1,027,000	$2,759,000
Government	2	$515,000	$515,000	$1,030,000
Education	3	$1,256,500	$1,256,500	$2,513,000
TOTAL	**546**	**$79,337,500**	**$45,597,500**	**$124,935,000**

Table 12 Hazus-MH 2.1 Total Losses for 100-year and 500-year Flood

	Direct Losses		Indirect Losses					
Scenario	Building Losses	Contents Losses	Inventory Losses	Relocation Cost	Income Losses	Rental Income Losses	Wage Losses	Total Loss
1.0% ACF	$1,428,000	$1,745,000	$25,000	$0	$1,000	$0	$11,000	$3,210,000
0.2% ACF	$2,303,000	$2,447,000	$36,000	$0	$3,000	$0	$14,000	$4,803,000

Table 13 Hazus-MH 2.1 Total Direct Losses as a Percentage of Total Exposure

Scenario	Building Losses (%)	Contents Losses (%)	Total Direct Losses (%)
1.0% ACF	1.8	3.8	2.5
0.2% ACF	2.9	5.4	3.8

In addition, existing parcel, Emergency Site/E911 and critical facility data from the town was analyzed using the Hazus-MH generated floodplain. There are 280 parcels that intersect the 1.0-percent annual chance floodplain and 266 parcels that intersect the 0.2-percent annual chance floodplain. Table 12 shows the structures (point data) potentially at risk. The associated figures are Figure 6, Figure 7, Figure 8 and Figure 9. Table 13 shows the critical facilities potentially at risk, which are highlighted in Figure 10.

Table 14 Buildings Potentially at Risk to Flood (E911 sites)

Type	1.0% Annual Chance Flood (ACF)	0.2% Annual Chance Flood (ACF)	Type	1.0% Annual Chance Flood (ACF)	0.2% Annual Chance Flood (ACF)
Camps	2	2	**Mobile Home**	5	3
Cemetery	0	0	**Multi-Family**	0	0
Commercial	0	2	**Other**	1	14
Development Site	0	0	**Other Commercial**	0	0
Fire Station	0	0	**Other Residential**	0	0
Gated w/o Building	0	0	**Public Gather**	0	0
Government	0	0	**Public Telephone**	0	0
Gravel Pit	0	0	**Seasonal Home**	0	0
House of Worship	0	0	**Single Family**	4	0
Industrial	0	0	**Wind Facility/Wind Tower**	0	0
TOTAL STRUCTURES POTENTIALLY AT RISK					**33**

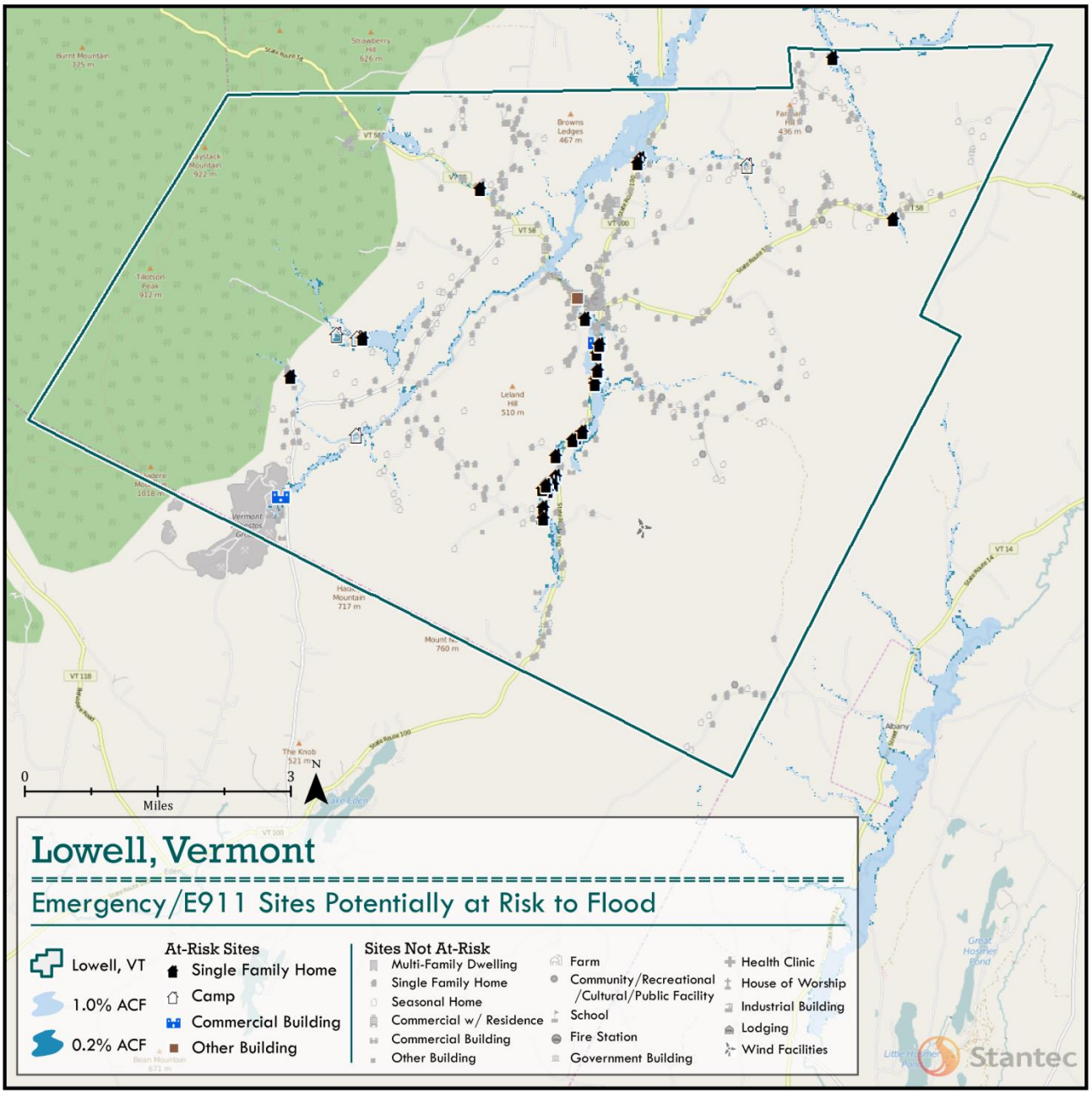

Figure 6 Buildings Potentially At Risk to Flood (E911 sites)

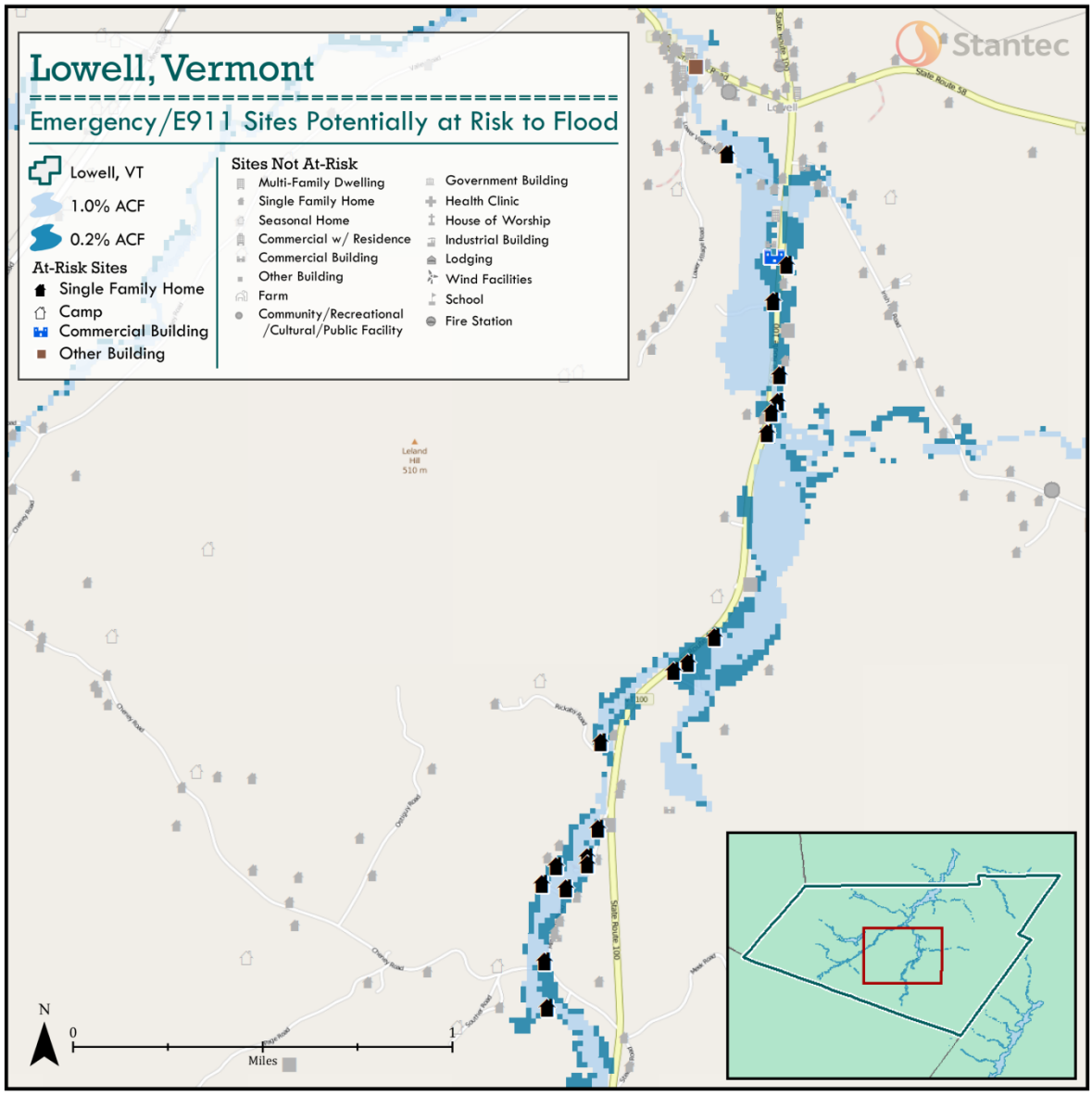

Figure 6 Buildings Potentially At Risk to Flood (E911 sites) – Area 1

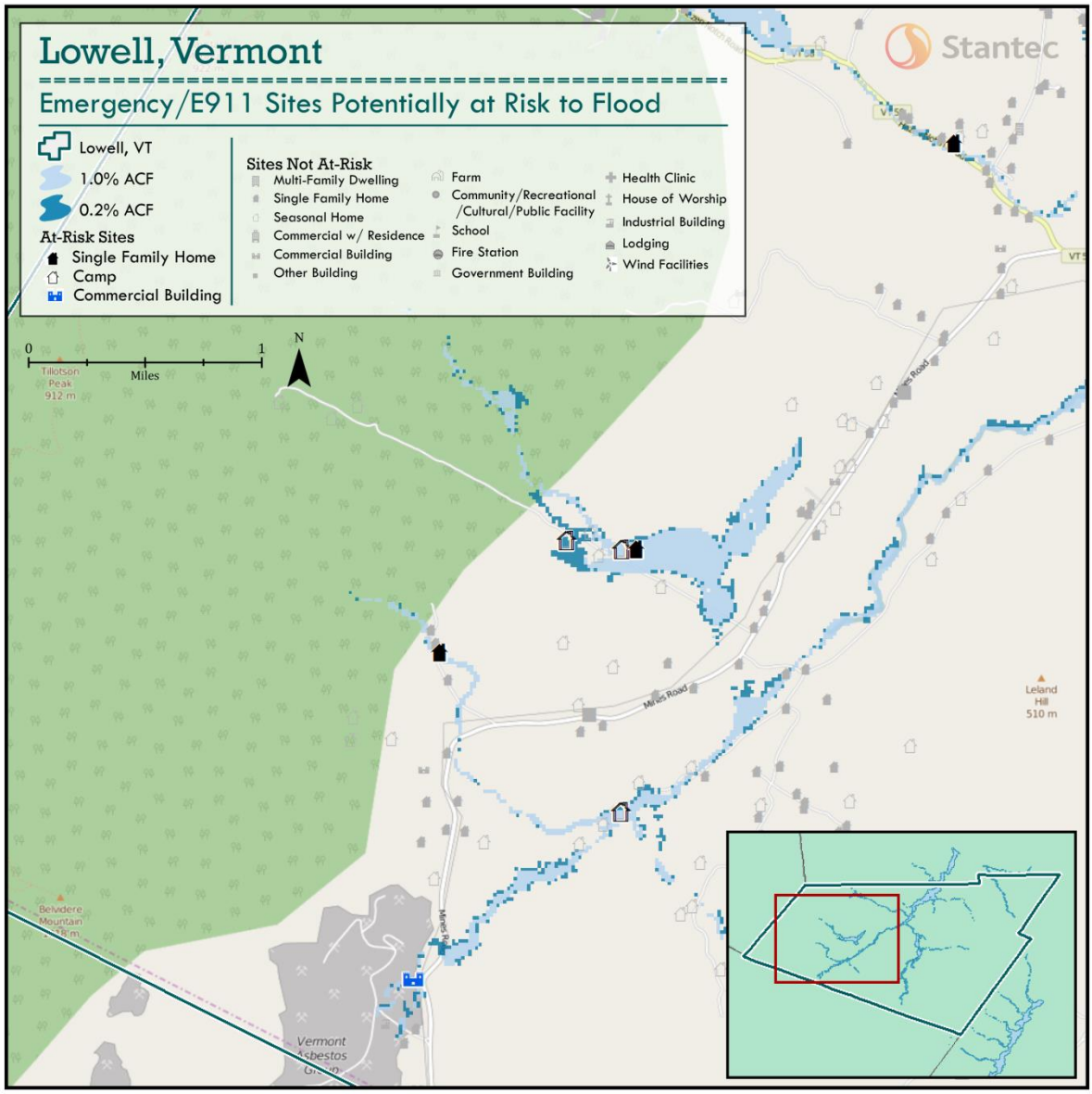

Figure 8 Buildings Potentially At Risk to Flood (E911 sites) – Area 2

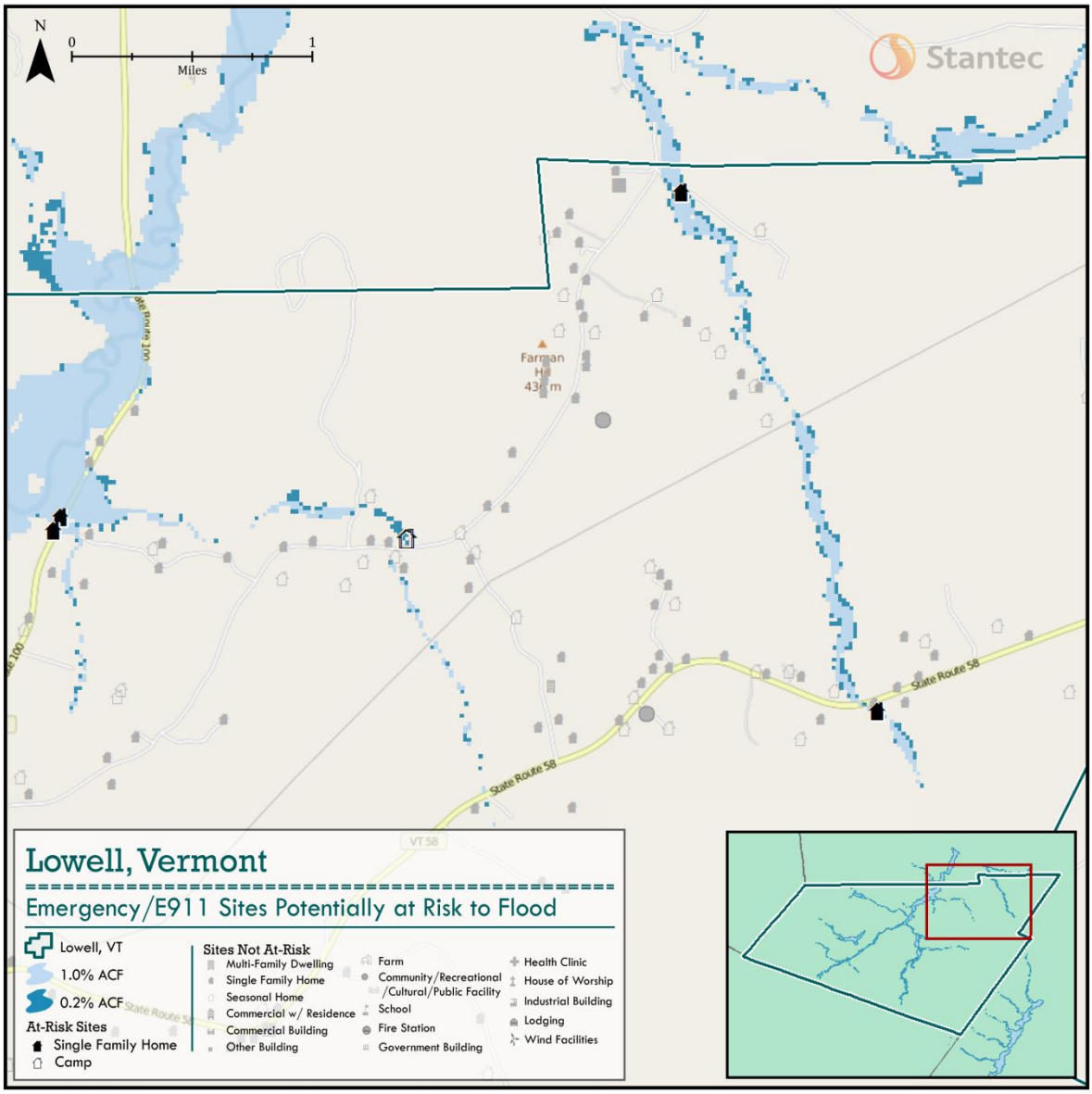

Figure 9 Buildings Potentially At Risk to Flood (E911 sites) – Area 3

Table 15 Critical Facilities Potentially at Risk to Flood

Critical Facilities Potentially At Risk	1.0% ACF	0.2%-ACF
Post Office	-	-
Catholic Church	-	-
Parish Hall	-	-
Lowell Grade School	-	-
Town Clerks Office/Historical Society/Library	-	-
Lowell Congressional Church	-	-
Lowell Fire Department	-	-
Lowell Town Garage	-	-
Wind Tower Control Building and Land	-	-
General Store	-	X

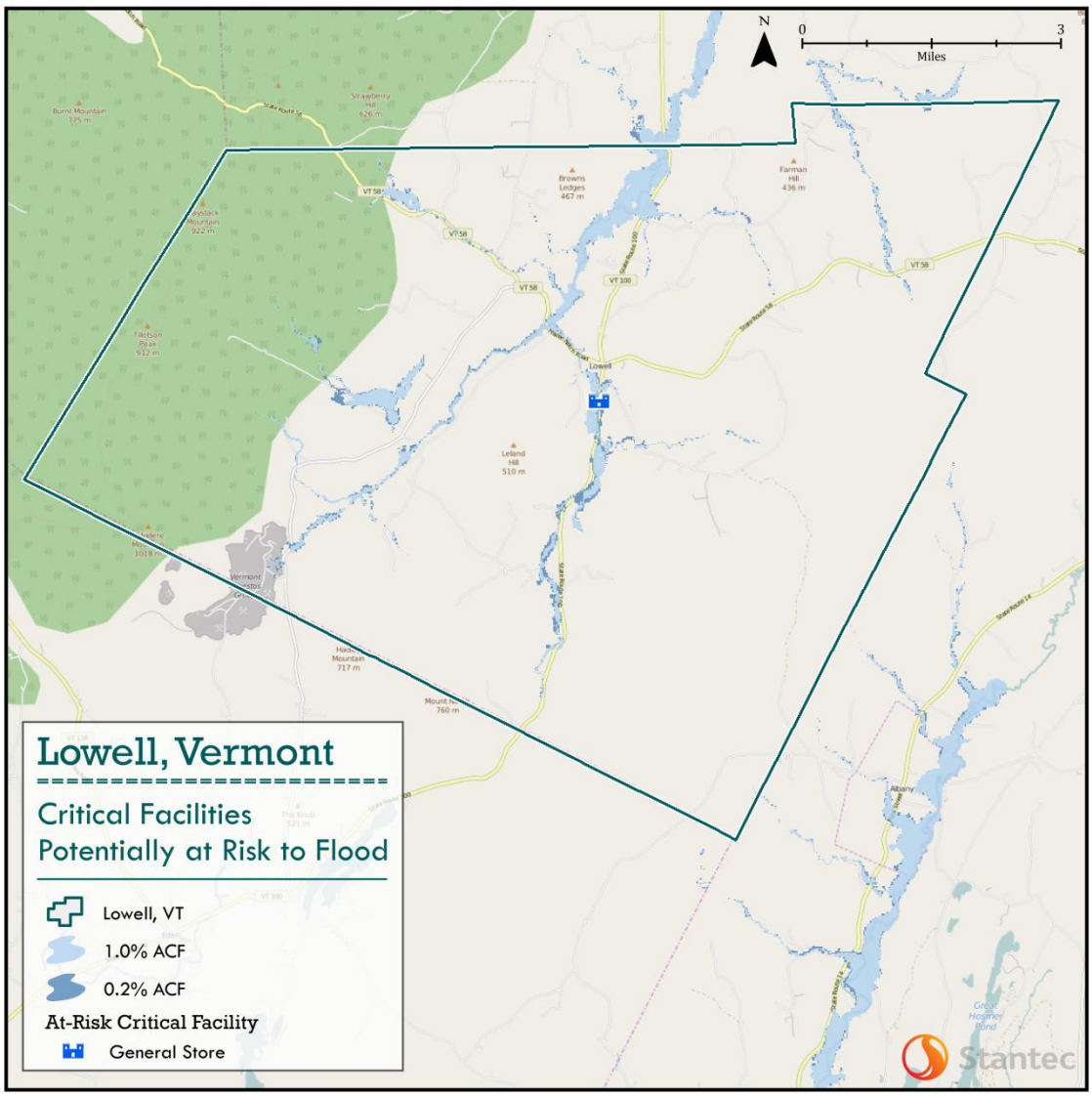

Figure 7 Critical Facilities Potentially at Risk to Flood

Negligible losses are expected with the erosion and beaver dam hazards. Given the lack of data, an exact figure is difficult to quantify.

Climate change may impact the frequency and severity of flooding. This indirectly may alter the severity of erosion and beaver dams. Research from the National Climate Assessment suggests that the Northeast should expect wetter winters due to climate change. Flooding due to the more frequent intense rainfall events projected for the Northeast may also increase mold problems and other water-borne disease outbreaks in homes and businesses.

SEVERE THUNDERSTORM (INCLUDING HIGH WIND AND LIGHTNING)

Description

A thunderstorm is defined as a local storm, invariably produced by a cumulonimbus cloud and always accompanied by lightning and thunder, usually with strong gusts of wind, heavy rain, and sometimes with hail.[35] These storms may also bring flash flooding and frequently result in flood watches and warnings. Under this hazard profile, the high wind and lightning produced by thunderstorms will be considered. Other associated hazards such as hail and tornado are addressed separately in this plan.

Lightning is a discharge of electrical energy resulting from the buildup of positive and negative charges within a thunderstorm, creating a "bolt" when the buildup of charges becomes strong enough. This flash of light usually occurs within the clouds or between the clouds and the ground. A bolt of lightning can reach temperatures approaching 50,000°F. Lightning rapidly heats the sky as it flashes but the surrounding cool air follows the bolt. This rapid heating and cooling of the surrounding air causes thunder, which is often accompanied by lightning strikes. While most often affiliated with severe thunderstorms, lightning may also strike outside of heavy rain and might occur as far as 10 miles away from any rainfall.

Location

These storms are atmospheric in nature. Therefore, the entire planning area is at risk.

Previous Occurrences

Lowell is a generally windy place. As a testament to this, there are wind turbines within the town. Many of these wind events result in downed trees and tree limbs which can make winds impassable. The following previous occurrences in Table 14 were gathered from NOAA's National Centers for Environmental Information Storm Events Database and are likely not inclusive of all events to impact the Town of Lowell. The NECI data reported 141 thunderstorm (wind) events in Orleans County; many of these events are shown as occurring across Orleans County, with no specific location. Of the 141 events, 5 were located in Lowell with the highest reported wind to 57 miles per hour (50 knots). No damage, deaths, or injuries are reported for these 5 events, but it is possible the information was not recorded or was unknown.

Table 16 Reported Thunderstorm (Wind) Events in Lowell, VT (NCEI 1996-2015)

Location	Date	Hazard Type	Magnitude (in mph)	Property Damage (2016 dollars)	Crop Damage (2016 dollars)	Death/ Injuries	Event Description
LOWELL	05/31/2002	Thunderstorm Wind	N/A	$1,513	$0	0/0	A severe thunderstorm moved across Orleans county of Vermont during the early afternoon of May 31st. Trees were blown down in the town of Lowell.

[35] Thunderstorm. (2012). Meteorology Glossary: American Meteorological Society. Retrieved December 11, 2014 from http://glossary.ametsoc.org/wiki/Thunderstorm

Location	Date	Hazard Type	Magnitude (in mph)	Property Damage (2016 dollars)	Crop Damage (2016 dollars)	Death/ Injuries	Event Description
LOWELL	08/1/2006	Thunderstorm Wind	57	$13,439	$0	0/0	A Mesoscale Convective System developed in an extremely warm, humid and unstable air mass across southern Quebec, during the late evening of the 1st. Severe thunderstorms moved into western Orleans county and knocked down numerous trees between Lowell and Westfield along Route 100, but concentrated more in the Lowell area.
LOWELL	06/10/2008	Thunderstorm Wind	57	$12,668	$0	0/0	A very energetic mid-atmospheric disturbance moved across the Great Lakes the afternoon/evening of June 10th. These features across Vermont, resulting in two rounds of widespread severe storms. In Vermont, hundreds to thousands of trees were damaged, downed, or uprooted causing downed power lines and structural damage to numerous buildings and vehicles. Tens of thousands of customers lost power, with some outages that lasted several days.

Location	Date	Hazard Type	Magnitude (in mph)	Property Damage (2016 dollars)	Crop Damage (2016 dollars)	Death/ Injuries	Event Description
LOWELL	07/18/2008	Thunderstorm Wind	57	$12,668	$0	0/0	Several mid-atmospheric impulses traveled along a stationary boundary across northern Vermont the afternoon/evening of July 18th. Several rounds of thunderstorms moved across Vermont during the afternoon. Widespread tree and structural damage occurred with this system in Orleans County. This squall line interacted with an individual produced an extensive damage, caused by straight-line winds of 60 to 80 mph. Within this greater damage field was a tornadic storm with two very brief touchdowns with EF0 and EF1 damage. Several trees down and power lines down in Lowell.
LOWELL	05/26/2011	Thunderstorm Wind	57	$11,593	$0	0/0	A surface low as well as upper atmospheric energy traveled along a quasi-stationary boundary across northern New York and Vermont during the afternoon and evening of May 26th. There were numerous reports of damaging winds and very large hail (up to 2.5 inches in diameter). Some 25,000+ customers lost power during these storms. Trees and power lines down along Route 100 between Lowell and Eden.
Total	**5**		**Avg: 57 mph**	**$51,881**	**$0**	**0/0**	

The NCEI Storm Database does not report any Thunderstorm (Lightning) Events in Lowell. However, there are nine events recorded in other locations of Orleans County since 1996. These events resulted in property damages of approximately $656,000 (2016 dollars).

An Associated Press news article stated in July 2014, two wind turbines were struck by lightning; costs of repairs were not reported.[36] Another turbine was previously struck by lightning in summer 2013.[37] There is concern that the tall metal wind turbines located on a ridge could attract more lightning strikes and an increased risk of forest fire. Figure 11 below illustrates a wind turbine in Lowell being struck by lightning. This event, as well as the referenced county events above, are indicative of that lightning does occur and has the potential to impact the town in the future. In addition, other sources have shown an increase in lightning strikes since the construction of the Green Mountain Power Wind Farm in 2012.

Figure 8 Lightning Striking Wind Turbine on Lowell Mountain[38]

Extent

The highest wind speed reported from the NCEI data was 57 miles per hour (50 knots), though stronger wind is possible. In Orleans County, winds have reached 75 miles per hour (65 knots).

Figure 12 below was compiled with data from 2005 to 2014, and shows the frequency of cloud-to-ground lightning flashes per square mile per year. This can be used to demonstrate location and measure extent. Lightning can occur anywhere, though it is less frequent near water. The Lowell planning area receives approximately 1.5 to 3 strikes per square mile per year. Greater strikes per square mile per year are possible.

36 2 Wind Turbines Struck by Lightning, Being Fixed. (2014). Associated Press; WCAX News. Retrieved from http://www.wcax.com/story/26011575/2-wind-turbines-struck-by-lightning-being-fixed

37 Damaged Lowell Wind Turbine Blade to be Replaced. (2013). *The Caledonian Record.* Retrieved from http://vtdigger.org/2013/11/22/damaged-lowell-wind-turbine-blade-repaired

38 Blake, B. (2015, August 25). Lightning strikes and wind turbines. *WindAction;* Citizens' Task Force on Wind Power. Retrieved from http://www.windaction.org/posts/43280-lightning-strikes-and-wind-turbines#.V1nHWrsrJD8

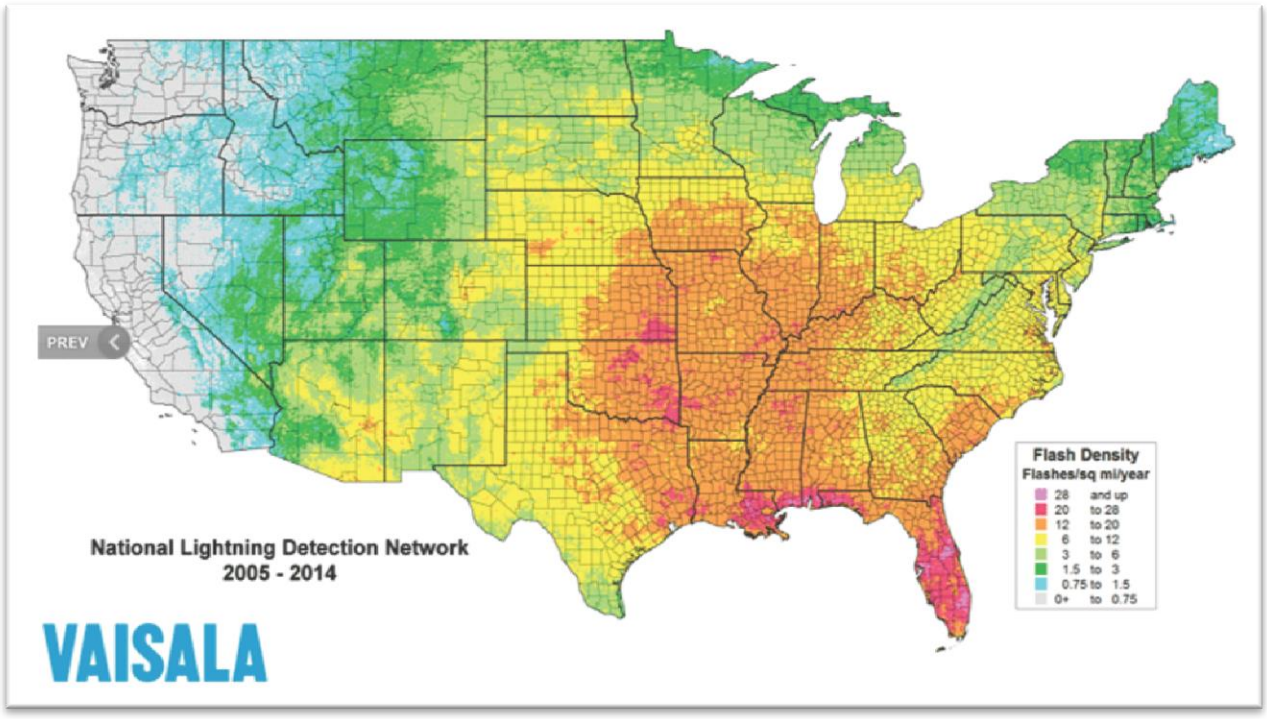

Figure 9 Cloud to Ground Lightning Strikes per square mile per year[39]

Probability of Future Events

Based on local knowledge and input from the planning team, as well as the 141 events reported over 65 years in the county, Thunderstorm (Wind) hazard is assigned a probability of highly likely.

The NCEI did not record any lightning events for the Lowell. However, 9 events over 19 years in Orleans County warrant a probability of 45% (likely on the PRI). While Lowell had limited information on specific events occurring, lightning strikes are just as possible in the Town as in other parts of the County.

Vulnerability Assessment and Estimated Losses

All current and future buildings and populations are at risk to the thunderstorm wind, high wind, and lightning hazards. Town of Lowell officials noted that wind is common and high winds frequently results in downed trees and fallen tree limbs. This may damage properties and/or close roads. Winds may also result in blown off shutters and roofs. Thunderstorm systems that stall and produce heavy rain can increase the severity of flooding. The impacts and vulnerability can best be reviewed under the flood hazard sub-section above but include damaged property, washed out roads and bridges, debris, and hazardous driving conditions.

Losses due to lightning include impacts from structural fires, debris cleanup from downed trees and power lines, and electronic equipment damage. These losses would likely be negligible if annualized over time for the Town, though each event may exceed thousands of dollars.

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39 National Lightning Detection Network. (2014). Vaisala. Retrieved December 11, 2014 from http://www.vaisala.com/en/products/thunderstormandlightningdetectionsystems/Pages/NLDN.aspx

Climate change impacts associated with this hazard are also aligned with those reported in the flood section including increased events and severity.

SEVERE WINTER STORM (INCLUDING BLIZZARD, ICE STORM, NOR'EASTER, AND HEAVY SNOW)

Description

A winter storm is an event in which varieties of precipitation are formed that only occur at low temperatures, such as snow, sleet, freezing rain or ice. Snowstorms generally occur with the clash of different types of air masses, with differences in temperature, moisture, and pressure; specifically, when warm moist air interacts with cold dry air. Snow storms that produce a lot of snow require an outside source of moisture, such as the Gulf of Mexico or the Atlantic Ocean. The winter storm profile for Lowell includes heavy snow, blizzard, ice storms, and nor'easters. Ice Jams and Extreme Cold are addressed as separate hazards below.

Heavy Snow: According to the NOAA weather glossary, snow is frozen precipitation composed of ice particles in complex hexagonal patterns. Further, snow forms in cold clouds by the direct transfer of water vapor to ice. A heavy snow event is defined by the National Weather Service as an accumulation of 4 of more inches within the timeframe of 12 hours or less. However, definitions do vary by source and may be defined as six inches over 48 hours.

Blizzards: Blizzards are severe snow storms with winds in excess of 35 mph and visibility of less than a quarter mile for more than 3 hours.

Nor'easter: A Nor'easter is a large weather system traveling from South to North, carving path along, or near the seacoast. As the storm approaches New England and its intensity becomes increasingly apparent, the resulting counterclockwise cyclonic winds impact the coast and inland areas from a Northeasterly direction. The sustained winds may meet or exceed hurricane force.[40] Nor'easters are caused by the interaction of the jet stream with horizontal temperature gradients and generally occur during the fall and winter months when moisture and cold air are plentiful. These events are known for dumping heavy amounts of rain and snow, producing hurricane-force winds, and creating high surf that causes severe beach erosion and coastal flooding.

Ice Storms, Sleet, and Freezing Rain: Ice storms are defined as storms with significant amounts of freezing rain and are a result of cold air damming (CAD). CAD is a shallow, surface-based layer of relatively cold, stably-stratified air entrenched against the eastern slopes of the Appalachian Mountains. With warmer air above, falling precipitation in the form of snow melts, then becomes either super-cooled (liquid below the melting point of water) or re-freezes.

In the former case, super-cooled droplets can freeze on impact (freezing rain), while in the latter case, the re-frozen water particles are ice pellets (or sleet). Sleet is defined as partially frozen raindrops or refrozen snowflakes that form into small ice pellets before reaching the ground. They typically bounce when they hit the ground and do not stick to the surface. However, it does accumulate like snow, posing similar problems and has the potential to accumulate into a layer of ice on surfaces. Freezing rain, conversely, usually sticks to the ground, creating a sheet of ice on the roadways and other surfaces. Generally, an ice storm is considered severe if there is an accumulation of ¼ inch or more of freezing rain or ½ inch or more of sleet (which can result in downed power lines).

Winter storms are defined differently in various parts of the country relevant to their standard weather. Two inches of snow may create serious disruptions to traffic in areas where snowfall is not expected, however this may

40 The Northeast States Emergency Consortium. (2014). Retrieved December 11, 2014 from www.nesec.org.

be considered a light dusting in regions where snowfall is typical. Therefore, there are multiple ways in which to measure a winter storm, based on snowfall, temperatures, wind speeds, societal impact, etc. Winter storm weather is common in Vermont and there is a high capacity to manage such events.

The NOAA Glossary also defines types of public advisory and warnings issued by the National Weather Service with winter weather:

- **Winter Weather Advisory:** May be issued when 4 to 6 inches of snow or sleet is expected in 24 hours; or any accretion of freezing rain or freezing drizzle is expected on road surfaces; or when blowing or drifting snow is expected to occasionally reduce visibility to 1/4 mile or less. Such events are expected to create hazardous or restricted travel conditions, but not as severe as expected with a winter storm.
- **Winter Storm Watch:** A significant winter storm may affect your area, but its occurrence, location, and timing are still uncertain. A winter storm watch is issued to provide 12 to 36-hour notice of the possibility of severe winter weather. A watch will often be issued when neither the path of a developing winter storm nor the consequences of the weather event are as yet well defined. Ideally, the winter storm watch will eventually be upgraded to a warning when the nature and location of the developing weather event becomes more apparent. A winter storm watch is intended to provide enough lead-time so those who need to set plans in motion can do so.
- **Winter Storm Warning**: Issued when 7 or more inches of snow or sleet is expected in the next 24 hours, or 1/2 inch or more of accretion of freezing rain is expected. A warning is used for winter weather conditions posing a threat to life and property.

Location

The winter storm hazard will impact the entire planning area.

Previous Occurrences

Just two federal disaster declarations have been made in Orleans County (including Town of Lowell) for winter storms.

The NCEI reports winter storm and associated winter weather at the county level, and, thus, there are no specific reports for Lowell. However, from 1996-2015, there were 231 reported events in the county. Damages from these events total $4,276,957. In addition, Lowell has received Public Assistance funds for snow removal as a result of the presidentially declared disaster DR-3167, a snow event occurring in April 2001. The full list of reported winter storm events is provided in Appendix B.

In addition, according to NCEI data, one ice storm in January 1998 was reported to have multiple indirect injuries due to carbon monoxide poisoning while improperly using generators.

In general, while snow is quite frequent in the late fall, winter, and spring months, the Town has a high capacity for managing such events.

Extent

The extent of winter storms and associated weather is measured by the highest level of snowfall and the greatest accumulation of ice in the planning area. The NCEI does not report any snowfall levels for Lowell; however, the highest amount of snowfall in Orleans County was 28 inches and occurred in Jay. Jay is 15 miles north of Lowell, but has a similar elevation and other geographical characteristics.

Another source, Snowfall Weather Database, stated Lowell's record snowfall occurred on March 7, 2011 at 26 inches.[41] The Lowell planning area also receives over 100 inches of snowfall annually.

41 Snowfall Weather Database. (2016). *Weather DB.* Retrieved from tps://snowfall.weatherdb.com/l/15175/Lowell-Vermont

Two reports of ice accumulation from the NCEI state accumulation levels of .75 inches. Also, as previously noted the county regularly receives several feet of snow annually and often in a single event. The Town is well equipped to manage this hazard.

Climate change is expected to bring more precipitation during winter months as further described in the vulnerability assessment.

Probability of Future Events

Winter weather is common in the northeast and typically occurring the winter months. Based on the historical information for Lowell and its surrounding areas, winter storms occur multiple times a year. Nor'easters are most common in the late fall to early spring from September through April. There is a 100% chance of winter storms occurring in the planning area; therefore, a probability of highly likely was assigned.

Vulnerability Assessment and Estimated Losses

All current and future buildings and populations are at risk to this winter storm hazard. It has variety of potential impacts. Ensuring roads remain accessible and passable are among the greatest concerns with this hazard. However, structural damage may also be associated with this hazard. For example, heavy snow loads that can cause roofs and trees to collapse. Deaths and injury are also possible due to exposure, falls, and vehicular accidents. Additional impacts include road closures, power outages, business interruption, hazardous driving conditions, frozen pipes, fires due to improper heating, and second health impacts caused by shoveling (such as a heart attack). However, in general, the impacts are minimized due to the high capacity of the Town to manage this hazard.

Limited information was available on previous damage estimates for Lowell, making it difficult to estimate a reliable annualized loss estimate. For Orleans County, average annual loss would be $225,103 based on combined losses of $4,276,957 (2016 dollars) over 19 years and 231 events (NCEI). Additionally, future losses are possible in the planning area due to property damage and snow removal costs, for example.

Another cause for concern in Lowell is the possibility of ice throw from the wind turbines. Ice projectiles from the blades of the turbines can travel nearly half a mile and may land with speeds in excess of 200 miles per hour.

Climate change impacts have the potential to affect this hazard. Increased hazard occurrence in terms of more snow and rising temperatures could mean greater snowmelt. UMASS Climate System Research Center data states that winter months are likely to be wetter (likely with rain) in the northeast. This could mean more favorable snowmelt conditions in the spring months, such as rain-on-snow events.

ICE JAMS

Description

Large chunks of melting ice in rivers can easily become stuck on debris, or lodged around bends on rivers and streams. As the flow of the water carries larger chunks into the same spots, a natural, temporary dam can develop. The water will eventually back up behind the dam, and severe flooding can occur. This is known as ice jam flooding.[42]

42 Sagliani, Anthony. (2013). Snowmelt Flood Risk: Worcester, Boston, Hartford. Accuweather. Retrieved December 11, 2014 from http://www.accuweather.com/en/weather-news/snowmelt-flood-risk-worcester/7955795

Ice jams (breakup jams) occur when warm temperatures and heavy rain cause rapid snow melting. The melting snow combined with the heavy rain, causes frozen rivers to swell. The rising water breaks the ice layer into large chunks. These large ice chunks can float downstream and pile up near narrow passages or near obstructions, such as bridges and dams. Cranes with wrecking balls and explosives are sometimes used to break up ice dams. Historically, there have been hundreds of ice jams in New England. The most devastating winter floods have been associated with a combination of heavy rainfall, rapid snowmelt, and ice jams. When river ice piles up at shallow areas, bends, and islands, it blocks the flow of water and may cause flooding of nearby homes and businesses.

Location

Ice jams occur on flowing water such as rivers, streams, and brooks. No specific areas of concern were identified, although vulnerability for areas near bridges is noted.

Previous Occurrences and Extent

The Ice Jam Database maintained by the US Corps of Army Engineers, Cold Region Research, and Engineering Lab, is a searchable database of historic ice jam events.[43] However, no events were reported in Lowell. In addition, the state list of historical ice jam events was reviewed from the state hazard mitigation plan. There were no referenced events in Lowell, though events were referenced on the Missisquoi River in Franklin, Vermont (approximately 40 miles west) and on the Black River in Orleans (15 miles east).

Probability of Future Events

Although there is no history of such events recorded for the Town of Lowell, a probably of possible was assigned.

Vulnerability Assessment and Estimated Losses

While ice jams are categorized as a separate hazard, their impacts and vulnerability are best aligned with flood impacts. However, all current and future structures and populations should be considered at risk to the flooding caused by this hazard. Dollar losses are difficult to estimate but losses may be associated with localized flood losses (depending on where the ice jam occurs). Ice jams may also cause damage to bridges as they float down swollen rivers. This is a particular concern in Lowell. Many of the bridges are narrow and historic in nature. This means excess hydrostatic forces from flooding due to ice jam breaches could wash out a bridge.

Climate change may impact this hazard due to greater extremes, as winters may be more severe. This may result in thicker ice on the river, which is more damaging if ice jam conditions arise during warming temperatures. Secondly, as opposed to gradual temperature rises, temperatures may rise rapidly following winter events, which could result in favorable conditions for ice jams.

TORNADO

Description

A tornado is a violent windstorm characterized by a twisting, funnel-shaped cloud extending to the ground. Tornadoes are most often generated by thunderstorm activity (but sometimes form from hurricanes and other tropical storms) when cool and dry air intersects and overrides a layer of warm, moist air forcing the warm air to rise rapidly. The damage caused by a tornado is a result of the high wind velocity and wind-blown debris, also accompanied by lightning or large hail. According to the National Weather Service, tornado wind speeds normally

43 Ice Jam Database, Bulletins & Surveys. (2014). US Army Corps of Engineers. Retrieved December 11, 2014 from http://rsgisias.crrel.usace.army.mil/apex/f?p=273:2:9514583758394

range from 40 miles per hour to more than 300 miles per hour. The most violent tornadoes have rotating winds of 250 miles per hour or more and are capable of causing extreme destruction and turning harmless ordinary objects into deadly missiles.

Each year, an average of over 800 tornadoes is reported nationwide, resulting in an average of 80 deaths and 1,500 injuries.[44] According to the NOAA Storm Prediction Center (SPC), the highest concentration of tornadoes in the United States has been in Oklahoma, Texas, Kansas, and Florida respectively. Although the Great Plains region of the Central United States does favor the development of the largest and most dangerous tornadoes (earning the designation of "tornado alley"), Florida experiences the greatest number of tornadoes per square mile of all U.S. states (SPC, 2002). Figure 13 shows tornado activity per county in the United States based on the number of recorded tornadoes between 1952 and 2010.[45]

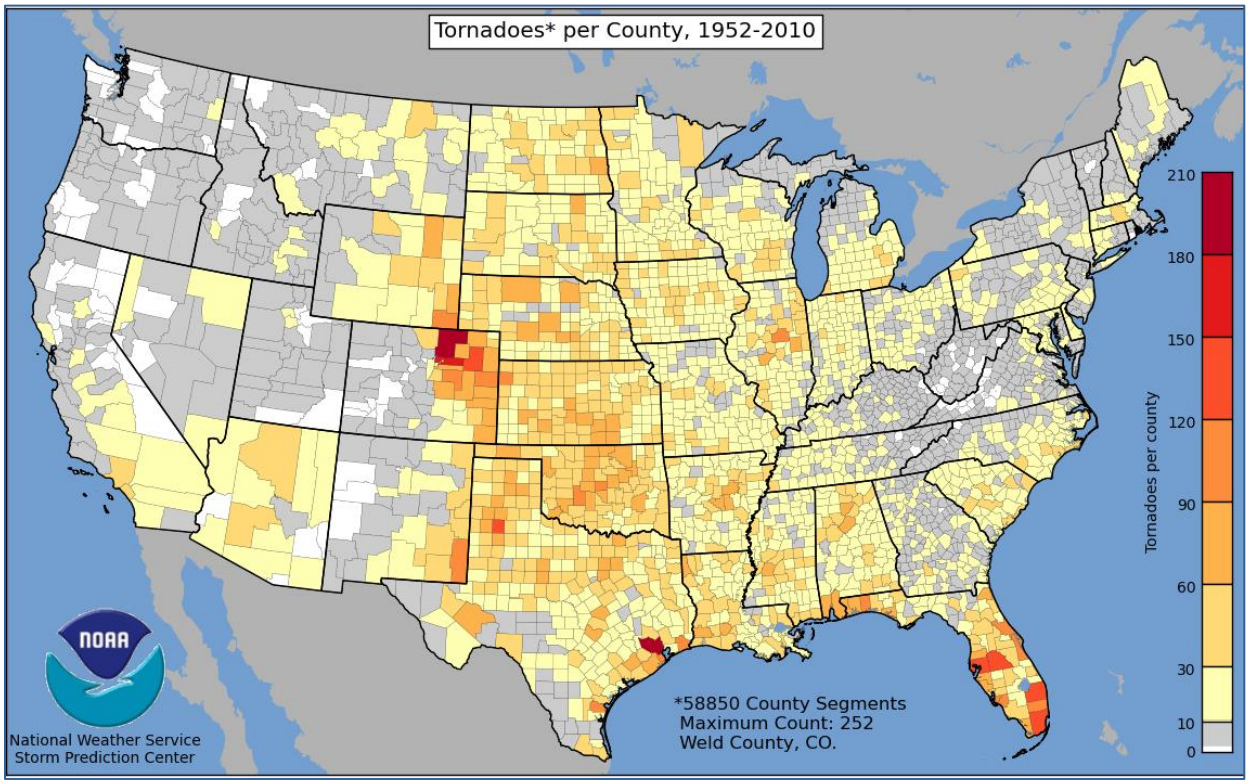

Figure 10: U.S. Tornado Interest

Tornadoes are most likely to form in the late afternoon and early evening. The average tornado moves from southwest to northeast, but tornadoes have been known to move in any direction. The average forward speed is 30 miles per hour, but may vary from nearly stationary to 70 miles per hour. Most tornadoes are a few dozen yards wide and touchdown briefly, but even small short-lived tornadoes can inflict tremendous damage. Highly destructive tornadoes may carve out a path over a mile wide and several miles long.

44 National Oceanic and Atmospheric Administration. (2009).
45 Storm Prediction Center, National Oceanic and Atmospheric Administration. Retrieved February 4, 2015. Available at http://www.srh.noaa.gov/images/hgx/swa/2013_graphs/tornadoes_county.png

The destruction caused by tornadoes ranges from light to inconceivable depending on the intensity, size, and duration of the storm. Typically, tornadoes cause the greatest damage to structures of light construction, including residential dwellings (particularly mobile homes). Tornadic magnitude is reported according to the Fujita and Enhanced Fujita Scales. Tornado magnitudes, prior to 2005, were determined using the traditional version of the Fujita Scale (Refer to Table 15). Tornado magnitudes that were determined in 2005 and on used the Enhanced Fujita Scale (Refer to Table 16).

Table 17 The Fujita Scale (Effective Prior to 2005)[46]

F-SCALE NUMBER	INTENSITY	WIND SPEED	TYPE OF DAMAGE DONE
F0	GALE TORNADO	40–72 MPH	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
F1	MODERATE TORNADO	73–112 MPH	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
F2	SIGNIFICANT TORNADO	113–157 MPH	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
F3	SEVERE TORNADO	158–206 MPH	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
F4	DEVASTATING TORNADO	207–260 MPH	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
F5	INCREDIBLE TORNADO	261–318 MPH	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.
F6[47]	INCONCEIVABLE TORNADO	319–379 MPH	These winds are very unlikely. The small area of damage they might produce would probably not be recognizable along with the mess produced by F4 and F5 wind that would surround the F6 winds. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage. If this level is ever achieved, evidence for it might only be found in some manner of ground swirl pattern, for it may never be identifiable through engineering studies.

46 Storm Prediction Center, National Oceanic and Atmospheric Administration. Retrieved February 4, 2014. Available at http://www.spc.noaa.gov/faq/tornado/ef-scale.html

47 F6 is not always included but has been used to describe extremely strong tornadoes that far surpass F5 levels.

Table 18 The Enhanced Fujita Scale (Effective 2005 and Later)[48]

EF-SCALE NUMBER	INTENSITY PHRASE	3 SECOND GUST	TYPE OF DAMAGE DONE
EF0	GALE	65–85 MPH	Some damage to chimneys; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards.
EF1	MODERATE	86–110 MPH	The lower limit is the beginning of hurricane wind speed; peels surface off roofs; mobile homes pushed off foundations or overturned; moving autos pushed off the roads; attached garages may be destroyed.
EF2	SIGNIFICANT	111–135 MPH	Considerable damage. Roofs torn off frame houses; mobile homes demolished; boxcars pushed over; large trees snapped or uprooted; light object missiles generated.
EF3	SEVERE	136–165 MPH	Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
EF4	DEVASTATING	66–200 MPH	Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
EF5	INCREDIBLE	Over 200 MPH	Strong frame houses lifted off foundations and carried considerable distances to disintegrate; automobile sized missiles fly through the air in excess of 100 meters; trees debarked; steel re-enforced concrete structures badly damaged.

Location

A tornado can strike anywhere. All areas in the planning area are at risk. It is notable that heavily developed or vegetated areas (trees) are generally less susceptible to tornado strikes.

Previous Occurrences

Several sources were investigated to determine past tornado occurrences including NCEI, previous disaster declarations, web searches, and the Town and State hazard mitigation plans. According to NCEI, six tornado events have occurred in Orleans County between 1950 and 2015. These events ranged from EF0-EF1 and F1. They resulted in one injury. Total damage is reported at over $1,555,735, an average of $26,000 per event. None were specifically reported as occurring in Lowell. Figure 14 below maps historical tornado tracks and touchdowns in Orleans County from 1950 to 2015. Additionally, there were no major disaster declarations due to tornado reported for Orleans County.

48 Storm Prediction Center, National Oceanic and Atmospheric Administration. Retrieved February 4, 2014. Available at http://www.spc.noaa.gov/faq/tornado/ef-scale.html

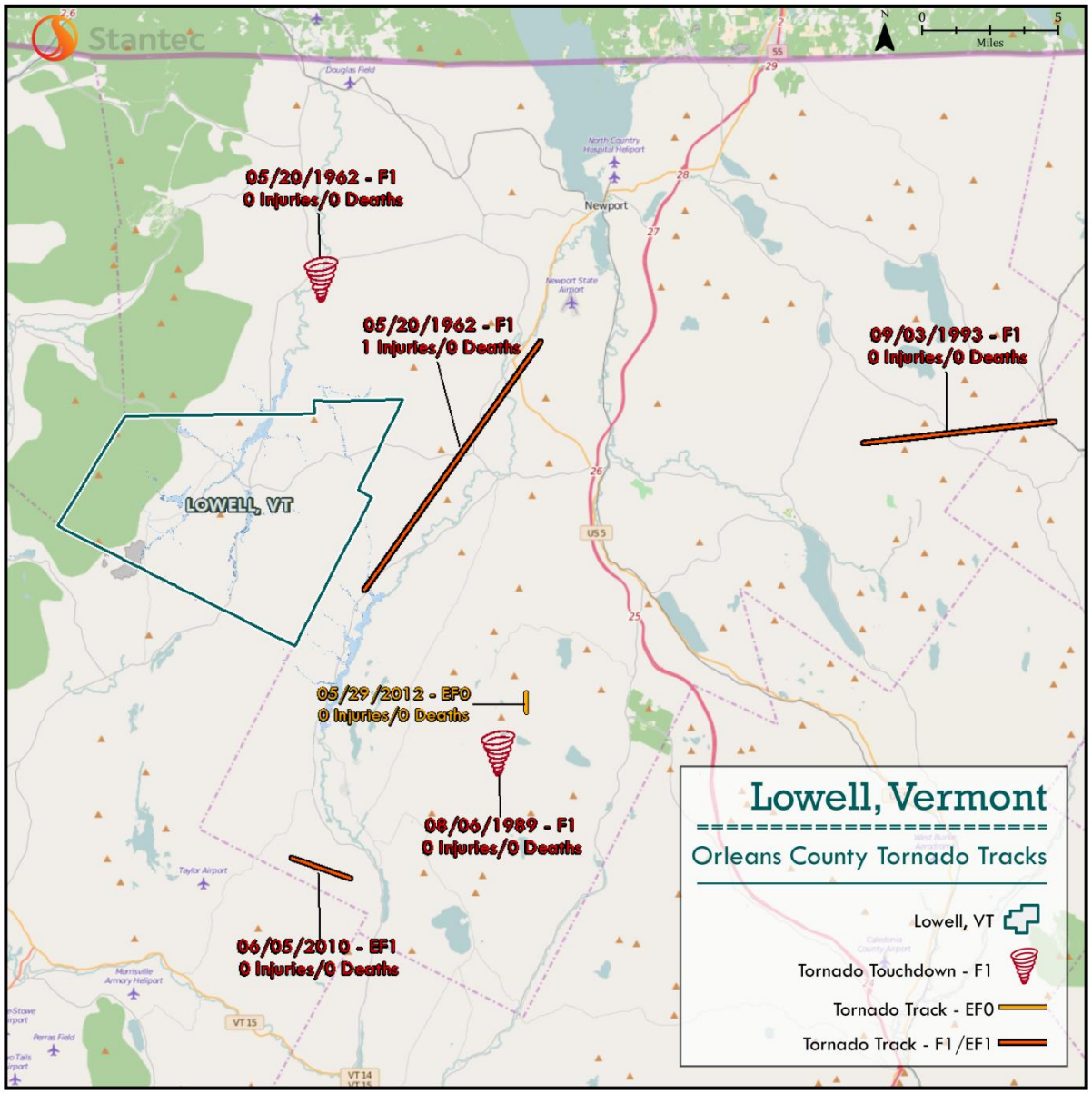

Figure 14 Tornado Tracks in Orleans County (1950 - 2015)

Extent

The greatest extent of tornado is an EF5 (over 200 miles per hour). Previous events around the planning area have ranged between EF0 and EF1, and the greatest event to impact Orleans County to date was an EF1 (86–110 miles per hour). However stronger events are possible.

There are mixed theories on the impacts that climate change may have on tornado frequency and occurrence as further described in the vulnerability assessment.

Probability of Future Events

The Tornado Index and historical events were also consulted to investigate probability. The tornado index indicates that Lowell has an index of 20, compared to an index of 88 for the state and 136 for the nation. The tornado index

value is calculated based on historical tornado events data using USA.com algorithms. It is an indicator of the tornado level in a region. A higher tornado index value means a higher chance of tornado events.

While no events were specifically reported in Lowell, 6 events over 65 years were reported in County. This results in an approximate annual probability of 10 percent. The tornado hazard is considered likely to occur in Lowell based on these results.

Vulnerability Assessment and Estimated Losses

All current and future buildings and populations should be considered at risk to tornadoes. Estimating accurate losses is difficult since is it impossible to predict where a tornado will strike, and there have been no direct losses reported in the Town. Tornadoes are capable of causing catastrophic damage, injuries and deaths. Additional impacts include power failure, loss of communications, business disruption and downed trees and debris.

Climate change could impact the frequency and severity of this hazard. Tornadoes occur due to unstable air. Warmer and moister air due to climate change could increase the frequency of favorable conditions for tornadoes to occur.[49] However, some evidence suggests that wind shear, which organizes a storm, may actually decrease due to lower temperatures contrasts from pole to pole.[50] This would limit increases in severity. Research from Florida State University (using NOAA Storm Prediction Center data) does predict more frequent tornadoes. The data indicates that larger numbers of tornadoes are occurring in a single day. Since 2001, there has been at least one day per year when 32 or more tornadoes occurred on a single day.[51] This is particularly important in terms of public awareness. The public needs to be informed that the risk of severe weather could result in multiple storms in a single day.

HURRICANE AND TROPICAL STORM

Description

Hurricanes and tropical storms are classified as cyclones and defined as any closed circulation developing around a low-pressure center. In the Northern Hemisphere, winds rotate counter-clockwise (or clockwise in the Southern Hemisphere) and measure on average 10 to 30 miles in diameter. A tropical cyclone refers to any such circulation that develops over tropical waters. Tropical cyclones act as a "safety-valve," limiting the continued build-up of heat and energy in tropical regions by maintaining the atmospheric heat and moisture balance between the tropics and the pole-ward latitudes. The primary damaging forces associated with these storms are high-level sustained winds, heavy precipitation, and tornadoes.

The key energy source for a tropical cyclone is the release of latent heat from the condensation of warm water. Their formation requires a low-pressure disturbance, warm sea surface temperature, rotational force from the spinning of the earth, and the absence of wind shear in the lowest 50,000 feet of the atmosphere. The majority of hurricanes and tropical storms form in the Atlantic Ocean, Caribbean Sea, and Gulf of Mexico during the official Atlantic hurricane season, which encompasses the months of June through November. The peak of the Atlantic hurricane season is in early to mid-September and the average number of storms that reach hurricane intensity per year in the Atlantic basin is about six (6).

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49 Biello, David. (2013). What Role Does Climate Change Play in Tornadoes? Scientific American. Retrieved December 11, 2014 from http://www.scientificamerican.com/article/kevin-trenberth-on-climate-change-and-tornadoes/
50 Is Climate Change Causing More Powerful Tornadoes? (2014). Accuweather. Retrieved December 11, 2014 from http://www.accuweather.com/en/weather-news/severe-weather-and-climate-change/62715
51 Haughney, Kathleen. (2014). New research links tornado strength, frequency to climate change. Florida State University News. Retrieved December 11, 2014 from http://news.fsu.edu/More-FSU-News/New-research-links-tornado-strength-frequency-to-climate-change

As an incipient hurricane develops, barometric pressure (measured in milliards or inches) at its center falls and winds increase. If the atmospheric and oceanic conditions are favorable, it can intensify into a tropical depression. When maximum sustained winds reach or exceed 39 miles per hour, the system is designated a tropical storm, given a name, and is closely monitored by the National Hurricane Center in Miami, Florida. When sustained winds reach or exceed 74 miles per hour the storm is deemed a hurricane. Hurricane intensity is further classified by the Saffir-Simpson Hurricane Wind Scale (Table 17), which rates hurricane wind intensity on a scale of 1 to 5, with 5 being the most intense.

Table 19 Saffir-Simpson Scale[52]

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

The Saffir-Simpson Scale categorizes hurricane intensity linearly based upon maximum sustained winds, which is used to estimate potential damage. Hurricanes of category 3, 4, and 5 are classified as "major" hurricanes, and while hurricanes within this range comprise only 20 percent of total tropical cyclone landfalls, they account for over 70 percent of the damage in the United States.

Table 18 describes the damage that could be expected for each category of hurricane. Damage during hurricanes may also result from spawned tornadoes, storm surge and inland flooding associated with heavy rainfall that usually accompanies these storms.

52 National Hurricane Center (2012). NOAA. Retrieved December 11, 2014 from http://www.nhc.noaa.gov/

Table 20 Hurricane Damage Classifications[53]

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

Location

Hurricane and tropical storms will impact the entire planning area.

Previous Occurrences

National Hurricane Center hurricane and tropical storm track data was reviewed. Four storms have passed through Vermont, but there were no storms that passed directly through the Town. However, Tropical Storm Floyd (1999) and Tropical Storm Irene (2011) resulted in major disaster declarations for Orleans County.

Hurricane Floyd's track passed Lowell with wind speeds between 45 – 50 knots (50 – 58 miles per hour, and Hurricane Irene passed Lowell with wind speeds between 80 – 95 knots (92 – 109 miles per hour). Both of these events resulted in flooding impacts in the planning area.

Few hurricanes ever make it all the way to Vermont, and only eight have had a notable impact since 1900. Several of these events are described below.[54]

The Hurricane that occurred on September 21st of 1938, known as the "Long Island Express," was a Category 3 storm and is considered one of the strongest hurricanes to impact New England and made landfall in Suffolk County, Long Island and onto Milford, Connecticut. From here, the track goes nearly straight up into Canada, tracking through western Massachusetts. Forecasting was still limited and often miscalculated. In fact, this storm

53 National Hurricane Center. Retrieved February 4, 2015. Available at: http://www.nhc.noaa.gov/aboutsshws.php
54 Taylor, C. J. (2011). "Hurricane Season in Vermont." PuroClean: Paramedics of Property Damage.

was not anticipated to strike New England that led to very little warning time for the population.[55] The storm moved across land very quickly with a forward speed of 70 miles per hour. In Massachusetts, sections of New Bedford were less than 8 feet of water, and there was substantial river flooding across the state due to rain.[56] A 186-mile per hour wind gust was reported at the Blue Hill Observatory (Milton, MA), and till this day, still one of the strongest gusts on record in the U.S. Further impacts from the storm included fires from downed power lines, especially in Connecticut. In all, the storm left over 550 people dead (5 deaths in Vermont), 1,700 injuries, 9,000 homes and buildings destroyed 15,000 buildings damages, and 250 million downed trees. In 2016 dollars, over $5.5 billion in damages lay in its wake. This hurricane is considered the most powerful tropical system to hit Vermont.[57] The Lowell Town Plan states the storm causes roofs to be blown off, other building damages, and many uprooted trees.

The State Hazard Mitigation Plan states Tropical Storm Floyd, in 1999, caused flooding and wind damage in parts of Vermont, as well as one associated death.

In 2003, Hurricane Isabel's strong winds down trees and power lines in Vermont, causing around $100,000 in damages.

In 2006, Hurricane Katrina produced gusty winds that downed trees across Vermont and other New England States.

According to the State Hazard Mitigation Plan, most of Vermont received between 4 – 5 inches of rain during Tropical Storm Irene in 2011, and nearly every river and stream flooded and/or experienced catastrophic fluvial erosion. The Lowell planning area received 5 – 6 inches of rain and was impacted by flash flooding. The planning area experienced transportation related damages, including road washouts, and received approximately $30,000 (2016 dollars) in Federal Public Assistance Funding for road and bridge repairs due to flooding.

Extent

Extent of hurricane can be defined by hurricane category and wind speed as defined by the Saffir-Simpson Scale. The strongest cyclone wind event to directly affect the Town was Tropical Storm Irene with over 50-mile per hour winds and five inches of rain. However, Category 2 and 3 hurricanes have passed within 150 miles of the planning area. Stronger events are possible but unlikely. The colder water and air temperatures of the Northeast region typically cause storms to dissipate before they make landfall. In fact, it is rare for hurricanes to reach Category 3 strength in the Northeast. It is notable that events, even small hurricane event can result in severe flooding, road/bridge washout, and building damage. For example, Hurricane Irene resulted in five inches of rain and associated flash flooding.

The State Hazard Mitigation Plan states that severe hurricanes are not considered likely nor do they pose a recurring threat for Vermont. However, it is possible with changing weather patterns due to climate change may make such events more frequent in the future.

55 Freeman, Stan. (2012). New England hurricane history shows path of deadly strikes from Hurricane of 1938 through Hurricane Bob in 1991. Masslive. Retrieved December 11, 2014 from http://www.masslive.com/news/index.ssf/2012/10/new_england_hurricane_history.html

56 The Great Hurricane of 1938. (2014). National Weather Service. Retrieved December 11, 2014 from http://www.weather.gov/box/1938hurricane

57 Vermont's Hurricane History. (2011). WCAX News. Retrieved from http://www.wcax.com/story/15335412/vermonts-hurricane-history

Probability of Future Events

In the last century, only two hurricanes/tropical storms (Long Island Express and Hurricane Irene) have caused notable direct impacts in Lowell, a probability of 2%. Therefore, hurricane/tropical storm hazard is assigned probability of possible. However, it should be noted the state of Vermont has been impacted by other hurricanes/tropical storms in the past, and the Vermont State Hazard Mitigation Plan considers hurricane hazard as likely.

Vulnerability Assessment and Estimated Losses

Hurricane and tropical storms had varying impacts on the planning area based on track location and storm characteristics. Since storms are atmospheric in nature, all existing and future buildings and populations are at risk to the hurricane and tropical storm hazard (including critical facilities). Hurricanes and associated flood and wind impacts have a large spatial extent and could affect many buildings. There is typically adequate warning with this hazard that allows for evacuation (or sheltering in place as advised) helping to reduce the impact on the population. The event itself would likely last less than 24 hours. Additional impacts include water damage in buildings from building envelope failure, business interruption, loss of communications, power failure, and research disruption. Utility disruption is a serious threat for areas with above ground electrical wiring. Flooding is also a major concern. Slow moving hurricanes (or ones that stall over an area) can dump tremendous amounts of rain on an area (as demanded by Tropical Storm Irene).

Climate change impacts are difficult to predict but likely will after hurricane behavior in the Northeast. A National Geographic article cited a National Aeronautics and Space Administration (NASA) study that indicates Atlantic winds may "blow more directly from west to east during hurricane season, pushing storms away from the United States."[58] However, this same article notes conflicting data and that rising sea temperature could lengthen the hurricane season and fuel stronger hurricane events. The National Climate Assessment report (2014) notes that hurricane "intensity, frequency, and duration have all increased since the early 1980s. This source predicts continuing intensity and associated rainfall with raising temperatures.[59] This would results in greater losses due to increased flooding, associated building damages and business interruption impacts.

HAIL

Description

Hailstorms are a potentially damaging outgrowth of severe thunderstorms. Early in the developmental stages of a hailstorm, ice crystals form within a low-pressure front due to the rapid rising of warm air into the upper atmosphere, followed by cooling of the air mass. Frozen droplets gradually accumulate on the ice crystals until they develop to a sufficient weight and fall as precipitation. Hail typically takes the form of spheres or irregularly shaped masses greater than 0.75 inches in diameter. The size of hailstones is a direct function of the scale and severity of the storm. High velocity updraft winds are required to keep hail in suspension in thunderclouds. The

[58] Drye, Willie. (2013). Scientists: Climate Change May Offer Hurricane Help. National Geographic News. Retrieved December 11, 2014 from http://news.nationalgeographic.com/news/2013/09/130902-hurricanes-climate-change-superstorm-sandy-global-warming-storms-science-weather/

[59] Walsh, John and Donald Wuebbles. (2014). Changes in Hurricanes. National Climate Assessment – U.S. Global Change Research Program. Retrieved December 11, 2014 from http://nca2014.globalchange.gov/report/our-changing-climate/changes-hurricanes

strength of the updraft is a function of the intensity of heating at the Earth's surface. Higher temperature gradients relative to elevation above the surface result in increased suspension time and hailstone size.

Hailstone size can range a great deal in size from 5 millimeters (mm) (approximately pea-sized) to greater than 100mm (approximately melon-sized). Table 19 shows the typical damage associated with different sizes of hail.

Table 21 TORRO Hailstorm Intensity Scale[60]

	Intensity Category	Typical Hail Diameter	Probable Kinetic Energy, J-m^2	Typical Damage Impacts	Size Code
H0	**Hard Hail**	5	0-20	No damage	1
H1	**Potentially Damaging**	5-15	>20	Slight general damage to plants, crops	1-3
H2	**Significant**	10-20	>100	Significant damage to fruit, crops, vegetation	1-4
H3	**Severe**	20-30	>300	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored	2-5
H4	**Severe**	25-40	>500	Widespread glass damage, vehicle bodywork damage	3-6
H5	**Destructive**	30-50	>800	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries	4-7
H6	**Destructive**	40-60		Bodywork of grounded aircraft dented, brick walls pitted	5-8
H7	**Destructive**	50-75		Severe roof damage, risk of serious injuries	6-9
H8	**Destructive**	60-90		Severe damage to multiple roof types (including sheet and metal); damage aircraft bodywork	7-10
H9	**Super Hailstorms**	75-100		Extensive structural damage (including concrete and wooden walls). Risk of severe or even fatal injuries to persons caught in the open	8-10
H10	**Super Hailstorms**	>100		Extensive structural damage (including destruction of wooden houses and damage to brick-built homes). Risk of severe or even fatal injuries to persons caught in the open	9-10

Location

Hail is atmospheric in nature and therefore can affect the entire planning area. Further, it typically coincides with thunderstorm events.

Previous Occurrences and Extent

A total of forty-one hail events were reported in Orleans County according to NCEI between 1950 and 2015. The hailstones ranged from 0.75 inches to 2.0 inches. Total damages were reported at just over $55,000 and there were no reports of injuries or fatalities. Of these reported hail events, two events occurred in Lowell as presented in Table 20.

[60] Hail Scale. (2014). The Tornado and Storm Research Organization. Retrieved December 11, 2014 from http://www.torro.org.uk/site/hscale.php

Table 22 Reported Hail Events in Lowell, VT (NCEI 1950-2015)

Date	Mag. (inches)	Death/ Injuries	Damage ($)	Details
05/30/2002	0.75	0/0	None reported	A cold front moved southeast from Canada and triggered late afternoon and evening thunderstorms. Dime size hail was reported in the town of Lowell. The end result was flash flooding in portions of north-central, northeast Vermont and Addison county with radar estimated storm total rainfall of 3 to 5 inches. Quarter to half dollar size hail reported.
3/14/2012	0.75	0/0	None reported	A warm front moved across Vermont during the morning hours of May 29th, which lead to numerous thunderstorms with heavy rain, damaging lightning and some isolated large hail and strong winds.

Extent

Extent for hail can be defined using hailstone size. According to the TORRO scale, this is more than 100 mm in diameter (3.94 inches). The largest recorded to date in the planning area is 0.75 inches (2.0 inches for Orleans County), though larger events are possible.

Probability of Future Events

According to available data, there is an approximate annual probability of 3 percent of hail impacting Lowell. However, previous occurrence information for the county indicates more frequent events (approximately 60% chance annually in the county). Therefore, a probability of possible was assigned.

Vulnerability Assessment and Estimated Losses

All current and future buildings and populations are at risk to the hail hazard. Hail is capable of causing damage, particularly to roofs, vehicles, and exposed metal and glass. Estimating a reliable loss for hail is difficult given lack of historical data. Events for the county indicate an average of approximately $850 per event. However, damage is likely unreported as a single hail events can total vehicles and destroy roofs.

Climate change impacts can potentially affect this hazard in terms of more frequent hailstorms. Consequently, this could increase associated damages.

EXTREME TEMPERATURES

Description

Extreme temperatures include extreme heat and extreme cold.

Extreme heat is defined as excessively dry and hot conditions where temperatures hover 10 degrees or more above the region's average high temperature that last for several weeks. Humid or muggy conditions,

which add to the discomfort of high temperatures, occur when a "dome" of high atmospheric pressure traps hazy, damp air near the ground. As a result, both drought and dust storms could occur.

What constitutes extreme cold and its effects can vary across different areas of the country. In regions relatively unaccustomed to winter weather, near freezing temperatures are considered “extreme cold.” Whenever temperatures drop decidedly below normal and as wind speed increases, heat can leave your body more rapidly. These weather-related conditions may lead to serious health problems. Extreme cold is a dangerous situation that can bring on health emergencies in susceptible people, such as those without shelter or who are stranded, or who live in a home that is poorly insulated or without heat.

Extreme cold can last for several days or more in Vermont putting people at risk of exposure and stressing heating systems. Extreme cold increases the risk of secondary hazards such as carbon monoxide poisoning and building fires. In addition, water pipes that freeze or break may cause flooding.

Location

Extreme temperature is an atmospheric hazard and can impact the entire Lowell planning area.

Previous Occurrences

The NCEI reports 20 Extreme Cold events across Orleans County, and there are no specific reports for Lowell. Freezing temperatures are common during winter months in this region. The Vermont Hazard Mitigation Plan states Vermont is characteristically known for straying below expected temperature values; this has been true since the 1920s. The plan also states that extreme cold events, including frost, have occasionally occurred in the summer. These instances have been detrimental to the growing season in the past. One event retrieved from the NCEI indicated $57 million dollars in crop damage in Orleans County. Maple syrup production is a major industry in the county, and extreme cold events slows sap flow and has shut down production during these periods of extreme cold.[61] There are no deaths or injuries associated with extreme cold events, but death and injuries are possible. Extreme cold events also have the potential to damage infrastructure such as water mains; one such incident in 2008 indicated damages of over $1 million dollars to infrastructure in Orleans County and the surrounding area. Though there are only damages recorded for two events, it is possible further damages have occurred, but are unreported. Table 21 presents the reported extreme cold events.

Table 23 Reported Extreme Cold Events in Orleans County, VT (NCEI 1996-2015)

Location	Date	Hazard Type	Temp. Reported	Wind Chill Reported	Event Description
ORLEANS (ZONE)	1/17/1997	Cold/ Wind Chill	- -	-30 to -60°F	N/A
ORLEANS (ZONE)	1/19/1997	Cold/ Wind Chill	-32°F	- -	N/A
ORLEANS (ZONE)	12/30/1998	Cold/ Wind Chill	- -	- -	Very cold air was ushered in on strong winds. Snow squalls occurred across the area with between 3 and 5 inches falling in the mountains.

[61] Vermont Maple Bulletin. (2016). Wordpress. Retrieved from https://vermontmaplebulletin.wordpress.com/

Location	Date	Hazard Type	Temp. Reported	Wind Chill Reported	Event Description
ORLEANS (ZONE)	1/13/2004	Cold/ Wind Chill	- -	-25 to -45°F	Weak low pressure moved across northern New England on Jan 12 with 2 to 4 inches of snow. Colder air. Then an arctic front moved through the area Jan 13. Arctic high pressure then settled across the area on Jan14.
ORLEANS (ZONE)	1/15/2004	Cold/ Wind Chill	- -	-25 to -45°F	Some sprinkler systems froze and burst in several area locations. One location on the University of Vermont campus resulted in 100,000 dollars of damage. Thereafter, it remained cold with arctic high pressure over the area, but winds abated.
ORLEANS (ZONE)	1/18/2005	Cold/ Wind Chill	- -	- -	A storm system east of New England combined with high pressure over the Midwestern US resulted in a flow of very cold air and gusty winds.
ORLEANS (ZONE)	1/20/2005	Cold/ Wind Chill	- -	- -	High pressure over the Great Lakes moved slowly east and resulted in a northerly flow of very cold temperatures and gusty winds.
ORLEANS (ZONE)	1/23/2005	Cold/ Wind Chill	- -	- -	A storm system east of New England combined with high pressure over the Midwestern US resulted in a flow of very cold air and gusty winds.
ORLEANS (ZONE)	10/20/2005	Frost/ Freeze	- -	- -	High pressure over the western Great Lakes with a ridge to PA early Thursday, Oct 20 moved east over New England and NY early Oct 21. Temperatures at or below freezing in most areas overnight. This cold snap ended any growing season after a mild fall season.
ORLEANS (ZONE)	1/15/2006	Cold/ Wind Chill	5-15°F	-10 to -25°F	An arctic cold front moved across northern Vermont early Jan 15. Record warm temperatures in the 50s on Sat 14, were replaced with temperatures 5 to 15 the next day. Blustery northwest winds 20 to 30 mph with gusts to 40 mph.
ORLEANS (ZONE)	2/18/2006	Cold/ Wind Chill	- -	-15 to -25°F	An arctic air mass moved into VT during the night of the 17th and delivered colder air through the 18th. Meanwhile, a strong pressure gradient between the arctic high across the Great Lakes and the departing storm in Newfoundland was creating brisk winds of 10 to 20 mph with higher gusts.

Location	Date	Hazard Type	Temp. Reported	Wind Chill Reported	Event Description
ORLEANS (ZONE)	2/27/2006	Cold/ Wind Chill	- -	-15 to -30°F	An arctic air mass moved across VT during the early hours of Feb 27. In addition, the pressure gradient between arctic high pressure in central Canada and low pressure in Labrador Canada accounted for brisk winds.
ORLEANS (ZONE)	1/25/2007	Extreme Cold/ Wind Chill	-10 to -30°F	-25 to -40°F	An arctic cold front moved across VT Jan 24 and delivered very cold temperatures below zero Jan 25. A secondary cold front developed late Jan 25 to Jan 26, and combined with a strengthening area of low pressure accounted for the brisk northwest winds of 10 to 15 mph. The cold wave diminished slightly on the 27th-29th, due to a slight air mass modification and clouds across the region, but it still remained some 10 to 20 degrees below normal. However, another arctic front pushed across the area on the 29th with a replenishment of arctic air that brought early morning low temperatures on the 30th.
ORLEANS (ZONE)	3/6/2007	Extreme Cold/ Wind Chill	-20 to -30°F	-20 to -40°F	An arctic cold front swept across VT during late Mar 5 and delivered frigid temperatures along with blustery winds. Temperatures plummeted below zero after midnight on Mar 6. These frigid temperatures, accompanied by winds of 15 to 30 mph. Brisk winds with temperatures around zero continued through the daylight hours of the 6th with wind chill readings in the 20s to around 30 degrees below zero. The winds subsided after sunset on the 6th but it remained extremely cold through the morning of the 7th.
ORLEANS (ZONE)	3/9/2007	Extreme Cold/ Wind Chill	-15 to -25°F	- -	Arctic high pressure settled across New England during the night of the 8th and morning of the 9th with more frigid temperatures, similar to a few days earlier across Vermont.
ORLEANS (ZONE)	12/8/2008	Cold/ Wind Chill	5 to -20°F	-15 to -25°F	This delivered the season's first arctic air mass with temperatures of 5 above to 10 below zero by the morning of December 8th along with brisk northwest winds of 10 to 20 mph with higher gusts at times.

Location	Date	Hazard Type	Temp. Reported	Wind Chill Reported	Event Description
ORLEANS (ZONE)	1/14/2009	Extreme Cold/ Wind Chill	-20 to -25°F	- -	An arctic cold front moved across VT early Jan 14, delivering some of the coldest temperatures across the region in several years. As the arctic front passed across northern VT, temperatures dropped over 20 degrees within hours. Temps averaged 20 to 25 degrees below normal values, which were already at climatological winter minimums. Minimums were 10 to 30 below zero with isolated readings colder than 40 below zero at times. These extremely cold temperatures led to numerous cold weather related problems including numerous dead vehicle batteries and broken home/business water pipes.
ORLEANS (ZONE)	4/28/2012	Frost/ Freeze	- -	- -	Several days of sub-freezing temperatures from the morning of April 28th to the morning of April 30th lead to damaging and possibly devastating killing freezes for various fruit-bearing crops in VT. Although these temperatures may not be seasonably uncommon, the preceding record breaking late winter and early spring warmth accelerated bud development in fruit crops by 2-3 weeks. Fruit crop damage estimates may exceed 25 percent of normal harvest. Orleans Co. saw $56k in crop damages (2016 dollars).
ORLEANS (ZONE)	1/7/2015	Extreme Cold/ Wind Chill	-15 to -30°F	-25 to -40°F	An arctic cold front pushed across VT during the afternoon of Jan 7 with plummeting temperatures and brisk, strong winds (15 to 30+ mph) causing dangerously cold wind. These wind chills lead to delayed school openings of 2 hours or cancelled classes Jan 8.
ORLEANS (ZONE)	2/1/2015	Cold/ Wind Chill	- -	- -	A persistent deep cold trough settled across the northeast US from late Jan through early March. Many locations did not witness temperatures above freezing for 25 to 45 consecutive days from mid-January through early March. Record Cold February 2015 for much of Vermont. Many communities witnessing the coldest month since Dec 1989 or Jan 1994. Damage to infrastructure, frozen water mains, etc. totaled at least $1 million across the region.
Total					**20**

The NCEI reports 2 Extreme Heat events across Orleans County, and there are no specific reports for Lowell though these events would apply to Lowell. Extreme heat is uncommon in the planning area. Table 22 presents the reported extreme heat events.

The Vermont HMP explains in the past, extreme heat events generally occur when high-pressure systems develop and intensify over the state. It also indicates there are approximately 6 days per year where temperatures exceed 90 degrees Fahrenheit in the region surrounding the planning area. Of the two heat events reported for Orleans County, one incident in the spring resulted in crop damages of over $1.1 million dollars (2016 dollars) to the maple syrup industry. Additionally, the 2015-2016 winter warmer than normal, resulting in significant losses of maple syrup production. One farm in the region usually produces 150 gallons of syrup; however, the warm winter reduced this number to 36 gallons. While vulnerable populations are generally at an elevated risk due to heat events, they typically are not extreme or long lasting in the planning area.

Table 24 Reported Extreme Heat Events in Orleans County, VT (NCEI 1996-2015)

Location	Date	Hazard Type	Temp Reported	Details
ORLEANS (ZONE)	8/1/2006	Excessive Heat	90 to 95°F	A "heat ridge" moved into Vermont during the early morning hours of the 1st. This "heat ridge" was part of a strong, upper level area of high pressure that brought record heat to a large majority of the country since mid-July. In Vermont on the 1st, afternoon temperatures soared into the 90s, but significantly more important were dew points that reached the middle to upper 70s to produce excessive heat index values of 100 to 105 degrees, some of the highest values in nearly a decade.
ORLEANS (ZONE)	3/17/2012	Excessive Heat	78 to 81°F	In Vermont, temperatures reached the mid-50s to lower 60s on March 17th, then climbed into the 70s on the 18th with 70s and lower 80s on the 19th through 22nd. The normal high temperature during this period is the mid-30s to lower 40s. These record temperatures combined with Winter 2011-12 conditions accounted for the Maple Sugaring industry to end by the last week of March. Preliminary estimates of a 30 percent loss in the maple sugaring industry or approximately 250,000 gallons at a market rate of $40/gallon or approximately a $10 Million loss statewide. Loss of $1,125,509 (2016 dollars) in Orleans County.

Extent

The extent of extreme cold events can be defined by the record low temperatures. The coldest temperature on record in Lowell was -43 degrees Fahrenheit on December 21, 1917.[44] Over the last 20 years, extreme cold temperatures have ranged between -20 to 30 degrees Fahrenheit, with wind chills ranging from -25 to 45 degrees. Colder events are possible in the planning area.

Similarly, the extent of extreme heat events is defined by the record high temperatures. The highest recorded temperature in Lowell was 99 degrees Fahrenheit on June 18, 1907. During the spring months, temperatures around 80 degrees are considered extreme heat, while 90 to 95 degrees or higher are recorded as extreme heat in

the summer. However, greater temperatures are possible. Further, the heat index (humidity level and atmospheric temperature) can impact the severity of this hazard.[62] According to the National Climate Assessment, temperature averages are expected to rise by at least 4 degrees Fahrenheit in the northeast over the next century.

Probability of Future Events

Although there are no events specific to Lowell, based on a 100% probability of Extreme Cold events in Orleans County (20 events in 19 years), Extreme Cold is considered highly likely in Lowell.

Additionally, based on 2 Extreme Heat events over 19 years in Orleans County and local knowledge of the area, an estimated annual probability of possible was assigned for Extreme Heat events in Lowell.

Vulnerability Assessment and Estimated Losses

Extreme temperature is an atmospheric hazard so it has the potential to impact all existing and future assets, essential facilities, and populations. In general, this hazard has adequate warning time, beyond 24 hours and lasts for less than a week. It has a large spatial extent, so the entire planning area would be impacted. Extreme temperatures are unlikely to damage structures though extreme cold may result in broken water pipes and extreme heat could result in the buckling of buildings.

Vulnerable populations, including the elderly and babies, have an increased risk and lower tolerance for such events. Extreme heat poses a health risk in terms of heat stroke and heat exhaustion. Those working or exercising outdoors should exercise caution. Extreme cold poses a health threat in terms of hypothermia and frostbite. During extreme cold events, motorists should use caution when crossing bridges and traveling secondary roads, which may be icy. In addition, sidewalks and driveways may become slippery. Lastly, death and injury risk from improperly using heating devices is also a concern for fire and carbon monoxide poisoning.

The maple syrup industry in Orleans County is particularly vulnerable to extreme temperatures. Both extreme cold and extreme heat have the potential to halt production. Extreme cold temperatures can slows sap production from maple trees and delay the start of the season, while extreme heat (particularly in March) can cause the production season to end early.

Although there were losses reported with one Extreme Heat event to the Maple Sugaring Industry were reported with this hazard, the future losses are expected to be minimal. They would be negligible if annualized overtime. Climate change may impact this hazard through increased occurrence and severity. However, some trends indicate a warming northeast (by a few degrees), which could reduce the severity of this hazard.

DROUGHT

Description

Drought is conceptually defined by the national Drought Mitigation Center as “a protracted period of deficient precipitation resulting in extensive damage to crops, resulting in loss of yield.” Drought is a normal, recurrent feature of climate, although many erroneously consider it a rare and random event. It occurs in virtually all climatic zones yet its characteristics vary significantly from one region to another. Drought is a temporary aberration and differs from aridity since the latter is restricted to low rainfall regions and is a permanent feature of climate. Droughts are slow-onset hazards, but over time can have very damaging affects to crops, municipal water supplies, recreational uses, and wildlife. If droughts extend over a number of years, the direct and indirect economic impact can be significant.

[62] Temperature Weather Database. (2016). *Weather DB.* Retrieved from https://temperature.weatherdb.com/l/15199/Lowell-Vermont

Drought should be considered relative to some long-term average condition of balance between precipitation and evapo-transpiration in a particular area, a condition often perceived as "normal." It is also related to the timing (i.e., principal season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to principal crop growth stages) and the effectiveness of the rains (i.e., rainfall intensity, number of rainfall events). Other climatic factors such as high temperature, high wind, and low relative humidity are often associated with it in many regions of the world and can significantly aggravate its severity.

The beginning of a drought is difficult to determine. Several weeks, months, or even year may pass before people know that a drought is occurring. The first evidence of drought usually is seen in rainfall records. Within a short period of time, the amount of moisture in soils can begin to decrease. The effects of a drought found in stream and river flows or on water levels in lakes and reservoirs may not be noticed for several weeks or months. Water levels in wells may not reflect a shortage of rainfall for a year or more after a drought begins.

The end of a drought can occur as gradually as it began. Dry periods can last for 10 years or more. During the 1930s, most of the United States was much drier than normal. In California, the drought extended from 1928 to 1937. In Missouri, the drought lasted from 1930 to 1941. Missouri's extended dry period produced 1930s' "Dust Bowl", which refers to crops and farms that were destroyed by dust storms.

Drought is a normal part of virtually all-climatic regimes, including areas with high and low average rainfall. Drought is the consequence of a natural reduction in the amount of precipitation expected over an extended period of time, usually a season or more in length. Drought can be defined according to meteorological, hydrological, or agricultural criteria. Drought is typically categorized in three types as shown in Table 23 below:

Table 25 Drought Types

Drought Type	Description
Meteorological Drought	Meteorological drought is usually based on long-term precipitation departures from normal, but there is no consensus regarding the threshold of the deficit or the minimum duration of the lack of precipitation that makes a dry spell an official drought.
Hydrological Drought	Hydrological drought refers to deficiencies in surface and subsurface water supplies. It is measured as stream flow, and as lake, reservoir, and ground water levels.
Agricultural Drought	Agricultural drought occurs when there is insufficient soil moisture to meet the needs of a particular crop at a particular time. A deficit of rainfall over cropped areas during critical periods of the growth cycle can result in destroyed or underdeveloped crops with greatly depleted yields. Agricultural drought is typically evident after meteorological drought but before a hydrological drought.

In addition, the U.S. Drought Monitor records drought and associated severity weekly by County. Conditions are categorized into five categories as shown in Table 24 below.

Table 26 U.S. Drought Monitor Categories

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

Drought should not be viewed as merely a physical phenomenon or natural event. Its impacts on society result from the interplay between a natural event and the demand people place on water supply. Human activities often exacerbate the impact of drought. For example, water use can deplete ground water supply.

Location

A drought is a regional event that is not confined to geographic or political boundaries; it can affect several areas at once. However, it can range in severity across those areas. All of Lowell is at risk to drought occurrence.

Previous Occurrences

Vermont is often considered a "water-rich" state and the Lowell Hazard Mitigation Planning Committee indicated that drought has never been an issue in the Town.

According to U.S. Drought Monitor data, the most recent severe drought conditions in the planning area were two weeks in mid-September in 2001. The event was part of a widespread drought that impacts one-third of the nation (including Vermont). The magnitude and complexity of drought hazards have increased in association with growing population, the shift of population to drier regions of the country, urbanization, and changes in land and water use. Climate change impacts may also be impacting drought.

U.S. Drought Monitor Data was gathered for Orleans County from the station nearest to Lowell in Newport, VT. The reporting period is January 2000 to April 2016. Records include a weekly drought condition including the percent of the area in each classification of drought. Results are presented below by reporting the highest drought classification that occurred each year and the number of weeks at that level. It should be noted that some weeks were not fully one condition as conditions are reported by category as a percentage. For example, D2 may be reported as the highest level but only a small percentage of the area may be involved in D2 drought levels. The information is compiled and presented in Table 25.

Table 27 Drought Monitor Data, Orleans County[63]

YEAR	MAXIMUM SEVERITY
2000	No drought
2001	Up to D1 conditions for 19 weeks; Up to D2 conditions for 2 weeks
2002	Up to D1 conditions for 13 weeks
2003	Up to D0 conditions for 15 weeks
2004	Up to D0 conditions for 2 weeks
2005	No Drought
2006	No Drought
2007	Up to D0 conditions for 2 weeks
2008	No Drought
2009	No drought
2010	Up to D0 conditions for 1 week
2011	Up to D0 conditions for 8 weeks
2012	Up to D0 conditions for 31 weeks
2013	Up to D0 conditions for 21 weeks
2014	Up to D0 conditions for 1 weeks
2015	Up to D0 conditions for 16 weeks
2016	Up to D0 conditions for 8 weeks (through 4/26/16)

Extent

Extent of drought can be defined in terms of the Drought Monitor classifications. Drought has ranged from D0 to D2 in the planning area. The highest classification to occur in Lowell (and the state) is D2. However, more severe conditions are possible.

Probability of Future Events

Drought conditions of D1 or higher have been reported in two out of seventeen years. This results in an approximate probably of 11 percent, bringing the probability of future drought events to likely.

Vulnerability Assessment and Estimated Losses

Drought is an atmospheric hazard so it has the potential to impact all existing and future assets, essential facilities, and populations. As previously noted, drought tends to have greater economic, environment, and social impacts than the built environment. The Lowell hazard mitigation planning committee indicated that drought has never been an issue in the Town. Potential impacts are presented in Table 26.

Table 28 Drought Impacts

Economic	Environment	Social
• Temporary closure of business and essential facilities (restaurants cannot operate safely without water)	• Crop damage • Stress on wildlife • Increased wildfires • Wind erosion • Loss of wetlands	• Water conservation requirements • Reduced quality of life • Food shortages • Political conflicts over water

63 Climate Data. (2014). National Drought Mitigation Center. Retrieved from http://droughtmonitor.unl.edu/MapsAndData/DataTables.aspx

Economic	Environment	Social
• Increase in food prices • Increased wildfires • Loss of incomes • Los of hydroelectric power	• Drying ponds/lakes	rights • Stress

Climate change may also influence drought. Recent projections from the UMASS Climate System Research Center are showing that the Northeast will warm by 2-2 degrees (about 1.8 degrees Celsius) and experience more precipitation in the winter months (likely in the form of rain).[64] Warmer temperatures could result in faster evaporation; however this is offset by wetter conditions. It is likely that drought will be a lesser concern but much uncertainty remains.

WILDFIRE

Description

A wildfire is an uncontrolled fire spreading through vegetative fuels, potentially consuming structures. They often begin unnoticed, spread quickly, and are finally detected by the dense smoke that fills the area from miles away. Wildfires can be caused through human acts like arson or careless accidents, or through natural occurrences of lightning. Wildfire danger can vary greatly season to season and is exacerbated by dry weather conditions. Brushfires are also possible The U.S. Fire Service defines brush fire as "a fire burning in vegetation that is predominantly shrubs, brush, and scrub growth."[65]

Three principal factors influence the behavior of wildfires, including brush fires: topography, fuel type, and weather. Steep slopes, fuel types like dry grasses and soft woods, and dry or windy weather conditions all spur the spread of wildfires.

Fires that burn forest plants can be classified in three ways: 1) ground fires, 2) surface fires, and 3) crown fires. Ground fires burn the humus layer of the forest floor. Surface fires burn forest undergrowth and surface litter. Finally, crown fires advance through the tops of trees. Atmospheric factors such as temperature, humidity, and rainfall are important factors in determining the combustibility of a given forest.

Wildfires are often a result of human activity. Humans, either through negligence, accident, or intentional arson, have caused approximately 90 percent of all wildfires in the last decade. Accidental and negligent acts include unattended campfires, sparks, burning debris, and irresponsibly discarded cigarettes. The remaining 10 percent of fires are mostly caused by lightning, but may also be caused by other acts-of-nature such as volcanic eruptions or earthquakes.

Wildfires, including brush fires, are a natural process. Its suppression is now recognized to have created a larger fire hazard, as live and dead vegetation (fuel) accumulates in areas where fire has been excluded. In addition, the absence of fire has altered or disrupted the cycle of natural plant succession and wildlife habitat in many areas. Consequently, federal, state and local agencies are committed to finding ways, such as prescribed burning to reintroduce fire into natural ecosystems, while recognizing that firef ighting and suppression are

64 Climate modelers see possible warmer, wetter winters in Northeast by 2070. (2012). UMass Amherst. Retrieved December 11, 2014 from http://www.umass.edu/newsoffice/article/climate-modelers-see-possible-warmer-wetter-winters-northeast-2070

65 Fire Terminology. (2013). U.S Forest Service. Retrieved January 20, 2013 from http://www.fs.fed.us/nwacfire/home/terminology.html#B

still important. In addition, wildfires leave problems behind them, such as debris flows and damage to water supply systems.

During an intense wildfire, all vegetation may be destroyed; also the organic material in the soil may be burned away or may decompose into water-repellent substances that prevent water from percolating into the soil. As a result, even normal rainfall may result in unusual erosion or flooding from a burned area. Water supplies are also affected by wildfires: the loss of ground surface cover, such as needles and small branches, and the chemical transformation of burned soils make watersheds more susceptible to erosion from rainstorms. For example, the U.S. Forest Service (USFS) uses greenness maps to generate national maps of selected fire weather and fire danger components of their Wildland Fire Assessment System.[66]

Location

Potential wildfire risk location in Lowell may be determined by investigating areas where development is near undeveloped areas. The area where urban development meets vegetated, wildfire prone lands is known as the Wildland Urban Interface (WUI). There are several areas in the planning area where this exists. The Silvis Lab (University of Wisconsin) produces wildland urban interface data. This data was used to map WUI areas in the Town of Lowell.

Silvis defines interface areas and intermix areas as follows:

- **Interface areas:** Housing density between 6.2 and 742 structures/census block combined with Wildland vegetation less than equal to 50% AND within 2.4 kilometers of areas with at least 75% Wildland vegetation.
- **Intermix areas:** Housing density between 6.2 and 741 structures/census block and Wildland vegetation is greater than 50%.

Figure 15 shows the WUI for the Town of Lowell.

66 Wildland Fire Assessment System. (2014). US Forest Service. Retrieved December 11, 2014 from http://www.fs.fed.us/land/wfas/welcome.html

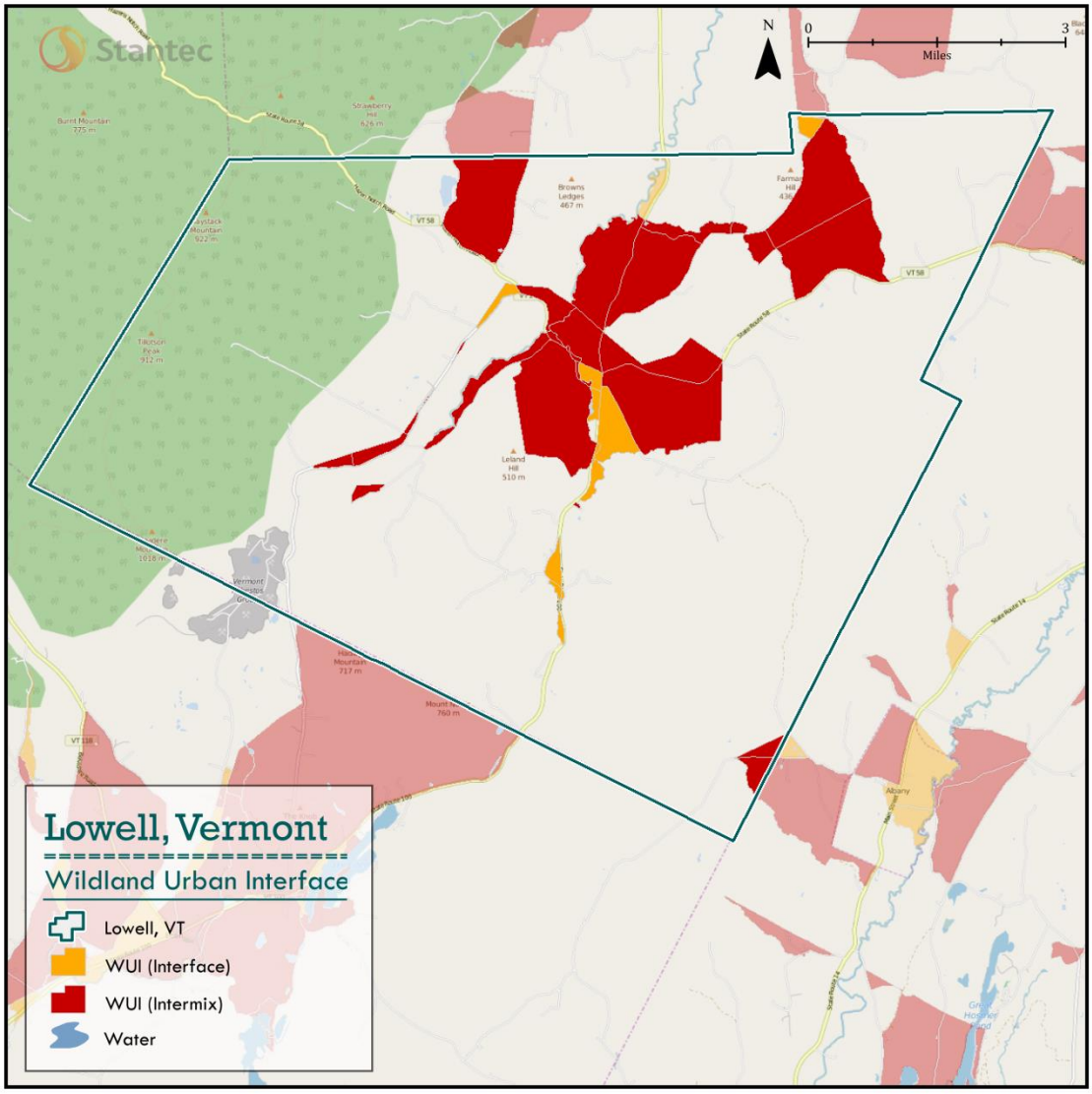

Figure 15 Wildland-Urban Interface/Intermix Hazard Areas

Previous Occurrences

Several sources were investigated to determine wildfires that have impacted Lowell. The Lowell hazard mitigation planning committee indicated that they have not experienced significant forest fires and there is frequent rain which mitigates a widespread burn. Burn permits are required and the fire department is actively involved in keeping fires safe. The State Hazard Mitigation Plan also notes that wildfires are uncommon and the threat is rare. While there has not been a major wildfire in Vermont in 50 years, there have been statewide burn bans in 1999, 2000, 2001, 2005, and 2012 to prevent potential fires during drought occurrences.

Extent

Extent of wildfire is typically determined by fire size. No specific information on wildfire was determined for Lowell; however, it can be inferred that wildfires in Lowell are likely to be small (a few acres). The WUI indicates that there are 360 acres of Interface areas and 4,400 acres of Intermix areas in Lowell.

Probability of Future Events

Wildfires and brush fires can occur every month of the year. Drought, snow pack, and local weather conditions can expand the length of the fire season impact or a probability of occurrence.

Limited reporting on previous occurrences makes it difficult to determine a reliable probability. Based on best available data, a probably of possible was assigned.

Vulnerability Assessment and Estimated Losses

According to the previous version of this hazard mitigation plan forest fires are a concern, especially for farms and residences. Further, there is potential for devastating forest fires due to logging and dead brush in the forested areas. A large fire would deplete local resources and require mutual aid within the Town of Lowell. Thankfully, the wildfire threat is generally low, and any incidents can generally be contained quickly given typically wet ground conditions.

Wildfire impacts include structure damage or loss, timber and habitat damage and loss, reduced air quality due to smoke, hazardous driving conditions due to smoke and ash, accelerated erosion and increased flood risk. Evacuations due to brush fires are less likely in the Town as the fires are quickly contained. Climate Change may also impact this hazard in terms of warmer summers and reduced precipitation (increased burnable area) and population increase due to rising summer temperatures, for example.

Small wildfires (a few acres in size) are expected in the planning area. Typically, fire incidents are very random and can't be modeled accurately.

All current and future buildings and populations are considered at risk to wildfire. However, WUI data permits further GIS intersection analysis to indicate specific risk in this area. Existing parcel, Emergency Site/E911 buildings and critical facility data from the town was analyzed using the Hazus-MH generated floodplain. There are 487 parcels that intersect the Interface areas and 114 parcels that intersect the Intermix areas. Table 27 shows the structures potentially at risk (based on structure point data) and Table 28 shows the critical facilities potentially at risk. The associated figures are Figure 16 and Figure 17.

Table 29 Buildings Potentially at Risk to Wildfire (WUI zones)

Type	Interface	Intermix	Type	Interface	Intermix
Camps	0	37	**Mobile Home**	8	40
Cemetery	0	1	**Multi-Family**	1	5
Commercial	4	6	**Other**	5	4
Development Site	0	1	**Other Commercial**	0	1
Educational	0	1	**Other Residential**	1	6
Fire Station	0	1	**Public Gather**	1	1
Gated w/o Building	0	2	**Public Telephone**	1	0
Government	0	3	**Seasonal Home**	0	0
Gravel Pit	0	1	**Single Family**	28	126
House of Worship	1	2	**Wind Facility/Wind Tower**	0	0
Industrial	0	1			
TOTAL STRUCTURES POTENTIALLY AT RISK	**Interface**		**Intermix**		
	50		**239**		

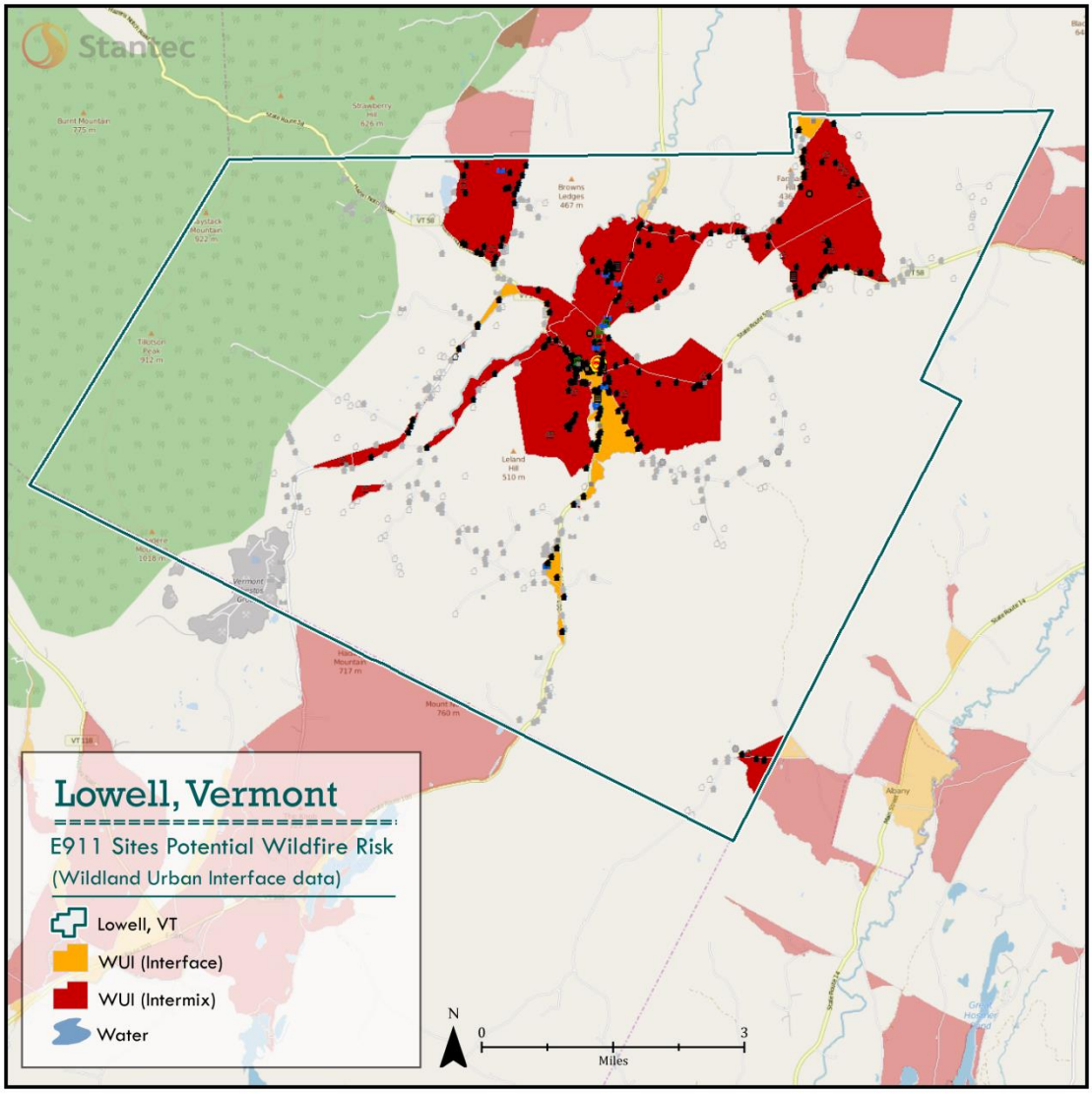

Figure 16 Emergency Sites/E911 Points Potentially At Risk to Wildfire

Table 30 Critical Facilities Potentially at Risk to Wildfire

Critical Facilities Potentially At Risk	Interface	Intermix
Post Office	-	X
Catholic Church	X	-
Parish Hall	X	-
Lowell Grade School	-	X
Town Clerks Office/Historical Society/Library	-	X
Lowell Congressional Church	-	X
Lowell Fire Department	-	X
Lowell Town Garage	-	X
Wind Tower Control Building and Land	-	-
General Store	X	X

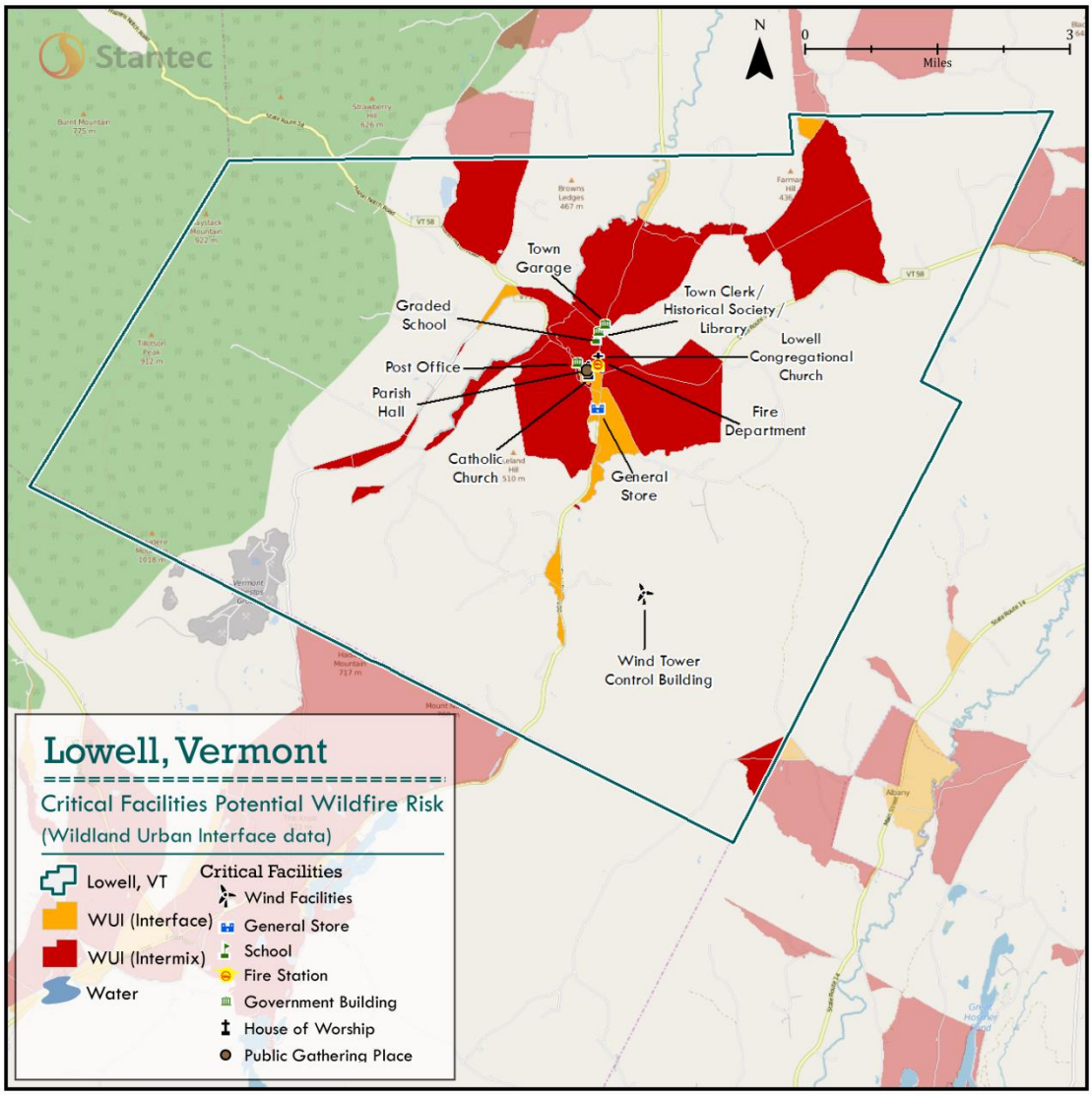

Figure 17 Lowell Critical Facilities Potentially At Risk to Wildfire

EARTHQUAKE

Description

Earthquakes are defined as the sudden release of strain (or displacement of rock) in the earth's crust, resulting in waves of shaking that radiate outward from the earthquake source. Earthquakes result from crustal strain, volcanism, landslides or the collapse of caverns. They can occur underwater or on land. Earthquakes ripples can extend across hundreds of thousands of square miles. Their intensity ranges from very minor (ground shaking not detected by humans without instruments) to very violent (catastrophic in nature). Damages follow this intensity ranging from minor to catastrophic. Earthquakes can result in high number of deaths and injuries and occur without warning.

To understand the nature of earthquakes, the composition of the earth must be explored. The earth is made up of four major layers and several sub layers (Refer to Figure 18 [67]): 1) a solid inner core, 2) a liquid outer core, 3) a semi-molten mantle, and 4) the rocky crust (the thin outermost layer of the earth). The upper portion of the mantle combined with the crust forms the lithosphere. This area is susceptible to fractures and can be thought of as a shell. The lithosphere breaks up into large slabs, known as tectonic plates. The tectonic plates are the areas where earthquakes occur.

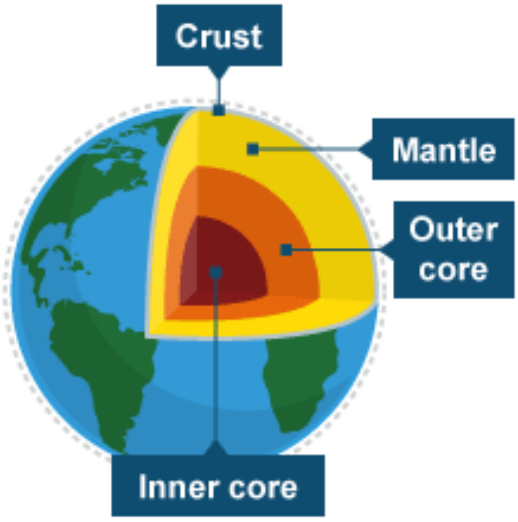

Figure 18 Earth's Sublayers

There are approximately twelve major plates and several dozen more minor plates on the earth's crust, as shown in Figure 19. Plates are regions of the crust that continually move over the mantle. The plate boundaries are areas where plates meet, where earthquakes occur when plates grind past each other, dive under each other, or spread apart. Most earthquakes are caused by the release of stresses accumulated as a result of the sudden displacement of rock in the Earth's crust along opposing plates. The areas bordering the Pacific Plate, also known as the "Pacific Ring of Fire", are at a particularly high risk since most of the largest earthquake events of the last century took place in the region.

While earthquakes typically occur along plate boundaries earthquakes may also result from crustal strain, volcanism, landslides or the collapse of caverns. However, according to the Boston College Weston Observatory, earthquake location in the Northeast rarely corresponds to tectonic plate locations. There are theories indicating that "ancient zones of weakness" exist, where once active faults reside.[68] However, locating such faults and proving they are the source of earthquake activity has proven difficult.

Earthquakes can affect hundreds of thousands of square miles, as a result, cause damage to property measured in the tens of billions of dollars, result in loss of life, injury to hundreds of thousands of people, and disrupt the social and economic functioning of the affected area. The point where an earthquake starts is termed the focus or hypocenter and may be many miles to several hundred miles deep within the earth. The point at the surface directly above the focus is called the earthquake's epicenter. Earthquakes are measured in terms of their magnitude and intensity.

67 The Earth's structure and plate movement. (2014). British Broadcasting Corporation. Retrieved December 11, 2014 from http://www.bbc.co.uk/bitesize/ks3/geography/physical_processes/plate_tectonics/revision/2/
68 Kafka, Alan L. (2014). Why Does the Earth Quake in New England? Boston College. Retrieved December 11, 2014 from https://www2.bc.edu/~kafka/Why_Quakes/why_quakes.html

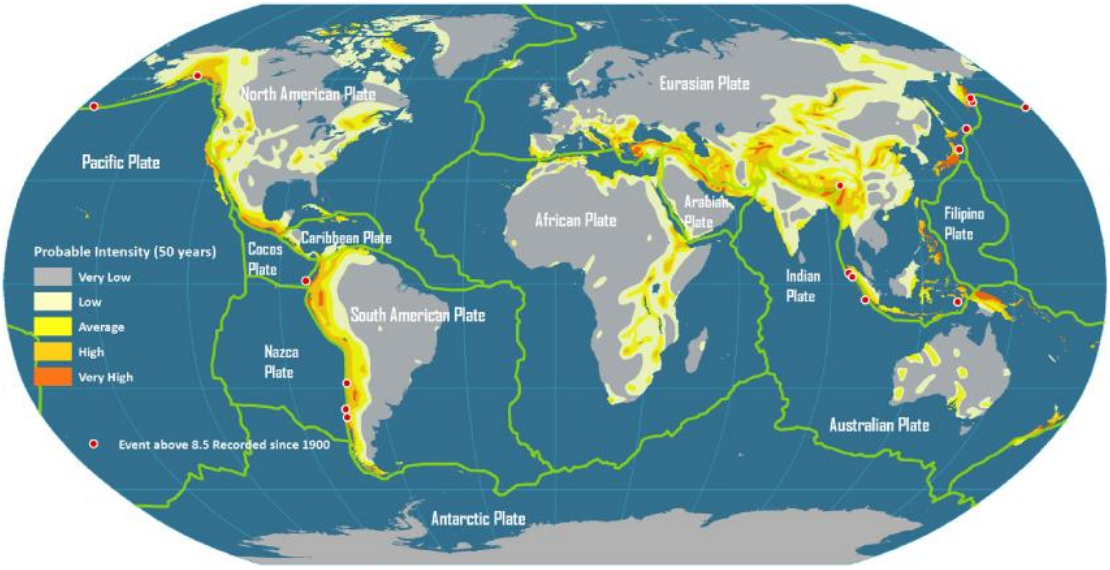

Figure 11 Global Plate Tectonics and Seismic Activity[69]

Earthquake magnitude is measured using the Richter Scale, an open-ended logarithmic scale that describes the energy release of an earthquake through a measure of shock wave amplitude (Table 29). Each unit increase in magnitude on the Richter Scale corresponds to a 10-fold increase in wave amplitude, or a 32-fold increase in energy. Beginning in 2002, the USGS began using Moment Magnitude as the preferred measure of magnitude for all USGS earthquakes greater than magnitude 3.5. This was primarily due to the fact the Richter Scale has an upper bound, so large earthquakes were difficult to measure. Moment Magnitude also has a scale, but no instrument is used to measure it. Instead, factors such as the distance the earthquake travels, the area of the fault, and land that was displaced (also known as "slip") are used to measure moment magnitude. Table 30 shows the Moment Magnitude Scale.

Table 31 Richter Scale

Scale Value	Effect
Less than 3.5	Often felt, but rarely causes damage.
3.5 – 5.4	At most slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.
6.1-6.9	Can be destructive in areas up to about 100 kilometers across where people live.
7.0-7.9	Major earthquake. Can cause serious damage over larger areas.
8 or greater	Great earthquake. Can cause serious damage in areas several hundred kilometers across.

69 Global Plate Tectonics and Seismic Activity (2014). The Geography of Transport Systems. Retrieved 11, 2014 from https://people.hofstra.edu/geotrans/eng/ch9en/conc9en/plate_tectonics.html

Table 32 Moment Magnitude Scale

Scale Value	Effect
Less than 3.5	Very weak; unlikely to be felt
3.5 – 5.4	Generally felt; rarely causes damage
6.1-6.9	Will not cause damage to well-designed buildings; will damage poorly designed ones
7.0-7.9	Considered a "major earthquake" that causes a lot of damage
8 or greater	Large and destructive earthquake that can destroy large cities

Earthquake intensity is most commonly measured using the Modified Mercalli Intensity (MMI) Scale based on direct and indirect measurements of seismic effects. The scale levels are typically described using roman numerals, ranging from "I" corresponding to imperceptible (instrumental) events to "XII" for catastrophic (total destruction). A detailed description of the Modified Mercalli Intensity Scale of earthquake intensity and its correspondence to the Richter Scale is given in Table 31.

Table 33 Modified Mercalli Intensity Scale for Earthquakes[70]

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

Location

Although earthquakes typically occur along fault lines, earthquakes in the Northeast do not always occur on known fault lines throughout the area. As discussed in the hazard description subsection, the location of where earthquakes will occur in the Northeast is still uncertain. The hard rock terrain in the northeast permits earthquake energy waves to travel long distances while dissipating slowly.

70 Federal Emergency Management Agency

All areas of the Lowell planning are susceptible to an earthquake occurrence. Fault lines, however, are not a sufficient indicator of earthquake location in the Northeast. Figure 20 below was used to indicate possible earthquake locations to demonstrate locational risk. It shows the location of relative seismic risk for the United States. It indicates that the planning area is in an approximate zone of 10-14 percent g hazard area (moderate risk). Percent g refers to the acceleration due to gravity.

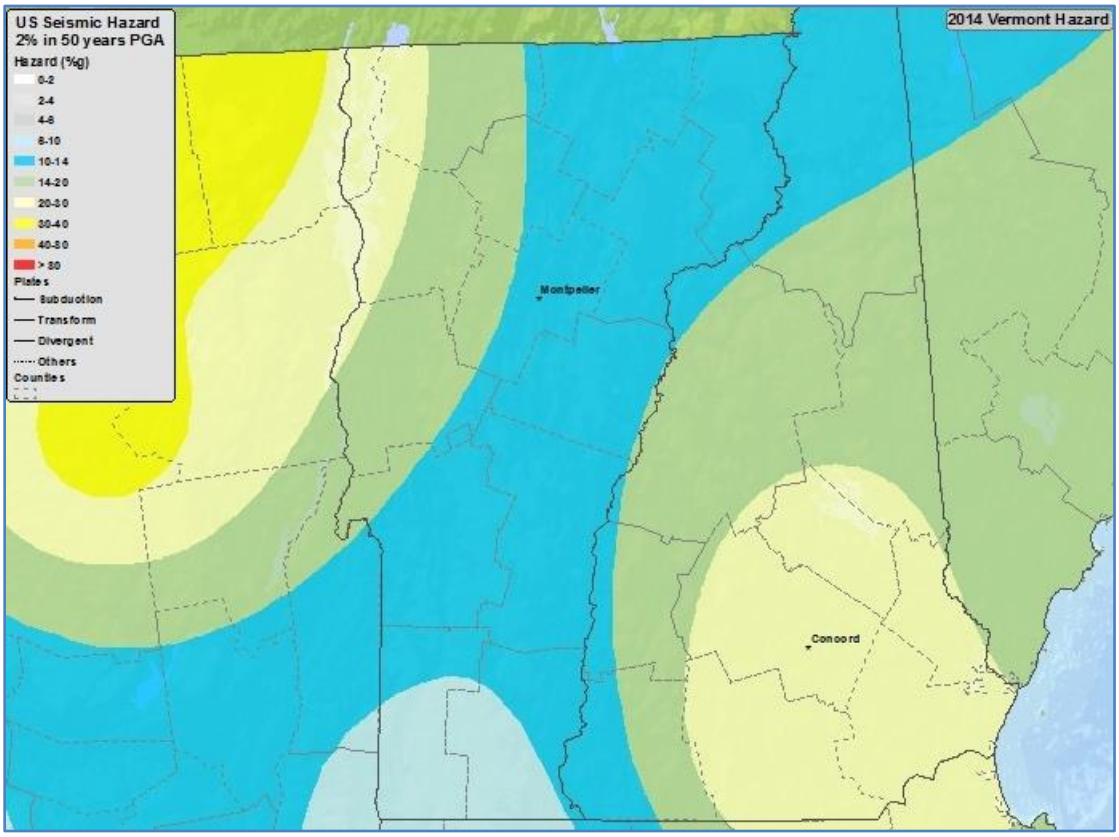

Figure 12 USGS Seismic Hazard Map for Vermont[71]

Previous Occurrences and Extent

Although it is well documented that the zone of greatest seismic activity in the United States is along the Pacific Coast in Alaska and California, it may be surprising to most people that an average of 5 earthquakes are felt each year somewhere in New England. New England has had a history of earthquakes including those recorded by the first settlers, and by the Plymouth Pilgrims in 1630. Figure 21 below depicts historical occurrence of earthquakes in the Northeast. The figure on the left that depicts 1924-1974 earthquake occurrences is from the USGS, and the figure on the right is from Weston Observatory archives recorded by the Northeastern United States Seismic Network.[72] As the maps indicate, earthquake activity in Vermont has been very limited in recent decades, but historically was more active in the early to mid-1900s.

The Hazard Mitigation Planning Committee indicated no damages or reports of earthquakes.

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71 Vermont Seismic Hazard Map (2014). USGS. Retrieved from http://earthquake.usgs.gov/earthquakes/states/vermont/hazards.php

72 Kafka, Alan L. (2014). Why Does the Earth Quake in New England? Boston College. Retrieved December 11, 2014 from https://www2.bc.edu/~kafka/Why_Quakes/why_quakes.html

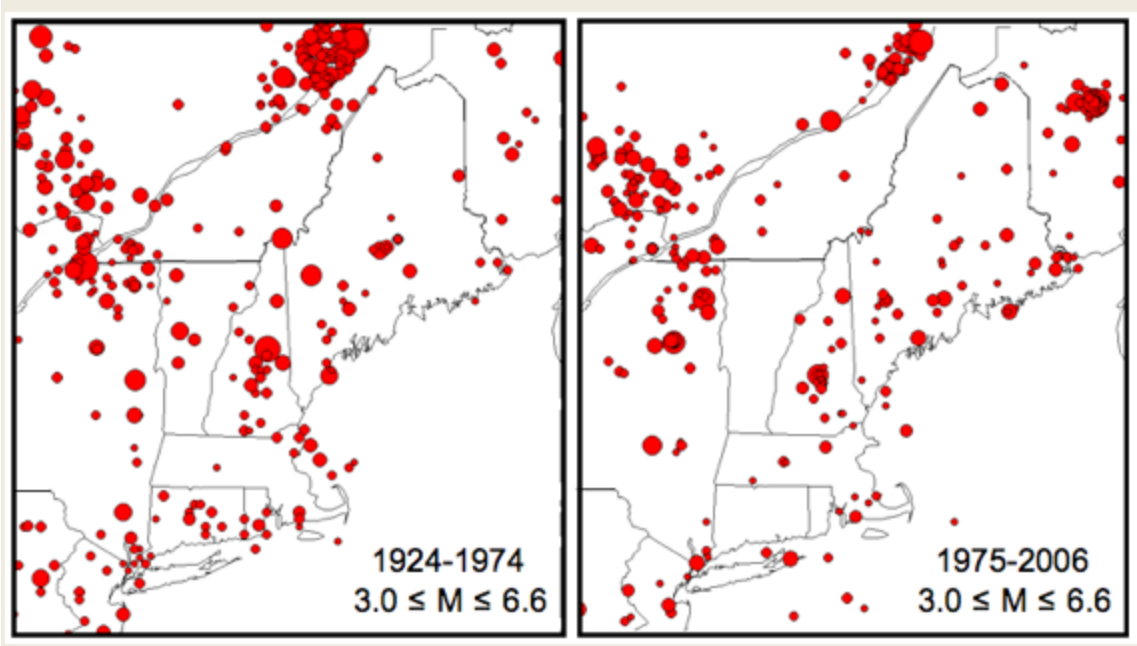

Figure 13 Northeast Earthquake Hazard Occurrence Map[73]

The New England Seismic Network, NOAA national Geophysical Data Center, and web searches were consulted to review historic events. Sixty-three known or possible earthquakes have been centered in the state since 1843 according to the State Hazard Mitigation Plan. Few events were found with information specific to Lowell. However, it is known that earthquakes in the northeast often travel far distances, meaning that earthquakes impacting nearby areas could have been felt in Lowell. However, it is unlikely damage occurred as no damage reports were located via research.

A violent earthquake, probably centered in the St. Lawrence Valley, was felt throughout the New England area on June 11, 1638. Other strong shocks on April 14, 1658, February 10, 1661, February 5, 1663, September 16, 1732, November 29, 1783, and October 17, 1860, were felt over broad portions of the region. Also, the major earthquake of November 18, 1755, east of Cape Ann, Massachusetts, affected a large area (about 777,000 square kilometers), including all of Vermont.

On December 18, 1867, an early morning shock awakened persons (MM V) in Burlington, Vermont, Odgensburg and Syracuse, New York, and Hamilton, Ontario, Canada. The tremor was also reported felt as far as east as Sackville, New Brunswick, Canada. Previously listed as centered in Vermont, this earthquake may have had its origin in the St. Lawrence Valley region, the dominant seismic zone in the area. Many of the earlier earthquakes have limited information and the historical accounts are indefinite.

Little damage resulted from what was described as a "severe" shock in northeastern New York on May 27, 1897. It was felt over an area approximately 288,000 square kilometers, including New York, New Hampshire, Vermont, Massachusetts, and parts of Quebec, Canada. A similar earthquake centered in southeastern Maine on March 21, 1904. This shock was felt throughout the greater part of New England and the provinces of New Brunswick and Nova Scotia. The affected area was about the same as that of the previous tremor. Chimneys were damaged at Calais and Eastport, Maine, and St. Stephen, New Brunswick, Canada.

73 Kafka, Alan L. (2014). Why Does the Earth Quake in New England? Boston College. Retrieved December 11, 2014 from https://www2.bc.edu/~kafka/Why_Quakes/why_quakes.html

An earthquake on October 22, 1905, was felt over a small area of northern Vermont. The early morning shock (estimated MM IV) was centered near Newport. A minor earthquake at Berlin, New Hampshire, on April 25, 1928, was also felt in parts of Maine and Vermont.

Two strong earthquakes in 1929 and 1935 located at great distances from the Vermont borders were felt throughout all or most of the State. A magnitude 7.2 shock on November 18, 1929, fractured 12 submarine cables in the Grand Banks area of the Atlantic Ocean. The tremor was felt in all the New England States. Many people in southeastern Maine were alarmed by the shock, which knocked articles from shelves. Reports of cracked plaster were received from Hartford, Vermont. At numerous other places in the State, slight rattling of doors and windows was reported. Two or three shocks were noted by many persons. On November 1, 1935, a magnitude 6.25 earthquake near Timiskaming, Quebec, Canada, was felt over an area of 2,600,000 square kilometers in the United States and Canada. The strongest intensities observed in Vermont were from Bennington, Brattleboro, St. Johnsbury, and White River Junction. Some cracks in walls were noted; also, beds shook and windows and dishes rattled.

On December 20, 1940, a strong earthquake (estimated magnitude 5.8) occurred near Lake Ossipee, New Hampshire. This was followed by a shock of approximately the same intensity 4 days later. Some damage resulted in the epicentral region. At Bloomfield, Vermont, the top bricks on some old chimneys were displaced. Many persons were awakened by the 2:27 a.m. tremor on December 20. Other effects reported included cracked plaster and stucco, broken dishes, and overturned objects. An earthquake near Massena, New York (12:29 a.m. Eastern War Time, September 5, 1944), was felt strongly at Burlington, Rutland, and St. Albans, Vermont. Lesser intensities were noted throughout the State.

On January 29, 1952, a local shock near Burlington affected an area of about 130 square kilometers. Minor damage included cracks in pavement, basement walls, and a city gas main (MM VI). Ground cracks about 3 kilometers long and 4.5 meters apart were observed in the North End. The earthquake was also felt at Essex Junction, where cracked walls were noted. Other tremors were felt in the area the following day. A moderately strong earthquake in the Rutland area about 1 year later caused only MM V effects. Houses trembled, some furniture was moved, knickknacks fell, and other small objects were disturbed at Brandon and Rutland from the March 31, 1953, tremor. Rattling of dishes and windows were observed at other communities in the nearby region.

Another local shock at Burlington occurred on February 2, 1955. Houses shook, windows and dishes rattled, and many thought their oil burners had blown up (MM V). A large ground crack was seen in the North Burlington area. Other tremors were reported a few hours later. An April 23, 1957, earthquake was felt by many within a radius of 24 kilometers of St. Johnsbury. Buildings shook; windows and dishes rattled (MM V). Many persons thought there had been an explosion or a plane crash. Felt reports were received from Danville, East Barnet, Lyndonville, Passumpsic, St. Johnsbury, Waterford, and West Barnet.

An earthquake centered in western Vermont on April 10, 1962, caused MM V effects over a large area. The total felt region covered about 52,000 square kilometers of Vermont, Maine, Massachusetts, New Hampshire, and New York. A beam supporting the Vermont State House at Montpelier was dislodged and the brace dropped about 127 millimeters, two beams under the dome were weakened, and 20 window panes cracked. Cracked plaster was reported. At Barre, several pieces of tile fell from the ceiling of a bank, and two cracks appeared in walls. The shock was also felt strongly at a number of places in nearby New Hampshire and New York. Less than 3 months later (June 20, 1962), a large portion of Vermont experienced MM V effects from a shock in southern Quebec Province, Canada. A chimney was cracked at North Montpelier. Slight damage occurred at Springfield, Vermont, from a June 20, 1964, earthquake centered at Warner, New Hampshire, about 55 kilometers away. MM V effects were also noted at White River Junction. Lesser intensities were observed in several other Vermont towns.

All of Vermont felt tremors from a magnitude 5.2 earthquake located in western Maine. The June 14, 1973, shock was felt over an area of about 250,000 square kilometers, including portions of Maine, New York, eastern Quebec Province, and all of Connecticut, Massachusetts, New Hampshire, and Rhode Island. MM VI effects were felt at

Canaan and Montpelier, Vermont. Plaster was cracked, chimneys moved away from walls, and some road surface cracks were reported

Extent

Earthquake severity can be measured in terms of percent g, Richter Scale and MMI Scale. Based on figure 14, percent g is 10 - 14 in the planning area.

Based on Figure 14, extent can be measured using percent g, which indicated as up to 14 percent (moderate risk). Instead of using fault locations, the USGS uses information based on historical occurrences to determine earthquake activity in the Northeast. Damage to older buildings, typically pre-1965, have an approximate damage threshold of ten percent g.[74] Newer buildings are typically less vulnerable due to enhanced building code requirements. Lowell will likely continue to feel small earthquakes ("dish rattlers"), and any earthquake event could cause minor damage in the area. Climate change is not anticipated to impact losses or impacts for this hazard.

Probability of Future Events

The results from the USGS Earthquake Probability Mapping website can be used to determine probability.[75] The website and corresponding graphic (Figure 22) shows the probabilities of earthquakes within a radius of 50 km. A probability was computed using the center of Lowell as the centroid, an earthquake depth of 50 kilometers and a time span of 100 years, and a magnitude of 5.0. This resulted in a probability of a magnitude 5.0 earthquake within the next 100 years is approximately 5 percent.

Lastly, the Earthquake Index was consulted. It reported that Lowell has an index of 0.13 compared to 0.31 for the state and 1.81 for the county. The earthquake index value is calculated based on historical earthquake events data using USA.com algorithms. It is an indicator of the earthquake level in a region. A higher earthquake index value means a higher chance of an earthquake.[76]

Using the aforementioned information, a probability of unlikely was assigned for future earthquakes impacting the planning area.

74 Earthquake Hazard Program: Frequently Asked Questions. (2014). United States Geological Survey. Retrieved December 11, 2014 from http://earthquake.usgs.gov/learn/faq/?faqID=218
75 2009 Earthquake Probability Mapping. (2014). United States Geological Survey. Retrieved December 11, 2014 from http://geohazards.usgs.gov/eqprob/2009/
76 Natural Disasters and Weather Extremes. (2014). USA. Retrieved December 11, 2014 from http://www.usa.com/

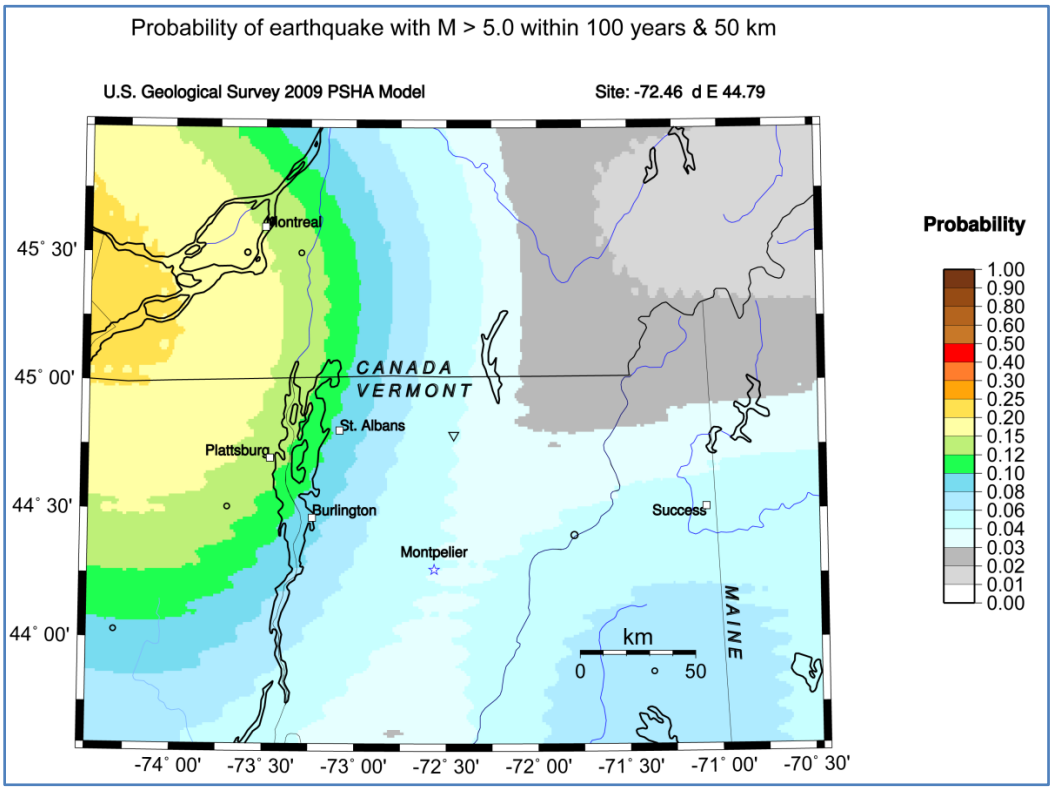

Figure 14: USGS Probability Mapper (Lowell shown as "▽"symbol)

Vulnerability Assessment

It can be assumed that all existing and future buildings and populations are at risk to the earthquake hazard. However, impacts from earthquakes in the planning area are expected to be minimal.[77] Newer buildings are typically less vulnerable due to enhanced building code requirements. The historic buildings in Lowell do face the highest risk given structural instability during a shaking event.

Events may cause cracked plaster and chimneys, broken windows, and shaken buildings and building collapse. When natural gas pipelines rupture from earthquakes, fire events are possible. Impacts of this magnitude are not expected in the planning area. Climate change is not anticipated to impact losses or impacts for this hazard.

77 Earthquake Hazard Program: Frequently Asked Questions. (2014). United States Geological Survey. Retrieved December11, 2014 from http://earthquake.usgs.gov/learn/faq/?faqID=218

LANDSLIDE/ROCKSLIDES

Description

Landslides are part of the natural, on-going process of smoothing topographical high points. Landslides occur when gravitational forces associated with slide mass exceed the resistance produced by the material holding that mass in place. Landslides are downhill or lateral movements of soil and rock that can include rock falls, slides, slumps, lateral spreading, earth and mudflows, and settlement. Landslides can result from ground saturation after intense or prolonged rainfall; erosion associated with surface water runoff, improper or poorly designed drainage systems or slopes, vegetation removal by land clearing, and shocks or vibrations from earthquakes. After wildfires, land is subject to landslide because resistance forces produced by roots associated with trees, shrubs, and grass is reduced. Landslides associated with rainfall tend to be relatively smaller; earthquake-induced landslides may be much larger.

The term landslide includes a wide range of ground movement, such as rock falls, deep failure of slopes, and shallow debris flows. Although gravity acting on an over steepened slope is the primary reason for a landslide, other contributing factors include:

- Erosion by rivers, glaciers, or ocean waves create over steepened slopes
- Rock and soil slopes are weakened through saturation by snowmelt or heavy rains
- Earthquakes create stresses that make weak slopes fail
- Earthquakes of magnitude 4.0 and greater have been known to trigger landslides
- Volcanic eruptions produce loose ash deposits, heavy rain, and debris flows
- Rockfalls along highways due to human removal of rock for construction
- Excess weight from accumulation of rain or snow, stockpiling of rock or ore, from waste piles, or from man-made structures may stress weak slopes to failure and other structures[78]

Location

Landslides are possible along steep slopes throughout the planning area. According to the State Hazard Mitigation Plan, fluvial erosion is the most important contributing factor to landslides. Where erosion has occurred, landslides are more likely.

Landslides could occur in the planning area but do not pose a major threat, as shown in the USGS Landslide Susceptibility Index (See Figure 23). About 20 percent of the town is located in a high risk area based on USGS Landslide Susceptibility Index data. Local interpretation was that landslide risk (and susceptible area) is much lower given substantial vegetation and limited development on hillsides.

78 Landslides 101, Landslide Hazards Program, United States Geological Survey. Retrieved February 4, 2015. Available at http://landslides.usgs.gov/learn/ls101.php

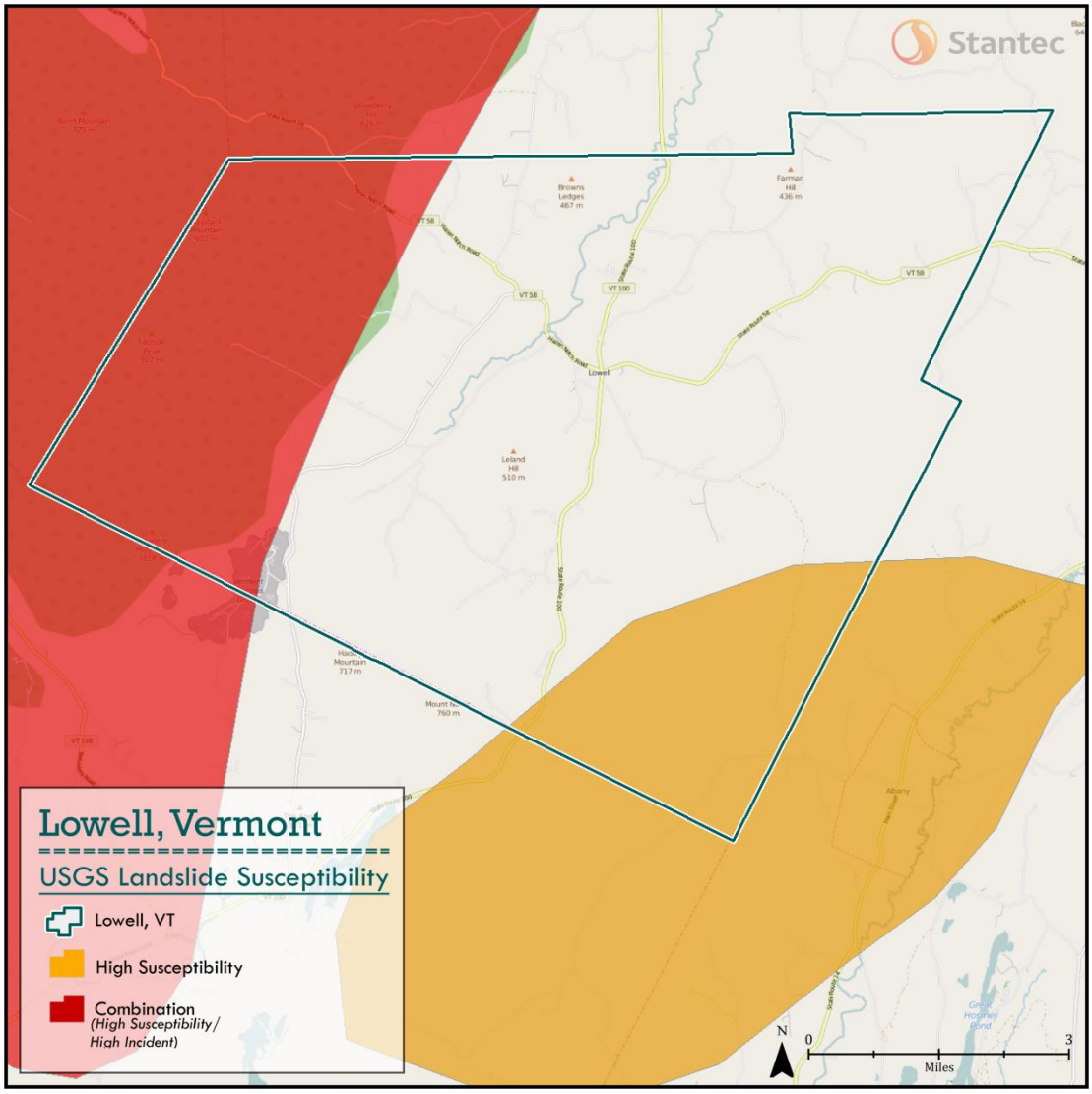

Figure 15 USGS Landslide Susceptibility

Previous Occurrences

According to the State Hazard Mitigation Plan, landslides constitute a major geologic hazard because they are widespread, occurring in all 50 states, and cause $1 to 2 billion in damages and more than 25 fatalities on average each year. Several sources were investigated for previous landslide occurrences in Lowell including web searches, Vermont Geological Survey, NCEI, the previous Town State Hazard Mitigation Plan and the State Hazard Mitigation Plan.

Extent

Extent is typically measured in terms of debris (tons) but no information was available given no history of occurrences. Lowell has approximately 11,500 acres of land located in a high risk area, based on USGS Landslide Susceptibility Index data. However, local interpretation is a lower landslide risk. The hazard mitigation planning committee noted that landslides are not an issue because the hillsides are so dense with vegetation and trees. Further, there is limited development (and thus population) in the hazard areas as they not build on the mountain slopes.

Probability of Future Events

Although there are no reported previous occurrences, the probability of future of occurrence was assigned as possible. The hazard mitigation planning committee noted that the dense tree cover helps stabilize the slopes in the planning area. Although the likelihood is low given root stabilization, these areas are still at risk to sliding following heavy rainfall, snowmelt, or a wildfire event.

Vulnerability Assessment and Estimated Losses

According to the State Hazard Mitigation Plan, fluvial erosion is the most important contributing factor to landslides.

Landslides pose serious threats to highways and structures that support fisheries, tourism, timber harvesting, mining, and energy production as well as general transportation. Landslides commonly occur with other major natural disasters, such as earthquakes and floods, exacerbate relief and reconstruction efforts. Development and other land use expansions also increased the number of landslide related disasters. However, such severe impacts are not expected in the planning area.

Climate change may impact this hazard indirectly through more frequent and severe hazard events including increased rain, hurricanes, tropical storms, and wildfires. As noted in early sections, winters are expected to the warmer and wetter in New England. All of these events may increase the risk of landslide occurrence in the planning area, although likelihood is low.

At risk structures were estimated using the USGS landslide susceptibility index for high risk areas of susceptibility or incident. There are 54 parcels that intersect the combination high susceptibility/high incident areas and 45 parcels that intersect the high susceptibility areas. Table 32 and Figure 24 show the structures potentially at risk to landslide. There are no critical facilities at risk. Future structures and populations that build in these areas will also be at risk.

Table 34 Buildings Potentially At Risk to Landslide

Type	High Susceptibility	High Susceptibility/ High Incident	Type	High Susceptibility	High Susceptibility/High Incident
Camps	6	15	**Mobile Home**	6	1
Cemetery	0	0	**Multi-Family**	0	0
Commercial	0	0	**Other**	0	0
Development Site	1	0	**Other Commercial**	0	5
Fire Station	0	0	**Other Residential**	0	0
Gated w/o Building	0	0	**Public Gather**	0	0
Government	0	0	**Public Telephone**	0	0
Gravel Pit	0	0	**Seasonal Home**	0	0
House of Worship	0	0	**Single Family**	9	10
Industrial	0	0	**Wind Facility/Wind Tower**	0	0

TOTAL STRUCTURES POTENTIALLY AT RISK	**High Susceptibility**	**High Susceptibility/ High Incident**	**Total**
	22	**31**	**53**

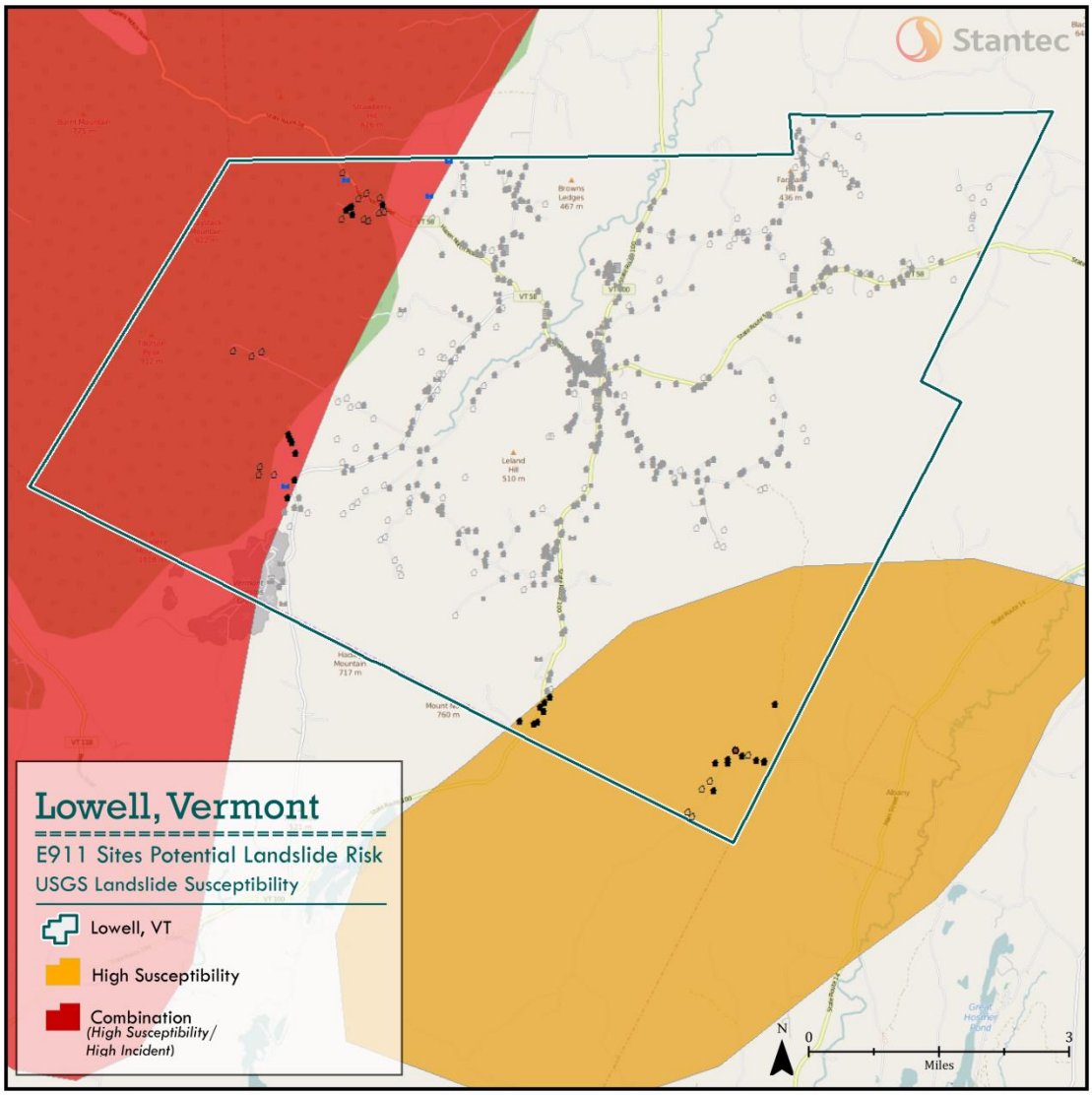

Figure 24 Buildings Potentially At Risk

TECHNOLOGICAL HAZARDS

Infectious Disease

Description

The description for infectious disease is referenced from the 2013 SHMP:

> Infectious diseases are caused by organisms, typically bacteria, protozoan, fungi, or viruses that enter the body and grow there. Many of these diseases require continuous monitoring, as they present seasonal threats to the general population. An epidemic emerges when an infectious disease occurs suddenly in numbers that are in excess of normal expectancy. Infectious disease outbreaks put a strain on the healthcare system, may cause continuity issues for local businesses, and can affect the economy when worker absences decrease overall production. These outbreak incidents are a danger to emergency responders, healthcare providers, schools, and the public. This can include influenza (e.g., H1N1), pertussis, West Nile virus, and many other diseases.

Infectious Disease Outbreak ranks fourth as a hazard in the SHMP.

Location

Diseases, depending on the type may spread in different manners (e.g. air, contact, insects, etc.). In some cases, the entire population may be at risk. Structures are not at risk, but bacteria and viruses may reside on surfaces presenting a need for quarantine or sterilization.

Previous Occurrences and Extent

According to the State Hazard Mitigation Plan, the great influenza epidemic of 1918 killed millions worldwide and would likely cause hundreds to thousands of deaths in Vermont should a similar outbreak occur today. In fact, it is anticipated that a more serious strain of the usual flu will occur in the future and that vaccines might not be ready in time. H1N1 influenza was not a serious threat in Vermont in 2009, although a very small number of people were affected.

Vulnerability Assessment and Estimated Losses

There are many potential vulnerabilities associated with infectious disease. In fact, in a widespread event, the impact is expected to have major impacts according to the state plan. For example:

- Commodity shortage (including food, household items, and medical supplies)
- Business interruption and impacts
- Social unrest
- Travel limitations
- Revenue losses

To date, the Town of Lowell has not offered vaccinations or engaged in preventatives measures, resulting in a potential need for mitigation actions related to this hazard. Given recent threats of Zika virus, which is spread by mosquitos (and potentially other mechanisms), a need exists to educate residents about reducing areas of standing water to limit insects from breeding. Other opportunities for education around the spread of infectious disease may also exist.

The State Hazard Mitigation Plan noted that the Vermont Department of Health recognizes possible connections between climate change and a number of emerging infectious diseases (e.g., eastern equine encephalitis, anaplasmosis, and babesiosis) and disease vectors. However, the occurrence of these diseases or the presence of their vectors in Vermont has not been conclusively linked to climate change.

SUMMARY OF VULNERABILITY

This section highlights the critical facilities at risk, PRI results, Hazard Rankings, and narrative summary of vulnerability.

CRITICAL FACILITY ANALYSIS SUMMARY

Critical Facilities in Lowell have a combined building exposure value of nearly $80 million. All critical facilities are assumed to be at risk to flood, heavy rain, hurricane, microburst, tornado, blizzard, hail, ice storms, nor'easter, snow storms, lightning, wildfire, earthquake, extreme cold, extreme heat, HAZMAT. However, data permits further GIS analysis to determine potential risk to specific buildings based on certain hazard areas including flood, landslide and wildfire (Table 33). For example, only critical facilities near rivers or brooks may also be susceptible to flooding caused by ice jams. Additionally, it should also be noted that not all hazards will cause extensive structural damage including drought, erosion, and extreme temperatures, for example. The extent of the hazard also has a direct impact on building damage.

Table 35 Critical Facility Risk Summary

Name	1.0% ACF (Hazus)	0.2% ACF (Hazus)	Landslide (High Susceptibility/ High Incident	Landslide (High Susceptibility)	Wildfire (WUI - interface)	Wildfire (WUI - Intermix)
Post Office	X	-	-	-	-	X
Catholic Church	-	-	-	-	X	-
Parish Hall	-	-	-	-	X	-
Lowell Grade School	-	-	-	-	-	X
Town Clerks Office/Historical Society/Library	-	-	-	-	-	X
Lowell Congressional Church	-	-	-	-	-	X
Lowell Fire Department	-	-	-	-	-	X
Lowell Town Garage	-	-	-	-	-	X
Wind Tower Control Building and Land	-	-	-	-	-	-
General Store	-	X	-	-	X	X
TOTAL STRUCTURES AT RISK	**1**	**1**	**0**	**0**	**3**	**7**

PRI RESULT AND HAZARD RANKING

Is there a description of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction? 44 CFR 201.6(c)(2)(ii)

The information below provides a brief summary of the hazards that impact the Town of Lowell. It includes the PRI index results (including anticipated impact), hazard ranking, and narrative summary of vulnerability.

PRI RESULTS

The PRI results are presented in Table 34. This information was used to rank hazards as presented in the text that follows.

Table 36 Summary of PRI Results for Lowell

Hazard	Category/Degree of Risk					
	Probability	Impact	Spatial Extent	Warning Time	Duration	PRI Score
ATMOSPHERIC HAZARDS						
Winter Storms	Highly Likely	Critical	Large	More than 24 hours	Less than 1 week	3.3
Flood	Likely	Critical	Moderate	6 to 12 hours	Less than 1 week	3
Extreme Cold	Highly Likely	Minor	Large	More than 24 hours	Less than one week	2.7
Severe Thunderstorm (High Wind)	Likely	Limited	Large	More than 24 hours	Less than 24 hours	2.5
Drought	Likely	minor	Large	More than 24 hours	More than 1 week	2.5
Extreme Heat	Possible	Limited	Large	More than 24 hours	Less than one week	2.4
Wildfire	Possible	Limited	Small	Less than 6 hours	Less than 24 hours	2.3
Severe Thunderstorm (Lightning)	Likely	Limited	Negligible	Less than 6 hours	Less than 6 hours	2.2
Tornado	Possible	Limited	Small	Less than 6 hours	Less than 6 hours	2.1
Hurricane and Tropical Storm	Possible	Minor	Large	More than 24 hours	Less than 24 hours	2
Hail	Possible	Minor	Moderate	Less than 6 hours	Less than 6 hours	2
Earthquake	Unlikely	Minor	Large	Less than 6 hours	Less than 6 hours	1.9
Landslide	Possible	Minor	Negligible	Less than 6 hours	Less than 6 hours	1.8
Ice Jams	Possible	Minor	Small	More than 24 hours	Less than 6 hours	1.7

HAZARD RANKING

The ranking of hazards was based on the PRI results. These were then reviewed by hazard mitigation committee which adjusted rankings based on local knowledge, as shown in Table 35 below. Additional information regarding the ranking process can be found in Chapter 2.

Table 37 Ranking of Hazards

Ranking	Hazard Ranking (PRI results)	Revised Hazard Ranking (committee input)
HIGH HAZARDS	Winter Storms Flood Extreme Cold Severe Thunderstorm (High Wind) Drought	Flood Winter Storms Extreme Cold Severe Thunderstorm (High Wind and Lightning) Hurricane and Tropical Storm (High Wind)
MODERATE HAZARDS	Extreme Heat Wildfire Severe Thunderstorm (Lightning) Tornado Hurricane and Tropical Storm Hail	Ice Jams Wildfire Hail Drought
LOW HAZARDS	Earthquake Landslide Ice Jams	Tornado Extreme Heat Earthquake Landslide

OVERALL SUMMARY OF VULNERABILITY

In summary, all of the hazards addressed in this plan pose a threat to the Town of Lowell, including the assets and population within. There are several factors that influence vulnerability including building construction type, date of construction, time of occurrence, and capacity to respond, for example. The hazards of greatest concern in Lowell are flooding, winter storms, and thunderstorm wind events. Each of these hazards has the potential for high consequence losses including wide-spread damages and loss of life. Other hazards pose a recognizable risk, but are likely less severe in terms of impacts incurred on the Town or are offset by a high capability to manage the potential impacts.

Based on the risk assessment analysis and input from the community, flooding is the greatest concern for the town. During flood events, the community can become isolated due to its location and the speed at which floods can occur.

Specifically for Lowell, any hazards impacting road conditions may impact the wellbeing of residents. Many of the roads in/around the town increase Lowell's vulnerability during flood events because they are unpaved or in poor condition. This increases the susceptibility of road washouts. As a result, the town is investigating mitigation actions related to paving roads.

In the spring, a combination of snowmelt and heavier rains results in a mud season further reducing accessibility to the town and increasing poor road conditions and possible washouts. Winds from winter storms and

thunderstorms also are of particular concern to the town because they tend to result in downed trees that may damage or block road access.

Multiple hazards could affect the Kingdom Community Wind farm in Lowell that produces power for more than 24,000 homes. There have been multiple lightning strikes to wind turbines, and winter storms have been known to produce ice throw from the turbine blades at speeds nearing 200mph. In addition, the town's maple syrup industry is vulnerable to extreme temperature conditions or future changing meteorological patterns.

Fortunately, the Town of Lowell is preparing for a variety of hazards and circumstances as demonstrated by this plan. In the following sections, a mitigation strategy to reduce the risks to current and future populations and structures will be presented.

5

CAPABILITIES ASSESSMENT

CHAPTER 5. CAPABILITY ASSESSMENT

C1. Does the plan document each jurisdiction's existing authorities, policies, programs and resources, and its ability to expand on and improve these existing policies and programs? FEMA Requirement §201.6(c)(3)

The purpose of conducting the capability assessment is to identify the strengths and weaknesses of the planning area in terms of mitigating risks. This analysis will point to shortfalls and weaknesses as well as positive measures already in place, which will continue to be supported.

The capability assessment serves as the foundation for designing an effective hazard mitigation strategy. It not only helps establish the goals and objectives for the planning area but it also ensures that those goals and objectives are realistically achievable under local conditions.

The capability assessment must answer two questions:

1. Does the Plan document address each jurisdiction's existing authorities, policies, programs and resources, and its ability to expand on and improve these existing policies and programs?[79]
2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate?[80]

The capability assessment includes a comprehensive examination of the following capabilities as summarized in **Table 38**.

Table 38 Capability Assessment Components

Components	Description
Planning and Regulatory Capabilities	Does the planning area have plans in place that include natural hazards? Do the plans identify mitigation projects? Can the plan be used to implement mitigation actions?
Administrative and Technical Capabilities	What skills does the planning area have and can they be used for mitigation planning?
Financial Capabilities	Is the planning area eligible for or have access to funding sources for hazard mitigation?
Education and Outreach Capabilities	What education and outreach programs are currently in place to communicate hazard-related information?
National Flood Insurance Program (NFIP)	How does the planning area participate in the NFIP?
Capability Assessment Conclusions	A summary of capability findings.

[79] 44 CFR 201.6(c)(3)
[80] 44 CFR 201.6(c)(3)(ii)

REVIEW PROCESS

The previous plan looked at preparedness goals, codes and standards, local planning and zoning, school drills, and preparedness tools. The format of this mitigation plan update includes a separate and expanded capability assessment chapter with the five categories shown in Table 1. The Planning Team updated the information from the 2005 Plan and added a significant amount of specifics with respect to the abilities of the Town. The Town Administrator, with support from the Select Board and Zoning Board, manages risk in Lowell. They have actively participated in the NFIP, secured grants, and improved their ability to respond to disasters. There has been limited development in Lowell and their priorities remain the same as those written in the 2005 Mitigation Plan.

PLANNING AND REGULATORY CAPABILITIES

A4. Does the Plan describe the review and incorporation of existing plans, studies, reports, and technical information? (Requirement §201.6(b)(3))

Planning and regulatory capabilities are the plans, policies, codes, and ordinances that prevent and reduce the impacts of hazards. The first step in the capability assessment was to gather and review existing plans to gain an understanding of the region's ability to mitigate risk.

The tables to follow are similar to FEMA's Worksheet 4.1[81] in the Local Mitigation Planning Handbook. It was used by the Planning Team to review the planning and regulatory capabilities of the planning area including plans, policies, codes, and ordinances that prevent and reduce the impacts of hazards. The Town's planning and regulatory capabilities have proven sufficient to mitigate risk.

Table 39 Existing Plans Reviewed

Plan	Does the plan address hazards?	Does the plan identify projects to include in the mitigation strategy?	Can the plan be used to implement mitigation actions?
State of Vermont, Hazard Mitigation Plan, November 2013	Yes – All hazards	Yes	No – But, it is good support to the mitigation plan.
Lowell Local Emergency Operations Plan, 2016	Yes – Drought, Flood, Fire, Winter Storm, Ice Storm, Power Outage, Infectious Disease, and Hazardous Materials plus others.	No	No – But it supports the need for mitigation actions. Previously Lowell had a Rapid Response Plan, the LEOP has replaced this.
Lowell Town Plan, August 2014	Yes – Flood and Fluvial Erosion. It	This document contains goals and objectives for	No – But the plan was used to develop mitigation actions.

[81] Capability Assessment Worksheet 4.1. (2013). Local Mitigation Planning Handbook. Federal Emergency Management Agency.

Plan	Does the plan address hazards?	Does the plan identify projects to include in the mitigation strategy?	Can the plan be used to implement mitigation actions?
	also addresses stormwater, utility infrastructure, public safety and emergency response	community growth, health, safety and welfare for public and private interests.	For instance, a goal in the Town Plan states "create a safer intersection at Routes 58 and 100." This modified to the mitigation action "Four Corner Intersection Maintenance for Safe Winter Travel." Town Plan includes information Act 16 and Flood Resilience.
Vermont Red Cross Shelter Pre-Agreement (VRCSP)	Lowell does have a Vermont Red Cross Shelter Pre-Agreement.	When a Pre-Agreement is in effect, local representatives are trained to open a shelter if needed.	This will allow for a more efficient use of the VT Red Cross if and when needed.
Northeast Kingdom Regional Plan, NVDA 2013	Yes - Flooding	Includes a Flood Resilience section.	Offers analysis as well as suggestions related to land use and flooding.
Planning for Flood Recovery and Long-Term Resilience in Vermont, EPA 2014	Yes - Flooding	Yes – 4 types of flood mitigation recommended.	No – But, it is good support to the mitigation actions recommended in the mitigation plan.
Upper Missisquoi River Corridor Plan, Orleans County, September 2011	Yes – Flooding, Erosion	Yes – River Corridor Planning and Protection, Buffer Establishment and Protection, Road-Stream Cross Retrofits and Replacements, Wetland Restoration	No – However it supports the need for mitigation and offers proven methods to mitigate risk associated with rivers.

The Town of Lowell does not have the plans listed in Table 3.

Table 40 Plans not specifically in place

Plans Not Specifically In Place	Description
Capital Improvements Plan	The Hazard Mitigation Committee considered recommending a Capital Improvements Budget, but this is not considered necessary at the moment. They do have a budget for roads and monetary savings reserved specifically for road paving and repair.
Economic Development Plan	The largest business in Lowell is the Wind Power. This business provides significant tax revenue to the Town.

Plans Not Specifically In Place	Description
Continuity of Operations Plan	The LEOP functions as the "disaster plan" and Lowell does not have a specific Continuity of Operations Plan.
Transportation Plan	Transportation is by personal vehicle, except for school children who are provided bus transportation.
Stormwater Management Plan	Lowell does not have a specific stormwater management plan but flooding and erosion management specifications are included in the Town Plan.
Community Wildfire Protection Plan	The State of Vermont has a Wildlife Protection Regulation that Lowell adheres to.

ZONING AND LAND USE REGULATIONS

The zoning bylaws in the planning area do support hazard mitigation; Table 4 indicates which zoning ordinances are in-place. The Town has four zoning districts, 1) Village District, 2) Rural Residential/Agricultural District, 3) Conservation Mountain District, and 4) Industrial District. They intend to add an Asbestos District and prohibit development in this area – this is a mitigation action included in the next chapter. The Town does not have an adequate zoning district map. The previous zoning district map on record is hand-drawn and is not duplicated in digital format. This effort has become part of a mitigation action called NVDA Hazard Mapping Support.

The Town Plan includes a plan to manage flood risk to homeowners. The plan indicates where homes are located in flood zones or fluvial erosion hazard zones, and includes a 5 step plan to mitigate risk to these properties. The list is shown in Figure 1. In addition, the Town Plan states that the Zoning Board will not issue permits for new buildings or new structures in the floodplain.[82]

[82] Lowell Town Plan. (2014). Town of Lowell. Pg.31.

1. Survey the indicated properties on the maps attached in Appendix A circled in red and make an accurate list of all buildings that were built within 50 feet of the river bed. This list will also need to be separated into homestead vs. seasonal and camps to identify which homeowners are full time residents. The Zoning Board can work on this in conjunction with the Town Listers as they survey and inspect properties in the Town.

2. After defining the list of properties in Lowell currently in flood zones or fluvial Erosion zones each homeowner will be sent a package informing them of the designation and will be provided with educational materials, suggestions and web links on protecting their home in the event of a flood.

3. Properties that are considered at extreme risk will be noted and a list will be attached to the Towns Local Emergency Operations Plan (LEOP) so first responders and the fire department will be aware of which residents might need assistance first in the event of a flood.

4. The Zoning Administrator will be given the list so he can make considerations before approving any building permits for these locations.

5. The Town Clerks Office will also be given the list of properties so they can inform any real estate agents that the home is in a Town Flood Zone.

Figure 16 Mitigation Actions for Flooding Named in Town Plan[83]

OPEN SPACES RESERVED FOR CONSERVATION PURPOSES[84]

Within 1989's Lowell Town Plan (adopted on December 12 of 1989) contains wording to authorize a Conservation Mountain district to limit development in those areas of Town as least suited for development. The Conservation Mountain district was established in the current Lowell Zoning Bylaw (adopted in 2009) and the objective for this district designates those areas over 2,000 feet in elevation to be contained within this district. These areas are generally forested, inaccessible, and have moderately steep to very steep slopes. It should be noted areas in Lowell that are above 1,500 feet also possess many of the same characteristics as those areas above 2,000 feet in elevation. These areas can be found along the Town's eastern, southern, and western boundaries.

PERMIT ALLOCATION[85]

The Town of Lowell adopted its Zoning By-Laws on May 25th in 2009. A copy can be obtained from the Town Clerk's office or from the Zoning Board. These policies describe the current criteria and requirements for anyone wishing

[83] Lowell Town Plan. (2014). Town of Lowell. Pg.37.
[84] Lowell Town Plan. (2014). Town of Lowell. Pg.20.
[85] Lowell Town Plan. (2014). Town of Lowell. Pg.22.

to build in Lowell. The Zoning Board will be updating and revising these in the near future to ensure they are current with today's trends and coincide with the Town Plan objectives.

The current procedure is prescribed for residents to fill out a building permit with required information, have the request signed and approved by the appointed Zoning Administrator, pay the indicated fee, and file with the Town Clerks office. In the last few years, there have been very few resident requests that have brought forth debate, extended discussion or caused any concern to the Town. Therefore, the Zoning Board agrees that the current procedure for building permits works well for the Town and there is no need to change the arrangement at this time. Should there be any challenge to the system in the future, the Zoning Board will then revisit the process.

In the year 2000, residents submitted a total of 34 Building Permits. In 2010, there were 33 permits issued showing no great change in the 10-year period. Building permits were issued for various reasons but mainly for small out buildings, sheds, and garage add-ons. There were also approval requests for housing additions, placements of trailers and sub-division of land into smaller parcels. The Hazard Mitigation Committee has included several mitigation actions related to education, for instance one stated, "educate homeowners about safe building practices for snow load, flooding, high winds and bank erosion."

The Zoning Board currently feels that any property that meets the specified requirements is eligible for a building permit. The Board stated, "We will not dictate to property owners and undermine their rights if they meet requirements for the Town and adhere to all state and federal by laws." The Zoning Board will intervene under the following conditions; if the resident's plans infringe on the rights of other residents or the Town; if the proposal does not meet State or Federal criteria; if the proposal violates flood zone regulations; or if the proposed use is not lawful. The Zoning Board will step in and make suggestions and do everything they can to help streamline the application procedure.

The Planning Team completed Table 4 to a more succinctly detailed land use and zoning ordinances in relation to hazard mitigation. They have also added a mitigation action to "Amend zoning ordinance to include asbestos mine."

Table 41 Land Use Planning and Ordinances

Land Use Planning and Ordinances	Yes/No	Is the ordinance an effective measure for reducing hazard impacts? Is the ordinance adequately administered and enforced?
Zoning ordinance	Yes	Lowell Zoning Bylaw, March 2003. Town intends to update the Zoning Bylaws when the asbestos area is zoned.
C & S = Highway Codes and Standards		Most Vermont communities have adopted the Vermont Transportation Agencies recommended Highway Codes and Standards. This is perhaps the one most beneficial mitigation program in Vermont and the NVDA region. By adopting these codes, all maintenance and new construction on roads, highways, bridges and culverts must be enhanced to meet the new standards to withstand large flood events.
Subdivision ordinance	Yes	A permit is required as part of the Zoning Bylaws, March 2003.

Land Use Planning and Ordinances	Yes/No	Is the ordinance an effective measure for reducing hazard impacts? Is the ordinance adequately administered and enforced?
Floodplain ordinance	No	The Zoning Bylaws do not refer to flooding. The Town would like digital floodplain maps to overlay with an updated zoning map.
Natural hazard specific ordinance (stormwater, steep slope, wildfire)	Yes	Building is prohibited in the Conservation Mountain District
Flood insurance rate maps	Yes	Paper maps are available from FEMA and a mitigation action is included to request digitized maps. Another mitigation action includes collaborating with NVDA for GIS support.
Acquisition of land for open space and public recreation uses	Yes	Lowell previously purchased one repetitive loss property.

In addition to zoning regulations, the planning area has building code and site plan requirements as show in Table 5.

Table 42 Building Code and Site Plan Requirements

Building Code, Permitting, and Inspections	Yes/No	Are codes adequately enforced?
Building Code	Yes	The Town of Lowell adheres to the State Building Code Standards for public buildings. These are enforced by district fire marshals employed by the State. Lowell does not have municipal codes. Vermont Residential Building Energy Standard (RBES) – The RBES has been revised as of November 24, 2014. Revisions take effect on March 1, 2015 and "shall apply to construction commenced on and after the date they become effective". RBES applies to all new residential construction, including additions, alterations, renovations, and repairs. On June 17, 2013, the Vermont legislature adopted Act 89, which clarifies the applicability of Vermont's residential and commercial building energy codes to mixed-use buildings and includes various amendments to promote compliance with those codes, such as using existing State and local permit processes to encourage compliance.[86]
Fire Department ISO Rating		9

[86] Residential Building Emergency Standards. (2015). Vermont Public Service Department. Retrieved on March 23, 2015 from http://publicservice.vermont.gov/topics/energey_efficiency/rbes

Building Code, Permitting, and Inspections	Yes/No	Are codes adequately enforced?
Site plan review requirements		The Zoning Bylaws include § 316: Site Plan Approval which stipulates that permits are issued only for "one and two family dwellings, farm structures and accessory uses until the Planning Commission grants site development plan approval."

IMPLICATIONS OF GROWTH AND DEVELOPMENT PATTERNS

The population growth from 2000 to 2010 has increased 19%.[87] As of 2010, the population of Lowell is 879. The Town of Lowell has adopted a local plan and zoning regulations to guard against future development in inappropriate locations such as flood prone areas. Lowell is a member of the National Flood Insurance Program (NFIP). Lowell is not a rapidly developing community and is not expected to have a rapid influx of new development in the near future. All development strategies are carefully reviewed by the Zoning Board. All building improvements in or near frequently flooded areas are required to elevate or provide additional mitigation measures.

"Any land area in Lowell that has steep slopes and/or shallow soils should have a very low intensity of development. This land is generally suitable only for forest purposes; some agricultural uses, and, at a very low-density, seasonal and year-round dwelling, which should be permitted only if the site can support a well and septic system and there is adequate public access to the site."[88]

Smart Growth is "development that is compact and walkable, provides a range of housing and transportation choices, and fosters distinctive, attractive communities with a strong sense of place. Smart growth approaches use land efficiently, enhance community vitality, protect natural resources, reduce costs for public services, save taxpayers' money, and create a higher quality of life."[89] The Hazard Mitigation Committee and the Lowell Town Administrator are aware of the following smart growth principles:

- Promote mix land uses
- Utilize compact building design
- Create a range of housing opportunities and choices
- Create walkable neighborhoods
- Foster distinctive, attractive communities with a strong sense of place
- Preserve open space, farmland, natural beauty, and critical environmental areas
- Strengthen and direct development towards existing communities
- Provide a variety of transportation choices
- Advocate predictable, fair, and cost effective development decisions
- Encourage community and stakeholder collaboration in development decisions

[87] Lowell, VT City Data. (2016). City-Data.com. Retrieved on May 20, 2016 from http://www.city-data.com/city/Lowell-Vermont.html
[88] Lowell Town Plan. (2014). Town of Lowell. Pg.24
[89] Planning for Flood Recovery and Long-Term Resilience in Vermont. (2014). US Environmental Protection Act. Pg.6.

FEMA and the Environmental Protection Agency (EPA) can provide assistance to the planning area through the Smart Growth Implementation Assistance Program.

ADMINISTRATIVE AND TECHNICAL CAPABILITIES

Table 6 outlines Worksheet 4.1 from FEMA's Local Mitigation Planning Handbook.[90] It was used by the Planning Team to review administrative and technical capabilities of the Town of Lowell. These include staff and their skills and tools that can be used for mitigation planning and to implement specific mitigation actions. According to the LEOP, the Town Clerks Office functions as the primary Emergency Operation Center (EOC), the first backup location is the Lowell Fire Department, and the second is the Town Garage. The primary shelter is the Lowell Graded School which has wiring in-place for a generator. A mitigation action has been added to purchase a permanent generator for the school. The St. Ignatius Parish Hall and Lowell Congregational Church are also considered shelters. Mitigation actions are included in this plan to acquire generators for the shelters and to conduct American Red Cross shelter training. None of the shelters have the capacity to house people overnight. However, the Town's priority is to educate their citizens to shelter-in-place if possible.

Table 43 Administrative and Technical Capabilities

Administration	Yes/No	Describe capability Is coordination effective?
Community Planning Commission	Yes	The Zoning Board functions as a Community Planning Commission and they prepare and update the Zoning Bylaws and support the Town Administrator.
Mitigation Planning Committee	Yes	This Committee was re-energized for the purposes of completing and implementing this plan update.
Maintenance programs to reduce risk (e.g., tree trimming, clearing drainage systems)	Yes	The Road Department manages all maintenance projects not covered by the State include roads, trees and stormwater systems such as culverts.
Mutual aid agreements	Yes	The Fire Department participates in the Northeast Mutual Aid Agreement with all fire departments in Orleans County. Lowell also has several informal agreements with adjacent towns.
Staff	**Yes/ No**	**Is staffing adequate to enforce regulations? Is staff trained on hazards and mitigation? Is coordination between agencies and staff effective?**
Chief Building Official	Yes	The Zoning Administrator approves permits and conducts site visits.

[90] Capability Assessment Worksheet 4.1, (2013) Local Mitigation Planning Handbook, FEMA.

Floodplain Administrator	Yes	The Town Administrator serves this role.
Emergency Manager	Yes	The Fire Chief is the Emergency Manager.
Community Planner	Yes	The Town Administrator serves this role.
Civil Engineer	No	
GIS Coordinator	No	Lowell receives support from NVDA for GIS. NVDA supported the development of this plan update.
Technical	**Yes/No**	**Describe capability** **Has capability been used to assess/mitigate risk in the past?**
Warning systems/services (Reverse 911, outdoor warning signals)	No	The Lowell Graded School has a reverse 911 system for their students. A mitigation action is included to update this system for use by the Town. Emergency communications and information systems (NOAA weather receivers, Emergency Alert System (EAS)) are at the Town Offices.
Hazard data and information	Yes	Lowell received FEMA funding for their last two major disasters and they have kept accurate records. A mitigation action is included to maintain accurate hazard data information to facilitate seeking funding and completing benefit-cost analysis. The town office has a vault to protect public records from damage or theft/vandalism.
Grant writing	Yes	Lowell does not have a designated grant writer but multiple people have written grants.
Hazus analysis	No	NVDA supports Lowell for all of their GIS needs.

FINANCIAL CAPABILITIES

Table 7 outlines Worksheet 4.1 from FEMA's Local Mitigation Planning Handbook.[91] It was used by the Planning Team to identify eligibility and access to hazard mitigation funding.

[91] Capability Assessment Worksheet 4.1. (2013). Local Mitigation Planning Handbook. Federal Emergency Management Agency.

Table 44 Funding Capabilities

Funding Resource	Access/ Eligibility (Yes/No)	Has the funding resource been used in past and for what type of activities? Could the resource be used to fund future mitigation actions?
Capital improvements project funding	No	A specific fund does not exist but the Zoning Board may allocate funds for capital improvements.
Authority to levy taxes for specific purposes	Yes	If approved during a vote, the Town may levy taxes for a specific purpose.
Fees for water, sewer, gas, or electric services	No	The Town does not provide municipal utility service. Homeowners have wells and private septic systems and receive gas and electric service from private companies.
Impact fees for new development	No	The State has this ability through Act 250.
Storm water utility fee	No	
Incur debt through general obligation bonds and/or special tax bonds	No	
Community Development Block Grant	No	
Other federal funding programs	Yes	
State funding programs	Yes	1) Vermont Transportation. 2) Land and Water Conservation

EDUCATION AND OUTREACH CAPABILITIES

Table 8 outlines Worksheet 4.1 from FEMA's Local Mitigation Planning Handbook.[92] It was used by the Planning Team to identify education and outreach programs used to implement mitigation activities. When discussing the process for making Lowell safer, the Hazard Mitigation Committee expressed an interest in emphasizing education and outreach as opposed to including additional laws or codes. For this reason, the following mitigation actions relate specifically to education:

- Educate the public about how to shelter-in-place and where to access emergency information
- Educate homeowners about floods and other natural hazards
- Conduct American Red Cross shelter training
- Educate residents about the risk of insects and how they may breed in standing water

[92] Capability Assessment Worksheet 4.1. (2013). Local Mitigation Planning Handbook. Federal Emergency Management Agency.

Table 45 Education and Outreach Capabilities

Program/Organization	Yes/No	Describe program/organization and how relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
Emergency Training	Yes	Fire and rescue personnel continue to participate in training offered for its volunteers, particularly with the equipment upgrades through the Department of Homeland Security.
Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	No	A formal group has yet to be formed. However, the mitigation planning process motivated significant public interest.
Ongoing public education or information program (e.g., responsible water use, fire safety, household preparedness, environmental education)	No	Several mitigation actions have been included to remedy the lack of public education.
Natural disaster or safety related school programs	No	The school participates in regular fire drills and they are willing to consider a formal school safety program.
StormReady certification	No	
Public-private partnership initiatives addressing disaster-related issues	No	

NATIONAL FLOOD INSURANCE PROGRAM (NFIP) COMPLIANCE

C2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate? 44 CFR 201.6(c)(3)(ii)

The Town of Lowell is a member of FEMA's National Flood Insurance Program (NFIP), which enables property owners in flood hazard areas to purchase flood insurance. Details regarding participation in the NFIP by property owners are outlined in Table 9. The Planning Team used the Capability Assessment Worksheet 4.3 to collect information regarding the Town's participation in the NFIP. The worksheet also helped the Planning Team identify potential mitigation actions. The Town Administrator functions as the floodplain manager and maintains NFIP compliance. Lowell has adopted a Town Plan and Zoning Regulations. All new development must be reviewed by the Zoning Board of Adjustment. All development in or near the identified flood areas must conform to zoning standards. During the Natural Hazards Preparedness Survey, 66% responded they don't have flood insurance because they don't live in a floodplain. Fifty-seven percent of respondents reported they do know where the floodplains in Lowell are located.

Many of the mitigation actions in the plan relate to flooding. Several mitigation actions also relate specifically to NFIP compliance and floodplain management including participation in the Community Rating System, buying repetitive loss properties, and educating residents about the risk of flooding to their properties. The Town Administrator and the Zoning Board are the responsible authorities for NFIP compliance. They will adhere to the NFIP Requirements Checklist provided by FEMA during the planning process (included in Appendix D). The Zoning Board will regulate new construction in the floodplain and the Town Administrator will work with NVDA for mapping support and assistance with monitoring the NFIP and possibly participating in the Community Rating System (CRS).

Table 46 National Flood Insurance Program Worksheet

NFIP Topic	Source of Information	Comments
Insurance Summary		
How many NFIP policies are in the community? What is the total premium and coverage?	State NFIP Coordinator or FEMA NFIP Specialist	Total premium $5,129, 3 A-Zone properties, 6 Total policies, $1,364,000 total coverage.[93] There aren't any repetitive loss properties at this time. [94]
How many claims have been paid in the community? What is the total amount of paid claims? How many of the claims were for substantial damage?	FEMA NFIP or Insurance Specialist	Four claims made since 1978. Total paid since 1978 $42,081.[95]
How many structures are exposed to flood risk within the community?	Community Floodplain Administrator (FPA)	
Describe any areas of flood risk with limited NFIP policy coverage	Community FPA and FEMA Insurance Specialist	
Staff Resources		
Is the Community FPA or NFIP Coordinator certified?	Community FPA	No
Is floodplain management an auxiliary function?	Community FPA	Yes – The Town Administrator and the Zoning Board are responsible for floodplain management.
Provide an explanation of NFIP administration services (e.g., permit review, GIS, education or outreach, inspections, engineering capability)	Community FPA	The Town Administrator is responsible for administering the NFIP in Lowell.
What are the barriers to running an effective NFIP program in the community, if any?	Community FPA	The Town Administrator has multiple responsibilities and is not a certified NFIP Coordinator.
Compliance History		
Is the community in good standing with the NFIP?	State NFIP Coordinator, FEMA NFIP Specialist, community records	Yes
Are there any outstanding compliance		No

[93] NFIP Insurance Report. Refer to Appendix D.
[94] NFIP Insurance Report. Refer to Appendix D.
[95] NFIP Insurance Report. Refer to Appendix D.

NFIP Topic	Source of Information	Comments
issues (i.e., current violations)?		
When was the most recent Community Assistance Visit (CAV) or Community Assistance Contact (CAC)?		CAV date 8/15/1994 CAC date 7/6/1992
Is a CAV or CAC scheduled or needed?		N/A
Regulation		
When did the community enter the NFIP?	Community Status Book http://www.fema.gov/national-flood-insurance-program/national-flood-insurance-program-community-status-book	12/4/1985 entered the NFIP[96]
Are the FIRMs digital or paper?	Community FPA	Paper – A mitigation action is included to encourage FEMA to develop digital maps and for NVDA to assist with additional mapping support.
Do floodplain development regulations meet or exceed FEMA or State minimum requirements? If so, in what ways?	Community FPA	The regulations exceed State requirements. The Zoning Bylaws state that building in the floodplain is limited.
Provide an explanation of the permitting process.	Community FPA, State, FEMA NFIP Flood Insurance Manual http://www.fema.gov/flood-insurance-manual Community FPA, FEMA CRS Coordinator, ISO representative CRS manual http://www.fema.gov/library/viewRecord.do?id=2434	Building permits are requested from the Zoning Administrator who checks the Zoning Bylaws for compliance. If necessary the Zoning Board and the Select Board are involved for further review.
Community Rating System (CRS)		
Does the community participate in CRS?	Community FPA, State, FEMA NFIP	No – however a mitigation action related to participation is included in this plan. The Town Plan states that the "zoning board would like to participation in the NFIP- CRS offered by FEMA."[97]
What is the community's CRS Class Ranking?	Flood Insurance Manual http://www.fema.gov/flood-insurance-manual	N/A
What categories and activities provide CRS points and how can the class be improved?		See below for more information.
Does the plan include CRS planning requirements	Community FPA, FEMA CRS Coordinator, ISO	Yes – see table below for details

[96] NFIP Insurance Report. Refer to Appendix D.
[97] Lowell Town Plan. (2014). Town of Lowell. Pg.34.

NFIP Topic	Source of Information	Comments
	representative CRS manual http://www.fema.gov/library/viewRecord.do?id=2434	

COMMUNITY RATING SYSTEM

The Town Plan states that the Zoning Board would like to participate in the Community Rating System (CRS) program. A mitigation action reflecting this statement has been added. Table 10 indicates how the planning process to develop this Hazard Mitigation Plan meets many of the requirements to receive CRS credit.

Table 47 CRS Requirements Met in this Mitigation Plan

Mitigation Planning Process Tasks	Actions Taken in Planning Process	CRS Credit Requirements
Adopt Mitigation Plan	Plan formally adopted as a resolution. The resolution is included in the front of the plan.	Documentation that the plan has been formally adopted by the governing body of the jurisdiction requesting approval of the plan. The adoption must be either a resolution or ordinance.
Planning Process - Organize	Chapter 3 describes the mitigation planning process.	Credit is based on how the community organizes to prepare its floodplain management plan.
Planning Process - Public Comment	Two public meetings were held to give the public an opportunity to provide feedback on the mitigation plan. They were able to review and provide feedback on the entire draft plan, which was posted to NVDA's web page.	The planning process must include an opportunity for the public to comment on the plan during the drafting stage and before plan approval. The term "public" includes residences, businesses, property owners, and tenants, as well as stakeholders in the community such as business leaders, civic groups, academia, nonprofit organizations, and major employers.
Planning Process - Public Involvement	The public had an opportunity to participate in the planning process through the Public Preparedness Survey and two Public Meetings. Representatives from neighboring towns were invited to all public meetings. Representatives from the privately held Wind Farm were also invited to participate in the planning process and the Public Meetings.	Other agencies and organizations must be contacted to see if they are doing anything that may affect the community's program and to see if they could support the community's efforts. Coordination with neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development as well as businesses, academia, and other nonprofit interests.

Mitigation Planning Process Tasks	Actions Taken in Planning Process	CRS Credit Requirements
Existing Plans and studies	This chapter includes a review of existing studies.	CRS requires that a plan include a review of existing studies, reports, and technical information and of the community's needs, goals, and plans for the area.
Risk Assessment - Hazard Assessment	Chapter 4 includes describes the location of all natural hazards in the Town including their location, previous occurrences and the probability of future events. Participation in the NFIP is reviewed in Chapter 4 and here in Chapter 5.	Credit is based on what the community includes in its assessment of the hazard. The minimum requirement is for the flood hazard only. However, additional credit can be earned by identifying and including a description of all other natural hazards. Credit is based on what is included in the assessment of vulnerability to the hazards identified. At a minimum the plan must include an overall summary of each hazard and its impact on the community. CRS credits is given for an assessment that includes a review of all properties that received flood insurance claims (in addition to repetitive loss properties) or an estimate of the potential dollar losses to vulnerable structures.
Risk Assessment - Assess the Problem	Critical facilities are identified in Chapter 2 and they are mapped according to hazard risk in Chapter 4. Vulnerability of each critical facility is described.	CRS credits the identification of the number and types of buildings subject to the hazards as well as the identification of critical facilities and infrastructure located in the hazard areas. CRS gives credit for a description of the development, redevelopment, and population trends and a discussion of what the future brings for development in the community.
Mitigation Strategy - Set Goals	Hazard mitigation goals are identified in Chapter 6.	Credit is based on a statement of goals of the community's floodplain management or hazard mitigation program.
Mitigation Strategy - Review Possible Activities	Chapter 6 includes information for past mitigation actions and their current implementation status. It also provides rationale for each of the newly identified mitigation actions.	Credit is based on a comprehensive review of floodplain management or hazard mitigation activities are reviewed in the plan. The review must include a description of why certain activities were recommended and why others were not.
Mitigation Strategy - Draft an Action Plan	Several Tables in Chapter 6 identify for each mitigation	Credit is based on an action plan that identifies who does what, when it will be

Mitigation Planning Process Tasks	Actions Taken in Planning Process	CRS Credit Requirements
	action that is responsible for implementation, when the action is to be implemented and a potential funding source. Chapter 6 shows the priority order of mitigation actions and their associated cost.	done, and how it will be financed. The actions must be prioritized and include a review of the benefits of the proposed projects and their associated costs.
Plan Maintenance – Implement, Evaluate, and Revise	Chapter 7 indicates how the plan will be implemented and calls for updating the plan on a five-year cycle.	Credit is based on how a community monitors and evaluates its plan on annual bases and updates it on a five-year cycle.

CAPABILITY ASSESSMENT CONCLUSIONS

In terms of preparing for a disaster, the majority of respondents to the Natural Hazards Preparedness Survey reported that they have installed smoke and carbon monoxide detectors and they have a generator for temporary power. The majority do not have disaster supply kits or emergency plans, which supports the mitigation actions of educating how residents could shelter-in-place and mitigate risks.

In conclusion, the Town of Lowell has the ability to expand their capabilities by implementing the identified mitigation actions in the next chapter of this plan. They recognize their priorities to protect lives and properties through education as opposed to legislate resident's actions. Climate change may impact the frequency and severity of risk to Lowell, but it is not expected to impact the Town's long-term resilience. In fact, nothing was identified that limits Lowell's long-term resilience to natural hazards. The Select Board, Town Administrator, and Hazard Mitigation Committee recognize the need to update this plan annually on an informal basis and a formal update every 5 years. These updates will be an opportunity to evaluate changing socio-economic conditions, environmental conditions, demographic changes, and changes to the built environment. The Town of Lowell is well positioned to implement their identified mitigation actions.

6

MITIGATION STRATEGY

CHAPTER 6. MITIGATION STRATEGY

The hazard mitigation strategy is the culmination of work presented in the town profile, risk assessment, and capability assessment. The hazard mitigation strategy is also the result of multiple meetings and public outreach. The work of the Hazard Mitigation Committee was essential in creating the mitigation goals. The committee also played the role of prioritizing the mitigation actions.

Table 1 includes problem statements based on the risk assessment, capability assessment, and discussions and interviews with stakeholders. These statements are of particular interest with regard to primary hazards of concern, geographic areas of concern, and vulnerable community assets. This analysis helped summarize risks and identify realistic solutions.

Table 48 Problem Statements

Primary Hazards
Flooding: Flooding was noted by all members of the Hazard Mitigation Committee as the most concerning hazard and posing the biggest risk to the Town. Flooding can strand homes and small neighborhoods. Flooding occurs rapidly, leaving little preparation or response time.
Winter Storms: Winter storms are anticipated in Northern Vermont. However, winter storms are mainly a threat in terms of maintaining clear roadways. Power outages may be a result of severe winter storms, but residents in Lowell are particularly prepared for this and many (as indicated by the Preparedness Survey) have generators.
High Winds: High winds are noted to occur with winter storms, severe thunderstorms, and hurricanes. Fallen trees and power lines caused by high winds pose a threat to roadways.
Geographic Areas of Concern
Hazen Notch Road: Hazen Notch Road includes Bridge #10 and Bridge #8, each need retrofit and have been on the VTrans list for a number of years. There is a potential for flooding along this road which may limit access to shelters and to evacuation.
Four Corner Intersection: This intersection is notoriously dangerous as indicated by multiple accidents recorded. Snow buildup on the sides of this intersection reduces clear view of incoming traffic and makes safe turns challenging. The Town Plan (p.59) mentions this intersection as one with limited visibility and a spot where the speed limit changes dramatically.
Route 100 and the Missisquoi River: Flooding is common along Route 100 and the distributary branches of the Missisquoi River.
Areas of potential erosion: These four areas were noted in the Risk Assessment as areas of concern, they include Bousquet Road and Lower Village Road, Irish Hill Road, Vermont Route 100 and Fiddlers Elbow Road, and Mink Farm Road.
Vulnerable Community Assets
Lowell Graded School: The Lowell Graded School is considered the primary shelter for the Town and an integral part of Town activities. However, Lowell Graded School lacks a stand-alone generator and both the school and Town officials have not received training in shelter management.

Roadways: Many Lowell's roadways are unpaved. As a consequence, vehicles are often stuck in the mud and these poorly paved roadways leads to road erosion, which may impact waterways. Personal vehicles are the main mode of transportation in the Town, and for this reason the roads must be well maintained.

General Store: The Lowell General Store is the only place within a 20-minute driving radius to purchase gas and groceries. The Store is vulnerable to flooding and the roadways leading to the Store are vulnerable to the effects of winter storms, flooding, and high winds.

HAZARD MITIGATION GOALS

C3. Does the Plan include goals to reduce/avoid long- term vulnerabilities to the identified hazards? 44 CFR 201.6(c)(3)(i)

The first Hazard Mitigation Committee meeting was held on March 22, 2016. The committee members reviewed the 2005 Draft Mitigation Plan goal statements as a part of their meeting. Taking into consideration FEMA's requirements and the interests of committee members, the goals were modified to represent four categories. All of the concepts from the original list are included in the new list of Mitigation Goals. 2016 Hazard Mitigation Plan Goal Statements are shown in Figure 1 and the 2005 goal statements are included in Appendix F.

The goal statements reflect the long-term vision of the Hazard Mitigation Committee to protect its citizens and critical facilities from hazards identified in the risk assessment. These goals also support the vision for the Town of Lowell as named in the Town Plan, "it is the primary and fundamental intention of Lowell to remain a rural, agricultural town that encourages farming and a town that encourages individual businesses and entrepreneurship of a scale that can integrate harmoniously into its residential areas."[98] The Town Plan includes a section titled "Flood and Fluvial Erosion Plan" which is consistent with the state requirement. The plan identifies flooding and fluvial erosion hazard areas and designates them as areas to be protected in order to maintain the resilience of Lowell.

[98] Lowell Town Plan. (2014). Town of Lowell. Pg.8

Figure 17 2016 Mitigation Goal Statements

COMPREHENSIVE RANGE OF MITIGATION ACTIONS

C4. Does the Plan identify and analyze a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure? 44 CFR 201.6(c)(3)(ii) and 44 CFR 201.6(c)(3)(iv)

Mitigation actions are more specific than mitigation goals and identify an activity or process that is intended to reduce or eliminate risk to natural hazards. They can be categorized into the following four categories:

1. Local Plans and Regulations
2. Structure and Infrastructure Projects
3. Natural Systems Protection
4. Education and Awareness Programs

Table 2, taken from the Local Mitigation Planning Handbook, clearly defines each of these mitigation types and provides examples.[99] The Hazard Mitigation Committee took these four categories into consideration when developing an updated list of mitigation actions for this Plan. These categories were presented to the public in

[99] FEMA Local Mitigation Planning Handbook. (2013). Federal Emergency Mitigation Agency. Pg.6-4.

each public meeting held as part of the planning process. In addition to these categories, the mitigation actions developed reflect risk perceived to both new and existing buildings and infrastructure.

Table 49 Mitigation Action Types[100]

Mitigation Action Categories	Description of Category	Examples of Mitigation Actions
1 **Local Plans and Regulations**	These actions include government authorities, policies, or codes that influence the way land and buildings are developed and built.	• Comprehensive plans • Land use ordinances • Building codes and enforcement • Capital improvement programs • Open space preservation • Stormwater management regulations and master plans
2 **Structure and Infrastructure Projects**	These actions involve modifying existing structures and infrastructure to protect them from a hazard or remove them from a hazard area. This could apply to public or private structures as well as critical facilities and infrastructure. This type of action also involves projects to construct manmade structures to reduce the impact of hazards.	• Acquisitions and elevations of structures in flood prone areas • Utility undergrounding • Structural retrofits. • Floodwalls and retaining walls • Detention and retention structures • Culverts • Safe rooms
3 **Natural Systems Protection**	These are actions that minimize damage and losses and also preserve or restore the functions of natural systems.	• Sediment and erosion control • Stream corridor restoration • Forest management • Conservation easements

[100] FEMA Local Mitigation Planning Handbook. (2013). Federal Emergency Mitigation Agency. Pg,6-4.

Mitigation Action Categories	Description of Category	Examples of Mitigation Actions
4 **Education and Awareness Programs**	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.	• Radio or television spots • Websites with maps and information • Real estate disclosure • Mailings to residents in hazard-prone areas. • StormReady • Firewise Communities

Beyond considering these four mitigation action categories, the Hazard Mitigation Committee identified mitigation actions for all of the hazards profiled in the risk assessment. Table 3 indicates each hazard with its corresponding summary of the mitigation actions.

Table 50 Range of Specific Mitigation Actions for Each Hazard Identified

Hazard	Mitigation Actions
High Hazards • **Flooding and Erosion** • **Winter Storms** • **Extreme Cold** • **Severe Thunderstorm (High Wind and Lightning)** • **Hurricane and Tropical Storm (High Wind)**	The majority of the mitigation actions relate to the high hazards identified in the plan. Several examples for the flood and erosion risk include maintenance projects along the Missisquoi River, maintaining water standards in accordance with Act 64, and maintaining culverts and roadways to VTrans standards. Mitigating the winter storm and extreme cold risk includes building a salt and sand shed, installing a permanent generator at the Lowell Graded School, and clearing the snow at the four corner intersection. The risk caused by high winds and rain associated with severe thunderstorms and hurricanes is mitigated by collaborating with VEC for tree clearing, maintaining culverts and roadways, and educating residents about natural hazards and safe building practices.
Moderate Hazards • **Wildfire** • **Ice Jams** • **Hail** • **Drought**	The development of an Emergency Operation Center, shelter training, and the Reverse 911 system address risks posed by these moderate risk hazards. The mitigation actions related to education mitigate risk caused by these moderate hazards by keeping residents informed of the possible risk and ways to minimize it. The updated FEMA flood maps will assist with the severe thunderstorm risk that inevitably brings heavy rain. Maintain culverts and roadways addresses ice jam and thunderstorm risk. Maintaining emergency access to the General Store is relevant to hazards such as wildfire and those that may cause flooding such as thunderstorms and ice jams.
Low Hazards • **Extreme Heat** • **Earthquake** • **Tornado** • **Landslide**	The risk assessment proved that the risk from these hazards is low. As someone mentioned in the planning process when discussing extreme heat, “it’s usually cold and raining in Lowell.” The mitigation actions regarding the Lowell Graded School address the potential need for a cooling center, these include purchasing a generator and shelter training.

Hazard	Mitigation Actions
	Mitigating earthquake and landslide risk in Lowell is included in safe building practices education, shelter training, and emergency operation center designation. All of the mitigation actions that relate to high winds such as the generator for the school, the tree clearing with VEC, and the road and bridge retrofits mitigate tornado risk, as does the education and awareness programs such as the Reverse 911 system, the shelter-in-place education and the safe building practices education.

In addition to these natural hazards, the Hazard Mitigation Committee and the Zoning Board mentioned their desire to amend current zoning ordinances in Lowell to include the abandoned asbestos mine as a way to prevent any future building development on the site. Asbestos is a naturally occurring combination of minerals found in the mountainside in Lowell. Asbestos as we know it today, is a byproduct of these naturally occurring minerals and may be considered a technological hazard. The mitigation action to amend the zoning regulations is included in this Plan, however, technological hazards were not profiled as they are not required by current FEMA regulations.

The Town of Lowell has written this Multi-Hazard Mitigation Plan Update to be consistent with the State of Vermont Hazard Mitigation Plan and Act 16 which relates to planning for flood resilience and requires that municipal and regional plans include a flood resilience element.[101] Act 16 includes land use regulations that state municipal plans must encourage "flood resilient communities" and lists the following specific goals:[102]

A. 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.
B. The protection and restoration of floodplains and upland forested areas that attenuate and moderate flooding and fluvial erosion should be encouraged.
C. Flood emergency preparedness and response planning should be encouraged.

The Environmental Protection Agency (EPA) "Planning for Flood Recovery and Long-Term Resilience in Vermont: Smart Growth Approaches for Disaster –Resilient Communities" was an excellent resource for the Planning Team. This document defines flood resilience as "measures taken to reduce the vulnerability of communities to damage from flooding and to support long-term recovery after an extreme flood."[103] The same study also recommends "easy ways to improve resilience"[104]

A. Update and integrate comprehensive plans and Hazard Mitigation Plans

B. Conduct thorough policy and regulatory audits

C. Amend zoning, subdivision, and stormwater policies and regulations to match plans.

D. Consider participating in the NFIP CRS.

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101 State of Vermont Hazard Mitigation Plan, (2013). Vermont Department of Public Safety – Division of Emergency Management and Homeland Security. Pg.3-20

102 Act 16. (2014). Vermont General Assembly. Retrieved from http://www.leg.state.vt.us/docs/2014/Acts/ACT016.pdf

103 Planning for Flood Recovery and Long-Term Resilience in Vermont. (2014). Environmental Protection Act. Pg.3.

104 Planning for Flood Recovery and Long-Term Resilience in Vermont. (2014). Environmental Protection Act. Pg.9.

The same report recommends four categories of land use policy options, which represent different areas within a river valley to improve flood resiliency. These categories, listed below, were incorporated in the developed mitigation actions for this plan:

1. River Corridors: Conserve land and discourage development in particularly vulnerable areas along river corridors such as flood plains and wetlands
2. Vulnerable Settlements: Where development already exists in vulnerable areas, protect people, buildings, and facilities to reduce future flooding rise
3. Safer Areas: Plan for and encourage new development in areas that are less vulnerable to future floods
4. The Whole Watershed: Implement enhanced stormwater management techniques to slow, spread, and infiltrate floodwater

The Northeast Kingdom Regional Plan listed six strategies (listed below) in the Flood Resilience chapter that the Planning Team considered when developing their list of mitigation actions:[105]

1. Coordinate with the County Conservation Districts in hosting flood mitigation workshops for residential landowners and business owners, to educate them on measures to reduce flood risk and damage
2. Encourage Towns to include restriction of development within River Corridors, as mapped by the Vermont Agency of Natural Resources
3. Encourage Towns to amend zoning and subdivision regulations to include limits on clearing and impervious coverage, and that avoids impacts to wetlands and steep slopes (slopes greater than 20%)
4. Encourage Towns to incorporate Planned Unit Development provisions in their bylaws as a means to minimize impervious coverage and clearing
5. Encourage towns to engage in a working partnership with adjacent communities to address control of stormwater runoff and actions that will allow rivers and streams to regain access to floodplains
6. Assist Towns in seeking funding to implement hazard mitigation projects identified in plans

MITIGATION ACTION STATUS – FROM PREVIOUS PLAN

D2. Was the plan revised to reflect progress in local mitigation efforts? (Requirement §201.6(d)(3))

Table 4 is from the 2005 plan and includes the 2016 status of each previously identified mitigation action. The 2016 status column describes why mitigation actions may not have been implemented to date and indicates which mitigation actions are carried forward into this updated Plan. The mitigation actions carried forward are included with an asterisk throughout the plan and the completed projects are rows shaded in gray.

Table 51 2005 Mitigation Actions and their 2016 Status

2016 Status	Project/Priority	Mitigation Action	Who is Responsible	Time Frame and Potential Funding	Initial Implementation Steps

[105] Flood Resilience: Northeast Kingdom Regional Plan. (2015). Northeastern Vermont Development Association. Retrieved August 3, 2015 from http://www.nvda.net/files/ Flood%20Resilience.pdf.

2016 Status	Project/Priority	Mitigation Action	Who is Responsible	Time Frame and Potential Funding	Initial Implementation Steps
Still a priority but has yet to be funded.	*Bridge #10 replacement - HIGH	The Brahana Bridge needs replacement due to deterioration.	The Road Foreman and Select Board	Sooner than later. 2005/6 - FEMA, HMGP, Vt. Agency of Transportation	Seek cost estimates, review grant requirements from FEMA, and get on the Bridge and Culvert/VTRANS funding list.
Still a priority but has yet to be funded.	*Bridge #8 replacement - HIGH	The Post Office Bridge built in 1927 is deteriorating and needs replacement	The Road Foreman and Select Board	Sooner than later. 2005/6 - FEMA, HMGP, Vt. Agency of Transportation	Seek cost estimates, review grant requirements from FEMA, and get on the Bridge and Culvert/VTRANS funding list.
Fire station added a bay for a tanker truck, portable generator and pumps. Considered adequate at this time.	New Fire Station - HIGH	The fire station needs to be enlarged to accommodate the equipment it has.	Fire Chief	2005/6 Rural Development, Community Development Block Grant	Seek appropriate funding sources and begin application process
Still a priority but has yet to be funded.	*River Bank Stabilization - HIGH	The riverbank 300' upstream from the Post Office Bridge is eroding away	Select Board	2005/6 – FEMA, HMGP, FMA, Natural Resources Conservation	Seek partners and funding sources and prepare to stabilize the river back to prevent

2016 Status	Project/Priority	Mitigation Action	Who is Responsible	Time Frame and Potential Funding	Initial Implementation Steps
The 2016 plan will prioritize these projects.		and is very close to a residential building.		District	further erosion.
Fire station has eighteen to nineteen volunteers which is sufficient.	New volunteers HIGH	Recruit new volunteers and provide adequate training programs.	Fire Chief	Town to recruit – 2005/6	Begin campaign to solicit for new recruits.

CHANGING PRIORITES

D3. Was the plan revised to reflect changes in priorities? 44 CFR 201.6(d)(3)

The plan was revised from the 2005 draft plan. The priorities have not changed. The list of hazards studied in the plan has increased but the highest risk hazards are consistent with previous studies. Most mitigation actions were developed in response to the flood risk.

IDENTIFYING AND PRIORITIZING MITIGATION ACTIONS

C5. Does the Plan contain an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction? 44 CFR 201.6(c)(3)(iii) and 44 CFR (c)(3)(iv)

Based on the hazard risk assessment, the capability assessment, and the identified problem areas, the Planning Team developed a list of mitigation actions with the help of the Hazard Mitigation Committee. The Planning Team took into account the mitigation actions in the 2005 mitigation plan as well as FEMA's mitigation action categories and identified risks and vulnerabilities specific to the Town of Lowell. Many of the mitigation actions in this Plan relate to flooding, a primary concern in the Town of Lowell. Act 64 which relates to improving the quality of water in Vermont requires standards to prevent and control activities that are harmful to water. The Town of Lowell is

committed to meeting all Act 64 requirements which mandates "forestalling degradation of water quality"[106] in the Vermont.

The criteria used to evaluate the mitigation actions was largely based on best available information and best judgment, as many of the projects are not fully scoped out at this time. The mitigation actions were prioritized into four categories of priority: very high, high, medium and low.

1. **Very High** – extremely beneficial projects that will greatly contribute to mitigation of multiple hazards and the protection of people and property. These projects are also given a numeric ranking within the category
2. **High** – Strategies that provide mitigation of several hazards and have a large benefit that warrants their cost and time to complete
3. **Medium** – Strategies that would have some benefit to people and property and are somewhat cost effective at reducing damage to property and people
4. **Low** – Strategies that would not have a significant benefit to property or people, address only one or two hazards, or would require funding and time resources that are impractical

These categories were developed utilizing the following criteria:

- **Application to multiple hazards** – Strategies are given a higher priority if they assist in the mitigation of several natural hazards.
- **Time required for completion** – Projects that are faster to implement, either due to the nature of the permitting process or other regulatory procedures, or because of the time it takes to secure funding, are given higher priority.
- **Estimated benefit** – Strategies which would provide the highest degree of reduction in loss of property and life are given a higher priority. This estimate is based on the Hazard Analysis, particularly with regard to how much of each hazard's impact would be mitigated.
- **Cost effectiveness** – in order to maximize the effect of mitigation efforts using limited funds, priority is given to low-cost strategies. For example, regular tree maintenance is a relatively low-cost operational strategy that can significantly reduce the length of time of power outages during a winter storm. Strategies that have identified potential funding streams, such as the Hazard Mitigation Grant Program, are also given higher priority.
- **Eligibility Under Hazard Mitigation Grant Program –** The Hazard Mitigation Grant Program (HMGP) provides grants to states and local governments to implement long-term hazard mitigation measures after a major disaster declaration. The purpose of the HMGP is to reduce the loss of life and property due to natural disasters and to enable mitigation measures to be implemented during the immediate recovery from a disaster.

The Hazard Mitigation Committee carefully considered each mitigation action. They considered the costs vs. the benefits in accordance to each action.

106 Act 64. (2015). Vermont General Assembly. Retrieved from http://legislature.vermont.gov/assets/Documents/2016/Docs/ACTS/ACT064/ACT064%20As%20Enacted.pdf

Priority	Mitigation Action	Description	Hazards Mitigated	Mitigation Category	Responsible Department	Cost	Potential Funding Source	Timeline
Very High	*Conduct Multiple River Bank Erosion Maintenance Projects in compliance with Act 64 Along Hazen Notch Road to Maintain Water Quality in the Missisquoi River that Drains Into Lake Champlain.	Maintenance on the Missisquoi River to protect the water quality of Lake Champlain. Flooding on Hazen Notch Road strands residents.	Flooding and Erosion, Landslide	Natural Systems Protection	Road Department and Select Board	High	Better Back Roads Grant, VTrans, Town	July 2016 – June 2021
Very High	Maintain road standards so that watershed health and water quality is maintained in compliance with Act 64.	Encourage water quality and watershed health through the implementation of wooded vegetative buffers along rivers and streams. Lowell is accountable to State and EPA because water drains into Lake Champlain where phosphorous levels are too high.	Flooding and Erosion,	Structure and Infrastructure Projects	Select Board and Road Department	High	Better Back Roads Grant, VTrans	July 2016 - June 2020
Very High	Purchase a permanent generator for the Lowell Graded School.	The generator will allow the school to function as a shelter instantly.	Winter Storms, Flood and Erosion, Extreme Cold, Severe Thunderstorm (High Wind and Lightning), Hurricane (High Wind),	Structure and Infrastructure Projects	Lowell Graded School	Medium	HMGP	July 2016 – June 2018

			Tornado					
Very High	Expand School's Reverse 911 System	Town needs a system to alert all residents to disasters. This action is supported by the LEOP which states, "Alert the public (including special needs or vulnerable populations) of the hazards of the event at the outset and during the event (including protective actions and evacuation information).	All Hazards	Education and Awareness Programs	School and Select Board	Low	HMGP	July 2016 – June 2017
Very High	Maintain Culverts and Roadways to VTrans Standards.	Include culvert survey and replacement, ditching along roadways and cutting vegetation to allow visibility at intersections.	Flooding and Erosion, High Wind Hazards, Ice Jams, Severe Winter Storms, Landslide	Structure and Infrastructure Projects	Road Department	Medium	Town, HMGP. VTrans	July 2016 - June 2021
Very High	Develop a Road Erosion Inventory	Act 64 requires this inventory by 2019.	Flooding and Erosion, Ice Jams, Landslide	Structure and Infrastructure Projects	Road Department	Low	Better Back Roads, VTrans	July 2016 - June 2018
Very High	Update FEMA Flood Maps	Encourage FEMA to update and digitize floodplain maps for the Town.	Flooding and Erosion, Ice Jams, Severe Thunderstorm (High Wind and Lightning)	Local Plans and Regulations	Select Board and NVDA	Low	Town	July 2016 – June 2021

Very High	Designate an Emergency Operation Center	The Fire Department will coordinate with the Hazard Mitigation Committee and the State to designate the Fire House as the EOC.	All Hazards	Local Plans and Regulations	Fire Department	Low	Town	September 2016-August 2017
High	*Retrofit Bridge #10	On Rte. 58 and Hazen Notch Road, maintain access to shelter and allow residents to evacuate.	Flooding and Erosion, High Wind Hazards, Wildfire, Landslide, Earthquake	Structure and Infrastructure Projects	Select Board	High	VTrans	July 2016 – June 2021
High	*Retrofit Bridge #8	On Rte. 58 and Hazen Notch Road, maintain access to shelter and allow residents to evacuate.	Flooding and Erosion, High Wind Hazards, Wildfire, Landslide, Earthquake	Structure and Infrastructure Projects	Select Board	High	VTrans	July 2016 – June 2021
High	Implement Zoning Board plan related to fluvial erosion named in the Town Plan, August 2014 p.36.	The Town Plan includes a list of 5 actions related to property and flood zones. These are also shown below in Figure 1.	Flooding and Erosion	Local Plans and Regulations	Zoning Board	Low	Town	July 2016 – June 2021
High	Four Corner Intersection Maintenance for Safe Winter Travel	The main intersection in Town is dangerous when snow builds up on the road banks.	Severe Winter Storm	Structure and Infrastructure Projects	Road Department, VTrans	Low	Town, VTrans	November 2016 – June 2021
High	Remediate Beaver Dam Issues As They Arise	Prevent flooding caused by beaver dams.	Flooding and Erosion	Natural Systems Protection	Road Department	Low	Town	July 2016 – June 2021
High	Maintain Emergency Access to the General Store.	The General Store is a critical facility and is the only place in Town for gas or groceries. Supported by	Flooding and Erosion, High Wind	Structure and Infrastructure Projects	Road Department and VTrans	Low	Town and VTrans	July 16 – June 2021

		LEOP which states, “make roads passable and restore emergency access.”	Hazards, Wildfire					
High	Educate the public about how to shelter-in-place and where to access emergency information.	For a rural community in Vermont, frequently sheltering-in-place is the best solution in a disaster. Keeping people off the roads allows the Road Department to clear the roads and first responders to move about.	All Hazards	Education and Awareness Programs	Hazard Mitigation Committee	Low	Town	September 2016 - April 2017
High	Elevate transportation corridor at Hazen Notch Road and Route 58 (the lowest point in the Town).	Conduct an engineering study of flooding along Hazen Notch Road and Route 58 to determine appropriate mitigation actions.	Flooding and Erosion, Severe Thunderstorm (High Wind and Lightning)	Education and Awareness Programs	Select Board	High	VTrans, HMGP	March 2017- April 2021
High	NVDA Hazard Mapping Support	Lowell needs assistance redrawing zoning maps for the asbestos area. They would like a clear zoning map so the Zoning Bylaws may be updated. They also would like to overlay an updated floodplain map with the zoning map.	Flooding and Erosion, Ice Jams, Landslide, Wildfire	Local Plans and Regulations	Town Administrator	Low	NVDA	June 2016 – June 2021
High	Build a sand and salt shed	Sand and salt used on the roads in the winter is kept outside and at risk to freezing. Access is limited during incidents of severe winter storms and ice storms.	Extreme Temperatures, Ice Storms, Severe Winter Storms	Structure and Infrastructure Projects	Road Department	Medium	HMGP	April 2016 – June 2017
High	Collaborate with VEC for tree clearing	Road obstruction and downed power lines are two of the biggest concerns in Lowell. Collaborating with	High Wind Hazards and Severe Winter	Structure and Infrastructure Projects	Road Department	High	HMGP	September 2016 – June 2021

		the Vermont Electric Company to keep trees trimmed and roads clear is essential to keep the roads free of debris and the power on.	Storms					
Medium	Retrofit Kempton Hill Bridge	The bridge is high up and the concern is safety and resident evacuation.	Flooding and Erosion, High Wind Hazards, Wildfire, Landslide, Earthquake	Structure and Infrastructure Projects	Select Board	High	VTrans	July 2018 – June 2021
Medium	Pave Mink Farm Road	Class 2 road that needs repaving.	Flooding and Erosion, Severe Winter Storm	Structure and Infrastructure Projects	Road Department	Medium	VTrans, Town	July 2016 – June 2019
Medium	Pave Mines Road	Class 2 road that needs repaving.	Flooding and Erosion, Severe Winter Storm	Structure and Infrastructure Projects	Road Department	High	VTrans, Town	July 2016 – June 2019
Medium	Get a generator for Town Garage	To maintain power in the building especially during evening disasters.	Flooding and Erosion, High Wind Hazards, Severe Winter Storms, Ice Jams, Extreme Temperatures	Structure and Infrastructure Projects	Road Department	Low	HMGP	September 2019 – August 2020

Medium	Educate homeowners about floods and other natural hazards.	The Hazard Mitigation Committee has prioritized education as one of the best methods to mitigate risks in Lowell.	All Hazards	Education and Awareness Programs	Hazard Mitigation Committee	Low	Town	July 2016 – June 2017
Medium	Educate home owners about safe building practices for snow load, flooding, high winds, and bank erosion.	Bring in an outside consultant/engineer who knows about safe building practices.	Flooding and Erosion, High Winds Hazards, Hail, Landslide, Earthquake	Education and Awareness Programs	Hazard Mitigation Committee, Road Department and Fire Department	Low	Town, HMGP	October 2017-Decembe r 2019
Medium	Maintain data on cost to Town related to flooding and other hazards.	Document costs incurred by Town departments responding to flooding and other hazards.	All Hazards	Local Plans and Regulations	Town Treasurer	Low	Town	July 2016 - June 2021
Medium	American Red Cross Shelter Training for all shelters.	Train representatives from the school and two churches how to run a shelter.	All Hazards	Education and Awareness Programs	Town Administrato r	Low	Town and American Red Cross	July 2018 – June 2020
Low	Amend zoning ordinance to include asbestos mine	Development on or near the asbestos mine is prohibited.	Technologi cal Hazard	Local Plans and Regulations	Zoning Board and Select Board	Low	Town	July 2016-June 2017
Low	Participate in the Community Rating System	Participate in the NFIP CRS program if a regional body shares the responsibility of participation.	Flooding and Erosion, Severe Thundersto rms (High Wind and Lightning), Severe Winter Storms	Education and Awareness Programs	Town Clerk and NVDA	Low	HMGP	August 2018 – June 2021
Low	Educate residents about the risk	Specifically related to mosquito borne illnesses.	Infectious Disease	Education and	Town Clerk Office	Low	Town	March 2018 -

	insects present and how they may breed in standing water			Awareness Programs				June 2021

Figure 18 2016 Mitigation Actions Based on Priority

The Zoning Board will set the following plan with a completion goal of five years for update in the next Town Plan.

1. Survey the indicated properties on the maps attached in Appendix A circled in red and make an accurate list of all buildings that were built within 50 feet of the river bed. This list will also need to be separated into homestead vs. seasonal and camps to identify which homeowners are full time residents. The Zoning Board can work on this in conjunction with the Town Listers as they survey and inspect properties in the Town.

2. After defining the list of properties in Lowell currently in flood zones or fluvial Erosion zones each homeowner will be sent a package informing them of the designation and will be provided with educational materials, suggestions and web links on protecting their home in the event of a flood.

3. Properties that are considered at extreme risk will be noted and a list will be attached to the Towns Local Emergency Operations Plan (LEOP) so first responders and the fire department will be aware of which residents might need assistance first in the event of a flood.

4. The Zoning Administrator will be given the list so he can make considerations before approving any building permits for these locations.

5. The Town Clerks Office will also be given the list of properties so they can inform any real estate agents that the home is in a Town Flood Zone.

Figure 19 Zoning Board Plan List

INTEGRATING HAZARD MITIGATION

The development of this Updated Hazard Mitigation Plan is an opportunity for the Town of Lowell to integrate their multiple planning mechanisms. It is the intent of the town, once this plan is formally approved by FEMA, to incorporate and address recommended mitigation strategies in the town's future comprehensive, emergency operations and disaster response planning, the town plan and in the update of town bylaws and ordinances.

FUNDING OPTIONS

FEMA GRANT FUNDING SOURCES

Currently, FEMA administers three programs that provide funding for eligible mitigation projects that reduces disaster losses and protect life and property from future disaster damages. The three programs are the Hazard Mitigation Grant Program (HMGP), the Flood Mitigation Assistance (FMA) Program, and the Pre-Disaster Mitigation (PDM) Program.

HMGP assists in implementing long-term hazard mitigation measures following a Presidential major disaster declaration

PDM provides funds for hazard mitigation planning and projects on an annual basis

FMA provides funds for projects to reduce or eliminate risk of flood damage to buildings that are insured under the National Flood Insurance Program (NFIP) on an annual basis

HMGP funding is generally 15% of the total amount of Federal assistance provided to a State, Territory, or federally-recognized tribe following a major disaster declaration. PDM and FMA funding depends on the amount congress appropriates each year for those programs.

Individual homeowners and business owners may not apply directly to FEMA. Eligible local governments may apply on their behalf.

FEDERAL FUNDING SOURCES[107]

The table below is a summary of federal funding sources that primarily support hazard mitigation projects and planning in the State of Vermont. Many of the identified funding sources below have been available to Vermont in the 2010-2013 timeframe as a result of Tropical Storm Irene. FEMA's Community Rating System, HMGP, Individual and Household Program, National Flood Insurance Program, and Public Assistance funding programs assisted Vermont citizens in recovering from the disaster. These funds were

[107] State of Vermont Mitigation Strategy, State of Vermont Hazard Mitigation Plan, 2013. P. 5-47-5-48.

utilized to replace and repair damaged homes and provide financial assistance to families and individuals for basic needs. The U.S. Department of Housing and Urban Development provided CDBG Disaster Recovery funds for long-term housing and economic recovery following the storm. Additionally, the Small Business Administration provided direct loans to home and business owners needing additional funding to repair or rebuild uninsured disaster damage. The U.S. Economic Development Association provided three grants for a total of $515,000 to assist in the economic recovery following Tropical Storm Irene. All funding sources provided are essential to Vermont remaining as resilient as possible.

Funding Agency	Program	Type of Assistance	Availability	Managing Agency
FEMA	Community Assistance Program	Pre-disaster funding for States to provide technical assistance to communities in the NFIP and to evaluate community performance in implementing NFIP floodplain management activities	Pre-disaster	DEMHS
FEMA	Community Rating System	Flood insurance discounts	Pre- and post-disaster	ANR
FEMA	Disaster Preparedness Improvement Grants	Pre-disaster cost share grants for plan improvement and updates, as well as for implementing identified mitigation projects	Annual, pre-disaster	DEMHS
FEMA	FMA Program	Pre-disaster cost share grants for projects and planning	Annual, pre-disaster	DEMHS
FEMA	HMGP	Post-disaster cost share grants	Post-disaster only	DEMHS
FEMA	Individual and Household Program	Post-disaster grants	Post-disaster	DEMHS
FEMA	National Flood Insurance Program	Pre-disaster flood insurance	Pre- and post-disaster	ANR
FEMA	PDM Program	Grants provided on competitive basis to state and local jurisdictions for projects and planning	Annual, pre-disaster	DEMHS
FEMA	Public Assistance	Post-disaster aid to state and local	Post-disaster	DEMHS

Funding Agency	Program	Type of Assistance	Availability	Managing Agency
U.S. Department of Agriculture, National Resources Conservation Services	Emergency Watershed Protection Program	Provides financial and technical assistance to remove debris from stream channels, road culverts, and bridges; reshape and protect eroded banks; correct damaged drainage facilities; establish cover on critically eroding lands; repair levees and structures; and repair conservation practices	Post-Disaster	ANR
U.S. Department of Housing and Urban Development	CDBG Disaster Recovery	Post-disaster aid to state and local jurisdictions for long-term housing and economic and community recovery	Post-disaster	ACCD
Small Business Administration	Disaster Assistance Programs	Direct loans to businesses to repair or replace uninsured disaster damage	Post-disaster	DEMHS
U.S. Army Corps of Engineers	Various programs, including the Silver Jackets Initiative	Large-scale infrastructure and watershed projects	Pre- and post-disaster	DEMHS, ANR
Economic Development Administration		Direct funding to RPCs	Annual, Post-disaster	RPCs

EMERGENCY RELIEF ASSISTANCE FUND (ERAF)[108]

The Emergency Relief and Assistance Fund (ERAF) provides State funding to match Federal Public Assistance after federally-declared disasters. Eligible public costs are reimbursed by federal taxpayers at 75%. For disasters after October 23, 2014, the State of Vermont will contribute an additional 7.5% toward the costs. For communities that take specific steps to reduce flood damage the State will contribute 12.5% or 17.5% of the total cost. Appendix C includes an ERAF Summary Report specific to the Town of Lowell.

The Town of Lowell intends to meet the requirements for 12.5% by taking the four essential mitigation steps as shown below.

1. **National Flood Insurance Program** (participate or have applied)
2. **Town Road and Bridge Standards** (adopt standards that meet or exceed the 2013 template in the current: VTrans Orange Book: Handbook for Local Officials)
3. **Local Emergency Operations Plan** (adopt annually after town meeting and before May 1)
4. **Local Hazard Mitigation Plan** - Adopt a FEMA- approved local plan (valid for five years). Or, a draft plan has been submitted to FEMA Region 1 for review

They have also included a mitigation action to join FEMA's Community Rating System. This would make the Town eligible for 17.5%.

[108] Emergency Relief and Assistance Fund. (2016). Vermont Flood Ready. Retrieved from http://floodready.vermont.gov/find_funding/emergency_relief_assistance

7

IMPLEMENTATION PLAN

CHAPTER 7. PLAN IMPLEMENTATION

The Town of Lowell and the Hazard Mitigation Committee will implement the strategies outlined in this mitigation plan, as well as update and maintain the plan according to the guidelines described in this chapter. Based on the Mitigation Plan's goals, the Town and committee will use the analysis of hazard risks and capabilities to weigh the available resources against the costs and benefits for each mitigation action. The committee understands the value of this plan and its positive mitigation impact, thus the committee intends to continue updating this plan and implementing the plan's strategies.

The Town Administrator and the Hazard Mitigation Committee have assumed responsibility to oversee the implementation of the mitigation plan. They recognize that future development in the planning area must coincide with the goals and objectives of this plan. Mitigation strategy updates will be shared at Select Board, Zoning Board meetings, and public Town meetings. They will also be published in the local paper as appropriate.

The Town of Lowell will comply with all applicable State and Federal statutes and regulations during the periods for which it receives grant funding, in compliance with 44 CFR 13.11(c), and will amend this plan as necessary to reflect changes in Tribal, State, or Federal laws and statutes as required in 44 CFR 13.11(d).

The 2016 Multi-Hazard Mitigation Plan Update includes all actions and logistical issues deemed possible at the time of printing. The Hazard Mitigation Committee recognizes that unforeseen events may occur that alter the priorities or actions in the plan. For this reason, the plan is reviewed and amended as needed.

METHODS FOR CONTINUED PUBLIC INVOLVEMENT

A5. Is there discussion of how the community(ies) will continue public participation in the plan maintenance process? (Requirement §201.6(c)(4)(iii))

Public participation was an integral part of this Plan's development. The Hazard Mitigation Committee is committed to continuing public outreach and public involvement during the 5-year life span of this Plan. To this end, the public will remain involved in discussions regarding hazard mitigation in the planning area. Specifically, in this Plan, public participation will be held through various discussions platforms. Public involvement will be fostered through the strategies listed below.

- Town of Lowell website (www.townoflowell.org) will contain a copy of the plan and all plan updates
- The NVDA website (http://www.nvda.net/towns.php?town=48) will contain a copy of the plan and all updates
- Public meetings will be advertised in the local newspaper and flyers will be posted in the Town Offices, Churches, General Store and Lowell Graded School
- Hazard Mitigation Committee members will incorporate information regarding the implementation of mitigation actions in their regularly scheduled meetings and outreach activities. In this way, the Plan becomes incorporated in the business of the Town
- Copies of this plan will be available in the Town Office for public viewing

METHOD AND SCHEDULE FOR MONITORING, EVALUATING AND UPDATING THE MITIGATION PLAN

A6. Is there a description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a 5-year cycle)? (Requirement §201.6(c)(4)(i))

In order to review the Mitigation Plan on a periodic basis, the Hazard Mitigation Committee has agreed to meet annually at a minimum. The Town Administrator will schedule and host these meetings.

Three key methods to keeping the plan current are monitoring, evaluating, and updating the plan. FEMA defines these methods in the following way[1]:

1. Monitoring: Tracking the implementation of the plan over time.
2. Evaluating: Assessing the effectiveness of the plan at achieving its stated purpose and goals.
3. Updating: Reviewing and revising the plan at least once every five years.

MONITORING

The Town Administrator and the Hazard Mitigation Committee will use the *Mitigation Action Progress Report Worksheet* (shown in Appendix G) to monitor individual mitigation actions/projects and their status. This worksheet will be completed by the identified responsible department assigned with responsibility for each mitigation action named in the Mitigation Strategy. This Worksheet will include project status and identify obstacles or problems to implementation. The Town Administrator will distribute the *Mitigation Action Progress Report Worksheet* to each responsible department at the start of each quarter with instructions to complete the Worksheet prior to the quarterly Mitigation Planning meeting. At the quarterly meeting, the Town Administrator, will review the status of all projects, identify potential funding streams and discuss any complications to implementation with the Hazard Mitigation Committee. Actions not included in this Plan will be added to the Plan via completion of the Mitigation Action Progress Report Form. Hazard Mitigation Committee members are responsible for identifying additional mitigation actions and completing the form as needed.

In summary, over the 5-year life span of this plan, the Hazard Mitigation Committee will gather quarterly (20 times) to review the progress of all of the mitigation actions identified in this plan. The Town Administrator will champion this effort by facilitating these meetings and distributing the *Mitigation Action Progress Report Worksheet* with a meeting invite 2 weeks prior to the scheduled meeting. The Hazard Mitigation Committee represents the many departments and constituencies in the Town of Lowell. It is their responsibility to monitor the progress of this plan's implementation. The Town Administrator will provide meeting minutes following each of the quarterly Hazard Mitigation Committee meetings. These notes will be used toward the update of the Plan in 5 years.

It is anticipated that the Town of Lowell may face several barriers when implementing this plan. The first and foremost is funding and grant writing. The Town does not have a person dedicated to grant writing, the Town Administrator and several department heads assume the grant writing responsibility. This burdens an already small town with leaders assuming multiple responsibilities. Receiving grant funding is part of a competitive process that is beyond the control of town leaders. The other challenge the Town faces is out-of-date flood maps. The FEMA flood maps are from the 1980's and are still in paper form. Finally, the bridges that need replacing/retrofitting in Lowell have been on the State's list for many years and it is beyond the control of the Town when they receive funding.

EVALUATING

The Town Administrator and Hazard Mitigation Committee will use the *Plan Update Evaluation Worksheet* (shown in Appendix G) to evaluate this Plan and make recommendations for future Plan updates and enhancements. The worksheet will be completed approximately 3 months after the town adopts this Plan. It will then be completed annually with any updates to the Plan as a part of the fourth quarter Hazard Mitigation Committee meeting.

UPDATING

The Town Administrator assumes responsibility for maintaining this plan by applying for funding toward plan updates every 5 years. In the event of a large-scale disaster, the Hazard Mitigation Committee will review the plan to verify the plan's accuracy. A meeting will be convened and the plan will be updated as necessary. Beyond 5-year updates, the Town Administrator will coordinate a Hazard Mitigation Committee meeting on a quarterly basis, to look at the plan and discuss possible updates and to add or subtract mitigation actions.

INTEGRATING THE MITIGATION PLAN

C6. Does the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate? (Requirement §201.6(c)(4)(ii))

Integrating components of this Plan with other plans is the responsibility of the Town Administrator and the Hazard Mitigation Committee. They will each work in collaboration with the Select Board and the Zoning Board. The Northeastern Vermont Development Association will support efforts to integrate mitigation planning into the Town Plan and other plans that the NVDA may support.

The integration process and schedule of incorporating elements of this Plan will vary based on the particular plan's update cycle. The quarterly mitigation meetings will provide an opportunity to track the progress on the integration of this Plan into other planning mechanisms.

The Town Plan emphasizes flood resilience, an integration of the previous Hazard Mitigation Plan. The symbiotic relationship between the two plans will continue as each is updated. The Town's commitment to adhering to Act 64 and improving water quality within all rivers running through the Town of Lowell is another way that the goals of the mitigation plan and the mitigation actions will be implemented and integrated into multiple planning mechanisms in the Town.

8

APPENDIX

RESOURCES

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APPENDIX A: PLANNING PROCESS SUPPORTING MATERIALS

WORK PLAN

WORK PLAN

Complete a FEMA-approved Local Hazard Mitigation Plan for the Town of Lowell, Vermont.

1	Planning Process and Outreach Strategy
Roles	**Responsibilities**
Consulting Team	• Develop agendas for all calls. • Lead meetings and calls. • Aid in identifying Planning Team and Committee participants.
NVDA	• Assist with identifying and contacting potential planning team members. • Schedule and announce Kick-off Meeting Teleconference. • Assist with determining a regular call schedule. • Post documents to the web.
Town of Lowell	• Participate in the meeting. • Assist with identifying and contacting potential planning team members.
Deliverables	
• Assembled Planning Team with bi-monthly call schedule	

2	Develop Work Plan
Roles	**Responsibilities**
Consulting Team	• Develop Work Plan. • Lead meetings and calls. • Aid in identifying Planning Team and Committee participants.
NVDA	• Provide feedback on the Work Plan approach.
Town of Lowell	• Provide feedback on the Work Plan approach.
Deliverables	
• Documented Work Plan agreed upon by Planning Team. • Documented public outreach strategy.	

3	Hazard Data Review
Roles	**Responsibilities**
Consulting Team	• Develop a "wish list" of data. • Gather all best-available data. • Inform data collection needs for plan development. • Provide digital storage space (or transfer mechanism) as needed.
NVDA	• Identify contacts with potential data. • Assist with data collection from outside agencies. • Share available GIS data.
Town of Lowell	• Identify contacts with potential data. • Assist with data collection. • Share available GIS data.
Deliverables	
• List of natural hazards and man-made hazards to include in Mitigation Plan. • Collection of best-available data for study. • List of critical facilities.	

4	Public Meeting #1
Roles	**Responsibilities**
Consulting Team	• Develop outreach materials including Public Preparedness Survey, Press Release and Flyer. • Lead Public Meeting and Hazard Mitigation Committee meeting. Develop PowerPoint presentation for each. • Develop Preparedness survey. • Oversee data review and hazard profile development.
NVDA	• Assist with meeting location and logistics. • Print meeting materials developed by JCC. • Publicize meeting to public. • Assist with data collection as needed. • Distribute Public Preparedness survey.
Town of Lowell	• Assist with meeting location and logistics. • Print meeting materials developed by JCC. • Publicize meeting to public. • Assist with data collection as needed. • Distribute Public Preparedness survey.

Deliverables
• Public Meeting and associated outreach materials. • Hazard Mitigation Committee Meeting.

5	Risk and Vulnerability Assessment
Roles	**Responsibilities**
Consulting Team	• Complete vulnerability assessment for all identified natural hazards. • Consider climate change, water contamination, the rail line and hazardous materials as extenuating circumstances to identified hazards. • Map the location of each area of concern. • Assist with team collaboration and map review. • Develop risk and vulnerability assessment for multiple hazards.
NVDA	• Provide feedback on hazard ranking and provide information on land use and development trends.
Town of Lowell	• Provide feedback on hazard ranking and provide information on land use and development trends.
Deliverables	
• Completed risk assessment that meets all state and FEMA requirements.	

6	Identify Viable Mitigation Actions
Roles	**Responsibilities**
Consulting Team	• Develop viable mitigation actions using risk assessment, capability assessment results, research and public participation.
NVDA	• Provide feedback and review of all potential mitigation strategies. • Work with local agencies to determine if cost estimate is available. • Assist with mapping of mitigation actions.

Town of Lowell	• Provide additional mitigation actions and feedback on those identified by the consulting team. • Work with local agencies to determine if cost estimate is available.
Deliverables	
• Mitigation actions identified and prioritized.	

7	Public Meeting #2
Roles	**Responsibilities**
Consulting Team	• Develop outreach materials including a flyer and press release for the public meeting. • Facilitate a public meeting as well as a Hazard Mitigation Committee meeting. Develop PowerPoint presentations for each. • Document the mitigation plan.
NVDA	• Coordinate all logistics and outreach for the Public Meeting. • Collect a sign-in sheet at the meeting and take minutes. • Distribute digital copies of each to the Planning Team.
Town of Lowell	• Assist with outreach and logistics for the public meeting. • Participate in the Hazard Mitigation Committee and public meeting.
Deliverables	
• Public Meeting and associated outreach materials. • Hazard Mitigation Committee Meeting.	

8	Submit plan to NVDA, Town of Lowell and DEMHS
Roles	**Responsibilities**
Consulting Team	• Prepare plan for submission to DEMHS for compliance review. • Address public and planning team comments. • Address any state required revisions.
NVDA	• Publicize draft for public review. • Submit the plan for State review.

Town of Lowell	• Publicize draft for public review.
Deliverables	
• Draft final version of plan provided for review.	

9	Submit Plan to FEMA
Roles	**Responsibilities**
Consulting Team	• Continue to provide guidance on federal compliance review. • Provide guidance and paperwork for local plan adoption. • Address any DEMHS or FEMA required revisions.
NVDA	• Coordinate plan adoption by the Town. • Submit the plan to FEMA.
Town of Lowell	• Coordinate plan adoption by the Town.
Deliverables	
• Final version of plan delivered. The Consulting Team will provide a digital copy of the plan. In addition, three hard copies of the plan will be mailed to NVDA upon request.	

PROJECT SCHEDULE

The nine steps below will overlap somewhat, as that is the nature of mitigation planning. The project will be complete in August 2016. We cannot guarantee how quickly Vermont Emergency Management and Homeland Security or FEMA will review the plan. However, we will inform them of our timeline so they can anticipate receiving the plan for review. It is our team's policy to make any necessary changes requested by the state or FEMA within ten days.

Steps	Description	Jan 2016	Feb	Mar	Apr	May	Jun	Jul - Aug	Aug - Sep
1	Planning Process and Outreach Strategy	X	X	X	X	X	X	X	X
2	Develop Work Plan	X							
3	Hazard Data Review		X	X					
4	Review Hazard Data in Public Meeting #1		X	X					
5	Complete Vulnerability Assessment		X	X	X				
6	Identify Viable Mitigation Actions			X	X	X			
7	Review Mitigation Strategies Public Meeting #2				X	X	X		
8	Submit Plan to NVDA, Town of Lowell and DEMHS							X	
9	Submit Plan to FEMA for Review								X
Meetings									
Kick-off Meeting		X							
Planning Team Calls		X	X	X	X	X	X	X	X
Stakeholder Meetings			X	X			X		
Public Meetings				X			X		

Public Outreach Strategy

Public outreach is an essential component of mitigation planning. The Consulting Team firmly believes in the benefit of public outreach. The more engaged the public becomes in the planning process, the more likely they are to support future mitigation strategies. In addition, participation in mitigation planning often serves as a foundation for additional emergency preparedness and response planning, and adds important local knowledge to the mitigation plan.

The Public Outreach Plan will include strategies to:

- Generate public interest in mitigation planning.
- Accommodate special populations identified in the Town of Lowell.
- Solicit public input.
- Engage local stakeholders.
- Create opportunities for the public and local stakeholders to be actively involved in the mitigation planning process.

Hazard Mitigation Committee

A Hazard Mitigation Committee will be created to guide the Consulting Team and to provide local "ground-truthing" throughout the planning process. This committee will include leaders from the public and private sectors in the Town of Lowell. The Hazard Mitigation Committee will meet a minimum of two times throughout the planning process in conjunction with the Public Meetings.

Public Meetings

Two Public Meetings will be held to give the public an opportunity to participate in the planning process. The first meeting will be held in March to identify and review a list of natural and man-made hazards relevant for the plan. This meeting will also include identification of critical facilities. The second meeting will be held in May and focus on the mitigation strategy and specific mitigation actions. The Consulting Team will prepare PowerPoint presentations for each meeting. NVDA will handle all logistics and outreach for the meetings.

The Consulting Team requests NVDA to ensure the Public Meetings be accessible to disabled populations. If necessary, an interpreter for non-English speakers or the deaf should be provided by NVDA.

Public Preparedness Survey

A Public Preparedness Survey will be drafted to provide an opportunity for individuals in the Town of Lowell to participate in the mitigation planning process. The information provided might help the Hazard Mitigation Committee to better understand what hazards are of most concern and what mitigation actions are of particular interest. The survey will be posted online (hosted by SurveyMonkey) and a link will be provided via NVDA and the Town of Lowell Website. Hard copies of the survey will be distributed at all meetings.

News Media

The Consulting Team will draft press releases for each public meeting. The first press release will include mention of the Public Preparedness Survey. NVDA and the Town of Lowell will send the press releases to all relevant media sources.

Website

The Town of Lowell webpage will be used to advertise the Public Preparedness Survey, public meetings and for review of the draft mitigation plan.

Draft Plan Review

The Consulting Team will provide a digital copy of the Draft Plan for review. It is anticipated that each member of the Hazard Mitigation Committee will review the plan. In addition, the public will have the opportunity to review and comment on the plan. A digital version will be placed on the NVDA and Town of Lowell webpage.

PLANNING TEAM MEETING SUMMARIES

JANUARY 4, 2016 KICK-OFF CALL

The project began with a kick-off call between Amanda Carlson, Town Administrator, Frank Maloney, NVDA Planner and Jamie Caplan, Consulting Team Leader. Ms. Caplan presented and reviewed the Draft Work Plan, which is included in the Appendices. During review of the Work Plan, Ms. Carlson mentioned that the Town of Lowell does not have GIS capabilities. Ms. Caplan will coordinate with Mr. Maloney for data collection that NVDA may have. Mr. Maloney mentioned having GIS data sets for parcels, roads, railroad and water.

Populating a Hazard Mitigation Committee was discussed in detail. It was agreed that the Road Commissioner, a school representative, a volunteer fire fighter and a representative from the Zoning Board and Select Board should sit on the Hazard Mitigation Committee. Ms. Carlson agreed to contact potential committee members.

Public outreach and public meetings were also discussed. Ms. Carlson mentioned the possibility of having the public meetings during Town Hall Meetings as a way to get the highest number of participants. Mr. Maloney emphasized that if part of the meeting purpose is to identify points on a base map that this should be the first part of the meeting, not held until the end of the meeting. Ms. Carlson will review with the Select Board their interest in having mitigation planning on the Town Hall Meeting agenda. Mr. Maloney will use the NVDA newsletter and website for outreach as this will attract Town participants as well as neighboring towns.

JANUARY 19, 2016 PLANNING TEAM CALL

A quick and productive call with the Planning Team this morning. Mr. Maloney shared lots of data with the consulting team since our last call and Ms. Carlson is reviewing the 911 data to identify critical facilities. We determined that March 22, 2016 is a good day for the first Public Meeting. The meeting will be held at the Town Office. Ms. Carlson asked the Select Board about adding our Public Meeting content to Town Meeting and it was determined not to be feasible, the mitigation project would have been given ten to fifteen minutes at the end of the meeting and most people would probably leave. We are planning to also hold the first Hazard Mitigation Committee meeting on March 22, 2016 at 1pm. We will have several stakeholder meetings that day as well. We discussed the usefulness of a public survey. Ms. Caplan is going to send a draft survey to Mr. Maloney and Ms. Carlson for their review.

FEBRUARY 3, 2016 PLANNING TEAM CALL

This call included a review of the natural hazards to be considered in the risk assessment. The previous plan included flood, hazardous materials, structure fire/forest fire and severe weather/power outages. With a review the State Hazard Mitigation Plan (SHMP) the list was expanded to include all of the hazards in the SHMP. The conversation then turned to the outreach for the public meeting and Hazard Mitigation Committee meeting. It was agreed that the draft survey would be shortened so it could be copied and distributed on two pages. Ms.

Carlson will make a big effort to distribute the survey during the March 1, 2016 Town Meeting because a large attendance is predicted. The Hazard Mitigation Committee was scheduled for 4:30pm – 6:00pm and the Public Meeting scheduled for 6:00pm. This should ease the burden of participants trying to attend both.

FEBRUARY 29, 2016

This call among Planning Team members was about the upcoming public and Hazard Mitigation Committee meetings. It also included a discussion about critical facilities and hazards. Impacts from past hazard events were discussed. The public outreach methods were also reviewed.

MARCH 21, 2016

The focus of this Planning Team call was the upcoming public and Hazard Mitigation Committee meetings. Logistics such as sign-in sheets were discussed. Mr. Mahoney agreed to bring a large map indicating the locations of critical facilities to display at both meetings. Ms. Carlson agreed to print copies of the meeting materials for all participants.

APRIL 11, 2016

During this meeting the Planning Team reviewed the list of critical facilities and their need for generators. IT was agreed that the school needs a permanent generator. They also spoke about feedback the Select Board had to the planning process. The Select Board wants to prioritize river bank stabilization and intends to apply for Better Back Roads funding from VTrans. They understand that VTrans is prioritizing water quality and would like Hazen Notch Road to receive funding. The Planning Team discussed how the short length of bridges in Lowell as well as many other Vermont towns creates a problem.

MAY 10, 2016

This meeting discussion regarding Town capabilities specific to the NFIP. It also included a review of each hazard in the Vermont state plan and how they relate specifically to Lowell. The majority of the call focused on ranking the mitigation actions, very high, high, medium and low. Based on a worksheet prepared by the consulting team the Planning Team ranked the hazards for review by the Hazard Mitigation Committee.

MAY 18, 2016

The Planning Team spoke about several key issues during this meeting:

- Outreach for the Public Meeting scheduled for May 24, 2016. Including outreach to neighboring towns.
- Revision of the Goal Statements in the mitigation plan.
- Review of the priority order of mitigation actions.
- The potential for University of Vermont engineering students to assist the Town.

JUNE 2, 2016

The focus of this Planning Team call was mitigation actions and prioritizing them as well as making sure that sufficient efforts have been made to include neighboring communities and regional agencies in the planning process.

JUNE 30, 2016

The Planning Team reviewed a draft of the Risk Assessment Chapter of the plan. They spent some time discussing the inevitable confusion caused by using two data sets, E911 data and Hazus-MH data. They also determined that adding the Zoning Board's fluvial erosion plan to the list of mitigation actions makes good sense.

PUBLIC PREPAREDNESS SURVEY – BLANK SURVEY

Town of Lowell, VT Natural Hazards Preparedness Survey

The Town of Lowell is currently engaged in a planning process to become less vulnerable to disasters caused by natural hazards, and your participation is important to us!

The Hazard Mitigation Committee is working on developing a Hazard Mitigation Plan. The purpose of this plan is to identify and assess the Town's natural hazard risks (such as flooding, winter storms, hurricanes and earthquakes) and determine how to best minimize or manage those risks. Upon completion, this plan will be presented to the Town for adoption and submitted to the Vermont Division of Emergency Management and Homeland Security (DEMHS) and Federal Emergency Management Agency (FEMA) for review and approval.

This survey provides an opportunity for you to share your opinions and participate in the mitigation planning process. The information you provide will help us better understand your hazard concerns and can lead to mitigation activities that should help lessen the impacts of future disasters. Participation in this survey is voluntary and none of the information you provide will be attributed to you directly.

If you have any questions regarding this survey, or would like to learn about more ways you can participate in the development of the Hazard Mitigation Plan, please contact Frank Maloney, Northeastern Vermont Development Association at 802-424-1419 or fmaloney@nvda.net.

1. Have you ever been impacted physically, financially or emotionally by a natural disaster?

- ☐ Yes
- ☐ No

2. How concerned are you about the abandoned asbestos mine?

- ☐ I'm concerned this area is a threat to safety?
- ☐ I'm neutral when it comes to concern about the asbestos mine.
- ☐ I'm not worried, the mine is abandoned and nothing can cause problems there.

3. Are you aware of the location of designated shelters in Lowell?

- ☐ Yes
- ☐ No

4. Is your home at risk to any of the following hazards? (Check all that apply.)

- ☐ Floods
- ☐ Hurricanes or Tornadoes
- ☐ Wildfires
- ☐ Earthquakes
- ☐ Landslides
- ☐ I don't know

5. Which of these disasters have you experienced? How concerned are you about each of them.

I have experienced	Hazard	I am Very concerned	I am Neutral	I am Not concerned
	Dam Failure			
	Drought			
	Earthquake			
	Extreme Temperatures			
	Flooding			
	Hail			
	Hurricanes			
	Ice Jams			
	Invasive Species			
	Landslides/Rockslides			
	Severe Thunderstorm			
	Severe Winter Storm			
	Tornadoes			
	Wildfires			

6. Where do you live?

- ○ Town of Lowell
- ○ Other

7. Do you have flood insurance?

- ○ Yes
- ○ No
- ○ I don't know

8. If you don't have flood insurance, why not?

- ○ I don't live in a floodplain
- ○ It's too expensive
- ○ It never floods here
- ○ My house is elevated
- ○ I never considered it

9. Do you live in a floodplain?

- ○ Yes
- ○ No
- ○ I'm not sure

10. Do you know where the floodplains in Lowell are located?

- ○ Yes
- ○ No
- ○ I don't know

11. What is the most effective way for you to receive information about how to make your home and town more resilient to natural hazards?

- ○ Phone Call
- ○ Text Message
- ○ Mail
- ○ Public Workshop
- ○ Newspaper
- ○ Television
- ○ Radio
- ○ Internet (websites)
- ○ Internet (social media)

	Very Important	Neutral	Not Important
12. How important are each of the following community assets to you?			
Post Office			
Catholic Church			
Parish Hall			
Lowell Graded School			
Town Clerks Office/Historical Society/Library			
Lowell Congregational Church			
Lowell Fire Department			
Lowell Town Garage			
Wind Tower Control Building and Land			

	Very Important	Neutral	Not Important
13. Let us know your priorities regarding planning for natural hazards in your community?			
Protecting private property			
Preventing new development in high hazard areas			
Enhancing the natural environment			
Protecting historical properties			
Protecting and reducing damage to utilities			
Protecting emergency services			
Promoting cooperation among public and private agencies			
	Have done	**Plan to**	**Not done**
14. What have you done to prepare for a disaster?			
Gathered information on natural disasters or emergency			
Developed a "Household/Family Emergency Plan?			
Prepared a disaster supply kit			
Been trained in first aid and CPR in the last year			
Installed smoke detectors and carbon monoxide detectors in			
Discussed utility shutoff procedure in the event of a disaster			
Have a generator for temporary power			

15. Would you like information regarding flood insurance or flood mitigation?

- ○ Yes – Please contact me with information regarding flood insurance and flood mitigation.
- ○ No thank you

Contact Information

Name
Email
Phone

PUBLIC MEETINGS

Town of Lowell, Vermont

MEDIA RELEASE

For Immediate Release — **Contact: Frank Maloney**
February 2, 2016 — Phone: 802-424-1419

Disaster Planning Survey and Public Meeting

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

Join the Hazard Mitigation Committee on March 22, 2016 from 6:00 pm – 7:00 pm to share your ideas for reducing risk and becoming less vulnerable to natural hazards such as floods, hurricanes and winter storms. The meeting will be held at the Town Office Building, 2170 Vermont Rte. 100, Lowell, Vermont.

The public is also encouraged to complete the Public Preparedness Survey. It is online at https://www.surveymonkey.com/r/Lowellvt. The survey provides an opportunity for you to share your opinions and participate in the mitigation planning process. The information you provide will help us better understand your hazard concerns and can lead to mitigation activities that should help lessen the impacts of future disasters.

The purpose of the 2016 Hazard Mitigation Plan Update is to identify and assess the community's natural hazard risks and determine how to best minimize and manage those risks. Upon completion, the plan will be presented to the Town of Lowell for adoption and submitted to Vermont Division of Emergency Management and Homeland Security (DEMHS) and Federal Emergency Management Agency (FEMA) for review and approval. A FEMA approved plan makes the Town of Lowell eligible for federal and state mitigation grant funding.

The Northeastern Vermont Development Association (NVDA) was awarded a grant from the DEMHS to develop the 2016 Hazard Mitigation Plan Update; the previous plan was developed in 2005. The NVDA hired Jamie Caplan Consulting LLC to work with them and the Town to develop the 2016 Hazard Mitigation Plan Update.

If you have any questions regarding the meeting or the survey, or would like to learn about more ways you can participate in the development of the Hazard Mitigation Plan, please contact Frank Maloney, Planner, Northeastern Vermont Development Association at 802-424-1419 or fmaloney@nvda.net.

MARCH 22, 2016 – 6:00 PM

DISASTER PLANNING MEETING

The Town of Lowell is currently engaged in a planning process to become less vulnerable to disasters caused by natural hazards, and your participation is important!

Town Office Building
2170 Vermont Rte. 100, Lowell, VT

3/22/16 at 6:00 pm

Fires, Floods and Winter Storms

Share Your Ideas for Reducing Risk

Preparing a Hazard Mitigation Plan For FEMA Approval

MORE INFORMATION CONTACT

Frank Maloney Planner, NVDA

802-424-1419

fmaloney@nvda.net

PUBLIC MEETING SIGN-IN SHEET

Project: Lowell Hazard Mitigation Plan | Meeting Date: 3/22/16

Facilitator: Jamie Caplan | Place/Room: Town Offices

Name	Title	Organization	Phone	E-Mail
Carol Wood-Kobb				CarolWK@myfairpoint.net
Camellia Morrison				cmorr61@gmail.com
Carolyn Arel	Town Lister		744-6509	
Rolf Kobb	PLANNING ZONING		744-9993	
M. Sullivan	Resident.			madonnaSullivan@aol.com
Sam Thurston	Zoning Board		744-6859	samuelthurston@gmail.com
Charles Boulmetis	Zoning BOARD		744-6566	CBoulmetis@Gmail.com
Gordon Spencer	Zoning Admin.	Zoning Board	802-744-6612	GASPENCER42@Yahoo.com
Anita Gagner	Lowell School Principal	Lowell School	744-6641	anita.gagner@nesu.vt.org

Town of Lowell, Vermont

MEDIA RELEASE

For Immediate Release **Contact: Frank Maloney**
May 16, 2016 Phone: 802-424-1419

Public Meeting – Disaster Planning

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

Join the Hazard Mitigation Committee on May 24, 2016 from 6:00 pm – 7:00 pm to share your ideas for reducing risk and becoming less vulnerable to natural hazards such as floods, hurricanes and winter storms. A specific list of projects will be presented along with results from the hazard risk assessment. The meeting will be held at the Town Office Building, 2170 Vermont Rte. 100, Lowell, Vermont.

The purpose of the 2016 Hazard Mitigation Plan Update is to identify and assess the community's natural hazard risks and determine how to best minimize and manage those risks. Upon completion, the plan will be presented to the Town of Lowell for adoption and submitted to Vermont Division of Emergency Management and Homeland Security (DEMHS) and Federal Emergency Management Agency (FEMA) for review and approval. A FEMA approved plan makes the Town of Lowell eligible for federal and state mitigation grant funding.

The Northeastern Vermont Development Association (NVDA) was awarded a grant from the DEMHS to develop the 2016 Hazard Mitigation Plan Update; the previous plan was developed in 2005. The NVDA hired Jamie Caplan Consulting LLC to work with them and the Town to develop the 2016 Hazard Mitigation Plan Update.

If you have any questions regarding the meeting or the survey, or would like to learn about more ways you can participate in the development of the Hazard Mitigation Plan, please contact Frank Maloney, Planner, Northeastern Vermont Development Association at 802-424-1419 or fmaloney@nvda.net.

Picture from FEMA Photo Library, Barnard, VT, September 12, 2011

MAY 24, 2016 – 6:00 PM

DISASTER PLANNING MEETING

The Town of Lowell is currently engaged in a planning process to become less vulnerable to disasters caused by natural hazards, and your participation is important!

Town Office Building
2170 Vermont Rte. 100, Lowell, VT

5/24/16 at 6:00 pm

Fires, Floods and Winter Storms

Share Your Ideas for Reducing Risk

Preparing a Hazard Mitigation Plan For FEMA Approval

MORE INFORMATION CONTACT

Frank Maloney Planner, NVDA

802-424-1419

fmaloney@nvda.net

Figure 20 the Chronicle, May 18, 2016. Page 16.

In Lowell

Hearing on hazard mitigation plan set for May 24

The town of Lowell is currently engaged in a planning process to become less vulnerable to disasters caused by natural hazards, and public participation is essential.

Join the Hazard Mitigation Committee on Tuesday, May 24, from 6 to 7 p.m. at the town office building at 2170 Route 100 to share ideas for reducing risk and becoming less vulnerable to natural hazards such as floods, hurricanes and winter storms. A list of projects will be presented along with results from the hazard risk assessment.

The purpose of the hazard mitigation plan update is to identify and assess the community's natural hazard risks and determine how to best minimize and manage those risks. Upon completion, the plan will be presented to the town of Lowell for adoption and submitted to the Vermont Division of Emergency Management and Homeland Security (DEMHS) and Federal Emergency Management Agency (FEMA) for review and approval. A FEMA approved plan makes the town of Lowell eligible for federal and state mitigation grant funding.

The previous plan was developed in 2005. For questions regarding the meeting or the survey or to learn how to participate in the development of the Hazard Mitigation Plan, contact Frank Maloney, planner, at NVDA at (802) 424-1419, or fmaloney@nvda.net. — from the Northeastern Vermont Development Association.

MEETING SIGN-IN SHEET - Public Meeting	
Project: Lowell Mitigation	**Meeting Date:** 5/24/16
Facilitator: Jamie Caplan	**Place/Room:** Town Offices

Name	Company	E-Mail
Randy LaDeau	Clerk's Office Town of Lowell	sladeau@lowelltown.org
[illegible]	Lowell Fire	
[illegible]	LOWELL FIRE	[redacted] KOOB@HYPAIR POINT.NET
Sam Thurston	Zoning Board	samuelthurston@gmail.com
Dwight Richardson	S/B	
Charles Balmetis	Zoning Board	
Amanda Carlson	Town Administrator	
Richard Rion	Selectboard	

HAZARD MITIGATION COMMITTEE MEETINGS

HAZARD MITIGATION COMMITTEE MEETING SIGN-IN SHEET

Project: Lowell Mitigation Plan	Meeting Date: 3/22/16
Facilitator: Jamie Caplan	Place/Room: Town Hall

Name	Title	Organization	Phone	E-Mail
Gordon Spencer	Zoning Admist.	Town of Lowell	802-744 6612	G A Spencer 42 @ YAHOO . COM
Charles Boulmetis	ZONING BOARD MEMBER	Town of Lowell	802-744-6366	CBoulmetis@Gmail.com
ROLF KOOB	ZONING BOARD MEMBER	TOWN OF LOWELL	802-744 9995	KOOB@MYFAIRPOINT.NET
Dwight Richardson	Select Board	Lowell	802-744 6564	
ALDEN WARNER	SELECT BOARD		802 744-2758	alden@myfairpoint.net
Richard Pion	Select Board	Lowell	802 744-6838	
Sandy Lasdeau	Town Clerk Treasurer	Lowell	744-8028	slasdeau@lowell town.org
Anita Gagner	Lowell School Principal	Town of Lowell	744-6641	anita.gagner@ nesuvt.org
Amanda Carlson	Town Administrator	Town of Lowell	744 6559	acarlson@lowelltown.org
Sam Thurston	Zoning Board	Lowell	744-6859	Samuelthurston@ gmail.com
Keith Christensen	Zoning Board	Lowell	744 6226	—
Ron Canning	President	Lowell	802 744 0747	

Newport Daily Cronicle

MEETING SIGN-IN SHEET ~ Hazard Mitigation Committee

Project:	Lowell Mitigation Plan	**Meeting Date:**	5/24/16
Facilitator:	Jamie Caplan	**Place/Room:**	Town Offices

Name	Company	E-Mail
Sandy LaBeau	Town Clerk Town of Lowell	slabeau@lowelltown.org
Sam Thurston	town of Lowell - Zoning Board	samuelthurston@gmail.com
Rolf KooB	TOWN ZONING BOARD LOWELL FIRE DEPT.	
Charlie Boulmetis	Lowell Zoning Board	CBoulmetis@gmail.com
Amanda Carlson	Town Administrator	acarlson@lowelltown.org
Calvin Allen	Lowell Fire Chief Lowell Rd Comm.	" "
Dwight Richardson	S/B	
Frank Maloney	NVDA. Planner	fmaloney@nvda.net
Richard Pion	Select board	

APPENDIX B: NCDC SEVERE WINTER STORM EVENTS FOR ORLEANS COUNTY, VT

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Storm	1/3/1996	0	0	$10,000	$17,583	$0	$0	A storm system along the Mid Atlantic coast Tuesday night (1/2/96) intensified and moved northeast and passed south of Cape Cod Wednesday afternoon (1/3/96). Snow became steady across Vermont around 3 AM Wednesday morning and ended late Wednesday night. Snow accumulations ranged from 2 to 5 inches in Grand Isle Franklin, Orleans, Essex and Caledonia counties. In Chittenden and Lamoille counties 6 to 10 inches fell while a foot or more accumulated in Rutland, Orange, Addison, Washington and Windsor counties. A few of the greater snow amounta were: 14 inches in Montpelier (Washington County), 13.3 inches in South Lincoln (Addison County), 13 inches in Union Village (Orange County) and Rochester (Windsor County), 12 inches in Danby 4 Corners (Rutland County). Numerous minor automobile accidents were reported across the state with widespread power outages in Central and Southern Vermont.	N/A
ORLEANS (ZONE)	Winter Storm	1/12/1996	0	0	$5,000	$8,792	$0	$0	A storm system over eastern Kentucky early Friday morning (1/12/96) reformed along the North Carolina coast during Friday morning andmoved to the New Jersey coast Friday evening before continuingnortheast to the maine coast Saturday morning (1/13/96). Steady snow began across the state during the mid and late afternoon of Friday, with the heaviest snow falling between 9 PM Friday and 3 AM Saturday 91/13/96). Across Northern Vermont, the snow ended around 5 AM Saturday morning (1/13/96) while ending around 8 AM Saturday in Southern Vermont. In general, 3 to 6 inches fell in the Vermont counties of Chittenden, Franklin, Grand Isle, Orleans, Essex, Caledonia and Lamoille. Across the remainder of Vermont, generally 6 to 12 inches fell. A few of the heavier amounts were: 11 inches in Montpelier (Washington County) and Ludlow (Windsor County), with 9 inches in Chelsea (Orange County) and 7 inches in both South Lincoln (Addison County) and Wallingford (Rutland County). Numerous minor automobile accidents were reported statewide.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Storm	2/16/1996	0	0	$5,000	$8,792	$0	$0	A storm system off the Mid Atlantic coast Friday afternoon (2/16/96) moved to the east of Cape Cod Saturday morning (2/17/96) then into the Gulf of Maine Saturday night. Steady snow overspread central and eastern Vermont Friday night and tapered off to flurries midday Saturday. Across portions of southern and eastern Vermont between 3 and 6 inches of snow fell. A few of the heavier amounts were: Springfield (Windsor County) 5 inches, both Brookfield (Orange County) and Danby 4 Corners (Rutland County) received 4 inches. Automobile accidents were reported...especially in the counties of Windsor, Washington and Caledonia.	N/A
ORLEANS (ZONE)	Winter Storm	2/25/1996	0	0	$5,000	$8,792	$0	$0	An area of low pressuremoved from the Great Lakes into southern Canada on Saturday (2/24/96). This area of low pressure remained stationary over northern Maine and the Maritimes of Canada Saturday night into Sunday (2/25/96). Cold air with gusty winds and locally heavy snow rotated around this storm and moved across northern Vermont. In Vermont the heaviest snow fell during the early morning hours of Sunday (2/25/96). A few of the heavier snow fall reports were: Jay Peak (along the Franklin/Orleans County line) 18 inches, Albany (Orleans County) 12 inches, Canaan (Essex County) 8 1/2 inches, West Danville (Caledonia County) 6 inches and Montpelier (Washington County) 4 inches. Numerous minor traffic accidents were reported. The strongest winds were reported in Caledonia county. In East Burke wind gusts were estimated at 48 knots with power outages reported. Ski lifts were closed in East Burke due to the winds.	N/A
ORLEANS (ZONE)	Winter Storm	3/3/1996	0	0	$5,000	$8,792	$0	$0	A storm system moved across southern Canada on Saturday (3/2/96) and Sunday (3/3/96). On Sunday a cold front moved across the area followed by a blast of arctic air. Snow squalls with locally heavy snow and gusty winds accompanied the front. Accumulations were generally 1 to 3 inches in the valleys and 5 to 10 inches in the mountains of Washington, Lamoille, Caledonia, Orleans, Franklin and Chittenden counties. The heaviest snow was reported at Jay Peak along the Franklin and Orleans county line with 10 inches.	N/A

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Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Storm	3/5/1996	0	0	$0		$0	$0	A warm front approached New England from the Ohio Valley Monday (3/4/96) and Tuesday (3/5/96). Warm air associated with this front ran over cold surface air resulting in steady snow Tuesday. Accumulations of snow were generally 2 to 4 inches...except 4 to 6 inches across the counties of Orange, Windsor and Rutland. The heaviest amounts were: Danby 4 Corners (Rutland County) 5 inches, Springfield (Windsor County) 5 inches, Brookfield (Orange County) 4 inches.	N/A
ORLEANS (ZONE)	Winter Storm	3/7/1996	0	0	$10,000	$17,583	$0	$0	An area of low pressure in the Gulf of Mexico Wednesday night (3/6/96) moved to the Mid Atlantic coast and intensified late Thursday (3/7/96) then moved northeast to a position near Cape Cod Friday morning then into the Canadian Maritimes thereafter. Steady snow fell across the area from noon Thursday (3/7/96) through 10 PM Friday (3/8/96). Accumulations were generally 6 to 12 inches across Vermont with the highest amounts along and east of the Green Mountains. A few of the heavier amounts were as follows: Rutland (Rutland county) 14 inches, Waitsfield (Washington county) 13 inches, West Danville (Caledonia county) and Brookfield (Orange county) and Middlebury (Addison county) 12 inches, Ludlow (Windsor county) 11.7 inches, Burlington (Chittenden county) 9 inches and Canaan (Essex county) 8.5 inches and St Albans (Franklin county) 8 inches. Numerous traffic accidents were reported statewide.	N/A
ORLEANS (ZONE)	Winter Storm	4/10/1996	0	0	$5,000	$8,792	$0	$0	A storm system off the Virginia coast Tuesday morning (4/9/96) moved to near Cape Cod Wednesday morning (4/10/96). This system then continued to move northeast toward the Canadian Maritimes Wednesday night. Snow spread into Southern Vermont during the predawn hours of Wednesday and overspread the remainder of Vermont during the morning. The snow tapered off to flurries late Wednesday night except not until 3 AM Thursday (4/11/96) in Northeast Vermont. The heaviest snow fell over and east of the Green Mountains with 7 to 14 inches. In the Champlain Valley 2 to 5 inches fell with heaviest amounts above the 700 foot level. The wet snow resulted in some power outages and minor automobile accidents. A few snowfall reports include: Canaan (Essex County).....12 inches Newport (Orleans County).....10 inches West Danville (Caledonia County).....9 inches Cambridge (Lamoille County).....8 inches Fletcher (Franklin).....7 inches Wallingford (Rutland).....6 inches Bethel (Windsor County).....6 inches So. Burlington (Chittenden County).....5.5 inches	N/A

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Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Storm	11/26/1996	0	0	$20,000	$35,166	$0	$0	A storm system moved from Kentucky late Monday night, November 25, 1996 northeast across southern portions of New England Tuesday afternoon, November 26, 1996. Wet snow and ice resulted in the power being cut to 10,000 individuals especially in the Vermont counties of Rutland, Addison and Windsor. The heaviest snowfall reports included: Albany, VT (Orleans County).....8.5 inches Canaan, VT (Essex County).....8.2 inches Jericho, VT (Chittenden County).....8.0 inches Rutland, VT (Rutland County).....7.0 inches Brookfield, VT (Orange County).....6.4 inches Marshfield, VT (Washington County).....6.0 inches So. Lincoln, VT (Addison County).....5.7 inches St. Johnsbury, VT (Caledonia County)...5.5 inches Bethel, VT (Windsor County).....4.0 inches	N/A
ORLEANS (ZONE)	Winter Storm	12/7/1996	0	0	$50,000	$87,916	$0	$0	Narrative A storm system off the Carolina coast late Saturday, December 7 moved northeast across southeastern New England Sunday, December 8, 1996 resulting in significant snowfall in Vermont. Generally a foot or more of heavy wet snow fell in southern and eastern Vermont, with 5 to 9 inches in northwest Vermont. A few of the heavier snow amounts included: Albany (Orleans County).....22 inches West Danville (Caledonia County).....21 inches Marshfield (Washington County).....20.5 inches Norwich (Windsor County).....19 inches Chelsea (Orange County).....16 inches Island Pond (Essex County).....15 inches Sherburne (Rutland County).....14 inches Edne (Lamoille County).....11.5 inches Jericho (Chittenden County).....8.7 inches South Lincoln (Addison County).....7 inches Enosburg Falls (Franklin County).....5 inches There was one fatal traffic accident attributed to the storm, otherwise there were numerous minor automobile accidents. In addition, the heavy wet snow resulted in an unusually large number of power outages across southern and eastern Vermont.	N/A
ORLEANS (ZONE)	Winter Weather	12/19/1996	0	0	$10,000	$17,583	$0	$0	In general, this storm resulted in 3 to 6 inches of snow across central and northern Vermont. However, there were a few isolated higher amounts. For example, 8.4 inches fell in Canaan (Essex County) and 8.3 inches in Underhill (Chittenden County).	N/A
ORLEANS (ZONE)	Winter Weather	12/23/1996	0	0	$15,000	$26,375	$0	$0	Light freezing drizzle fell across portions of north central, northeast and southeast Vermont on Monday evening, December 23, 1996. The freezing drizzle resulted in very slippery roads between 8 PM and 11 PM with numerous traffic accidents reported.	N/A

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Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	12/26/1996	0	0	$5,000	$8,792	$0	$0	A weak upper level weather disturbance moved rapidly from the eastern Great Lakes Thursday night, December 26 to the Atlantic coast early Friday, December 27, 1996. Snow accumulations were generally 2 to 4 inches across extreme northern Vermont. A few accumulations were: Troy (Orleans County).....4 inches East Berkshire (Franklin County).....3.5 inches	N/A
ORLEANS (ZONE)	Winter Storm	1/9/1997	0	0	$10,000	$17,189	$0	$0	A storm system off the North Carolina coast Thursday afternoon (1/9/97) moved north across Long Island NY on Friday (1/10/97) and into Maine Friday night. Generally 6 to 12 inches of snow fell across northern Vermont with 4 to 8 inches in Rutland and Windsor counties of Vermont. A few of the heavier snowfall reports were as follows: Eden (Lamoille County).....12 inches Brookfield (Orange County).....10 inches Burlington (Chittenden County).....9.5 inches Albany (Orleans County).....9.2 inches Waitsfield (Washington County).....8 inches Bethel (Windsor County).....7.5 inches Sutton (Caledonia County).....7.5 inches	N/A
ORLEANS (ZONE)	Winter Weather	1/22/1997	0	0	$5,000	$8,594	$0	$0	Cold air was entrenched at the surface as a warm front moved north across the region into Canada. A mixture of light snow, sleet and freezing rain fell across the area. There were numerous automobile and truck accidents. Portions of Interstate 89 were closed in Washington and Chittenden Counties due to extremely slippery conditions. Burlington International Airport was closed during part of the morning with numerous flight delays.	N/A
ORLEANS (ZONE)	Winter Storm	1/24/1997	0	0	$10,000	$17,189	$0	$0	An area of low pressure moved through the eastern Great Lakes region Friday night (1/24/97) and then into Canada on Saturday (1/25/97). Snowfall across the region ranged from 3 to 8 inches, with the heaviest snowfall in southeast portions of the area. The heaviest snowfall reports received were: Springfield (Windsor County).....8 inches Albany (Orleans County).....6 inches Brookfield (Orange County).....5 inches East Wallingford (Rutland County).....5 inches Morrisville (Lamoille County).....4 inches Waitsfield (Washington County).....4 inches Burlington (Chittenden County).....4 inches	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Storm	1/27/1997	0	0	$10,000	$17,189	$0	$0	A low pressure system moved east from the Great Lakes region Monday (1/27/97) and up the St Lawrence Valley Monday night and then into Canada Tuesday morning (1/28/97). Across Central and Northeast Vermont between 6 and 12 inches of snow fell...except in the Champlain Valley where between 2 and 6 inches of snow fell. The heaviest snowfall reports were as follows: Canaan (Essex County).....12.5 inches Ludlow (Windsor County).....11.8 inches Sutton (Caledonia County).....9.1 inches Newport (Orleans County).....9.0 inches Marshfield (Washington County).....8.1 inches East Wallingford (Rutland County).....6.5 inches Union Village (Orange County).....6.0 inches East Berkshire (Franklin County).....6.0 inches	N/A
ORLEANS (ZONE)	Winter Weather	2/4/1997	0	0	$10,000	$17,189	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	3/5/1997	0	0	$20,000	$34,378	$0	$0	An area of low pressure moved out of the Ohio Valley Wednesday night (3/5/97) and across central New England early Thursday (3/6/97). It intensified into a "big one" and moved into the Canadian maritimes Thursday night. Accumulations of heavy wet snow were generally 10 to 20 inches across North Central and Northeast Vermont with 8 to 16 inches across Southern and Western Vermont. However, the greatest amount reported was 28 inches at Jay Peak along the Franklin/Orleans county border. At least 25,000 people lost power during the storm due to the heavy wet snow downing powerlines primarily in the counties of: Orange, Windsor, Caledonia, Rutland, Essex, Addison and Washington. In addition, portions of I-89 were closed due to numerous traffic accidents. Numerous traffic accidents were reported across the entire area. A few snowfall reports from this storm were: Jay Peak (Franklin/Orleans County border)....28 inches Sutton (Caledonia County).....18 inches Brookfield (Orange County).....18 inches Eden (Lamoille County).....17 inches Shoreham (Addison County).....16 inches Waitsfield (Washington County).....16 inches Albany (Orleans County).....16 inches Rutland (Rutland County).....12 inches Rochester (Windsor).....12 inches South Burlington (Chittenden County).....11 inches Enosburg Falls (Franklin County).....11 inches Island Pond (Essex County).....11 inches	N/A

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Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Storm	3/14/1997	0	0	$10,000	$17,189	$0	$0	An area of low pressure in the Ohio Valley Thursday (3/13/97) afternoon moved into the eastern Great Lakes region midday Friday (3/14/97) and across northern New England Friday night. Snow overspread the region Friday and mixed with sleet and freezing rain during Friday afternoon and night with ice accumulations on top of the snow. Snow accumulations were generally 4 to 7 inches across the area before the mix or change to sleet or freezing rain. A few of the snow reports were as follows: Bethel (Windsor County).....7 inches South Newbury (Orange County).....7 inches Newport (Orleans County).....6 inches West Burke (Caledonia County)....5 inches Island Pond (Essex County).....5 inches Morrisville (lamoille County).....5 inches St Albans (Franklin County).....5 inches Jericho (Chittenden County)...5 inches Rutland (Rutland County).....4 inches	N/A
ORLEANS (ZONE)	Winter Weather	3/21/1997	0	0	$5,000	$8,594	$0	$0	An area of low pressure moved across the Great Lakes late Friday (3/21/97) and reached the New England coast near Cape Cod, Massachusetts Saturday morning (3/22/97). Snow fell across the area during Friday night ending early Saturday morning. Generally between 3 and 5 inches of snow fell across the area...with the greatest amounts in the mountains.	N/A
ORLEANS (ZONE)	Winter Weather	3/25/1997	0	0	$5,000	$8,594	$0	$0	A low pressure system moved through the central Great Lakes region Tuesday morning (3/25/97) and into Canada early Wednesday morning (3/26/97). Across portions of North Central and Northeast Vermont snow accumulations were between 3 and 5 inches before the precipitation mixed with sleet and freezing drizzle.	N/A

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Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Storm	4/18/1997	0	0	$10,000	$17,189	$0	$0	A storm system intensified off the southern New England coast Thursday night (4/17/97) and Friday (4/18/97). The storm system slowly drifted east and out to sea Saturday (4/19/97). Heavy wet snow fell across portions of the area. Topography and elevation played an important role in snowfall amounts. The greatest snowfall amounts were along and west of the Green Mountains where some power outages resulted. East of the Green Mountains, milder maritime air resulted in mostly rain or a wet mix of rain and snow. The heaviest snowfall amounts were as follows: Huntington Center (Chittenden County)....15.8 inches East Wallingford (Rutland County).....14 inches South Woodstock (Windsor County).....14 inches South Lincoln (Addison County).....13.5 inches Williamstown (Orange County).....12 inches Eden (Lamoille County).....7 inches Berkshire (Franklin County).....4 inches Northfield (Washington County)....3 inches Sutton (Caledonia County).....1 inch Springfield (Windsor County).....Trace Snow	N/A
ORLEANS (ZONE)	Winter Weather	5/7/1997	0	0	$0	$0	$0	$0	A complex storm system over northern New York and southern Canada Tuesday morning (May 6, 1997) moved across northern Maine Tuesday night and into the Canadian Maritimes during Wednesday (May 7, 1997). The storm system deepened while over northern Maine and the Maritimes with locally 4 to 8 inches of snow over some of the mountains of northern Vermont above 2500 feet on May 7, 1997. The highest amount of snow recorded was 8 inches on top of Mt. Mansfield (Lamoille County). Across Caledonia County, Essex County and southern Orleans County between 2 and 4 inches of wet snow fell above 1500 feet.	N/A
ORLEANS (ZONE)	Winter Weather	10/23/1997	0	0	$5,000	$8,594	$0	$0	A weak trough of low pressure moved across Vermont late Thursday night, October 23 and Friday morning, October 24. Light snow fell across northern Vermont with the greatest accumulations in the higher terrain. In Vermont, a few accumulations included: Albany (Orleans county).....6.5 inches Underhill (Chittenden county).....6.0 inches Island Pond (Essex county).....6.0 inches West Danville (Caledonia county).....4.5 inches	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	10/26/1997	0	0	$5,000	$8,594	$0	$0	An area of low pressure moved across the Great Lakes region Sunday evening (10/26/97) and across New England during Monday (10/27/97). Light snow fell across portions of northern Vermont's higher terrain during late Sunday night (10/26/97) and mixed with sleet before changing to rain by early Monday morning (10/27/97). A few snow accumulations in Vermont were as follows: Albany (Orleans county).....5.2 inches Jay Peak (Franklin/Orleans county border)....4 inches Island Pond (Essex county).....3.5 inches Eden (Lamoille county).....3.0 inches Sutton (Caledonia county).....2.5 inches	N/A
ORLEANS (ZONE)	Winter Storm	11/14/1997	0	0	$5,000	$8,594	$0	$0	Steady snow overspread the region in response to an area of low pressure south of Long Island, NY Friday morning (11/14/97) which moved northeast out to sea by Saturday (11/15/97). A few snow reports from this storm system follow: Huntington Center (Chittenden county).....7.0 inches Ludlow (Windsor county).....10.0 inches Rutland (Rutland county).....10.0 inches Orwell (Addison county).....8.5 inches Waitsfield (Washington county)..... 8.0 inches Groton (Caledonia county).....8.0 inches Albany (Orleans county).....7.6 inches Chlesea (Orange county).....7.5 inches Eden (Lamoille county).....7.3 inches Berkshire (Franklin county).....4.3 inches	N/A
ORLEANS (ZONE)	Heavy Snow	12/1/1997	0	0	$5,000	$8,594	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	12/5/1997	0	0	$5,000	$8,594	$0	$0	A storm system over the Canadian maritimes Saturday (12/6/97) resulted in considerable moisture rotating across Vermont. Generally between 2 and 5 inches of snow fell across northern vermont with locally higher amounts in the northern Green Mountains. A few snow accumulations included: West Danville (Caledonia county).....5.0 inches East Haven (Essex county).....3.0 inches Albany (Orleans county).....3.0 inches Waitsfield (Washington county).....2.0 inches	N/A
ORLEANS (ZONE)	Winter Weather	12/25/1997	0	0	$0	$0	$0	$0	A storm system in the Great Lakes region early Thursday (12/25/97) moved northeast into Canada during the day. Another storm developed off the New Jersey coast early Thursday (12/25/97) and moved northeast to coastal Maine Thursday night (12/25/97). The steadiest snow fell across the eastern half of Vermont where generally between 2 and 6 inches fell with less than 2 inches elsewhere. A few specific snow accumulations were: Brookfield (Orange county).....6.0 inches Rochester (Windsor county), Eden (lamoille county), Greensboro (Orleans county).....4.0 inches Marshfield (Washington county).....3.0 inches	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Storm	12/29/1997	0	0	$20,000	$34,378	$0	$0	A major storm system moved rapidly northeast from coastal North Carolina on Monday (12/29/97) to southern New Jersey late Monday night (12/29/97) and across northern New England during Tuesday (12/30/97) and into Canada Tuesday night. Snow spread across the region late Monday night (12/29/97) and continued through Tuesday (12/30/97). Across eastern and southern Vermont the precipitation became mixed with sleet and rain. A number of traffic accidents were reported. In Vermont, the heaviest snow fell across north central and northwest portions with the greatest amount at Jay Peak with 25 inches. Elsewhere, across eastern and southern portions 7 to 12 inches fell. Specific snow accumulations included: Jay Peak (Orleans county).....25 inches Underhill Center (Chittenden county).....21 inches Eden (Lamoille county).....15.4 inches Sheldon Springs (Franklin county).....12 inches Waitsfield (Washington county).....12 inches East Wallingford (Rutland county).....11.5 inches Ludlow (Windsor county).....8.5 inches Sutton (Caledonia county).....7.4 inches Brookfield (Orange county).....6 to 8 inches Bridport (Addison county).....8.0 inches	N/A
ORLEANS (ZONE)	Ice Storm	1/6/1998	0	0	$80,000	$135,401	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	1/15/1998	0	0	$10,000	$16,925	$0	$0	An area of low pressure over the southeastern United States on Thursday, January 15th moved northeast to a position along the mid-atlantic coast late Thursday night (January 15) and moved to a location east of New England later Friday afternoon (January 16th). A few reports of snow accumulations were as follows: Eden (Lamoille county).....13 inches Island Pond (Essex county).....13 inches Albany (Orleans county).....12 inches Sutton (Caledonia county).....12 inches brookfield (Orange county).....9 inches Waitsfield (Washington county).....8 inches.	N/A
ORLEANS (ZONE)	Winter Storm	1/23/1998	0	0	$10,000	$16,925	$0	$0	An area of low pressure over the Gulf of Mexico Thursday (January 22) moved to the Ohio Valley Friday morning (January 23) and weakened. A secondary storm developed in the mid-atlantic coastal region Friday (January 23) and moved northeast. Snow mixed with sleet and freezing rain Friday night. A few snow and ice accumulations were as follows: West Danville (Caledonia county).....10 inches East Haven (Essex county).....10 inches Eden (Lamoille county).....10 inches Newport (Orleans county).....10 inches	N/A

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Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	2/24/1998	0	0	$0	$0	$0	$0	A storm system along the Virginia coast early Tuesday morning (February 24) moved northeast along the New Jersey coast during Tuesday to a position off the southern New England coast Tuesday night (February 24) before moving slowly east. Snow spread across the region Tuesday afternoon and became heavy Tuesday night. A number of traffic accidents were reported. The snow tapered off to light snow or flurries by or during Wednesday afternoon (February 25). Snow accumulations were generally 3 to 6 inches across this area with a few locally higher amounts in the mountains	N/A
ORLEANS (ZONE)	Heavy Snow	3/14/1998	0	0	$5,000	$8,463	$0	$0	N/A	N/A
ORLEANS (ZONE)	Heavy Snow	3/14/1998	0	0	$5,000	$8,463	$0	$0	N/A	N/A
ORLEANS (ZONE)	Heavy Snow	3/21/1998	0	0	$10,000	$16,925	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	11/26/1998	0	0	$10,000	$16,925	$0	$0	Low pressure along the New England coast Thursday afternoon, November 26th, resulted in a very wet snow across portions of northern Vermont...especially along and east of the Green Mountains. The storm moved into eastern Canada on Friday, November 27th. The snow started during the morning of November 26th in the mountains and slowly worked down to lower elevations in the afternoon and evening. Some areas in northeast Vermont reported over 2 inches of water content which included a period of rain before the changeover to snow. Snow accumulations generally ranged from 2 to 5 inches, with the greatest amounts in the higher elevations. Numerous cars were reported off area roads, especially Route 2, during the evening and night of November 26th due to very slippery conditions. The wet snow snapped power lines and tree limbs. There were about 2000 residents without power, mostly in portions of Orleans, Caledonia and Essex counties. The heaviest snow accumulations included: Summit of Mt Mansfield (Lamoille county)...8.0 inches Barton (Orleans county).....6.0 inches Newark (Caledonia county).....4.5 inches Island pond (Essex county).....4.0 inches West Danville (Caledonia county).....3.0 inches Elsewhere accumulations were generally 2 inches or less.	N/A

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Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	12/17/1998	0	0	$10,000	$16,925	$0	$0	An area of low pressure moved across eastern New England during Thursday, December 17th, 1998 and then into the Canadian maritimes early Friday, December 18th. Light snow fell across the area with the heaviest accumulations in and east of the Green Mountains. A number of minor automobile accidents were reported. General snow accumulations in these areas were 4 to 5 1/2 inches. A few specific reports follow: Newport (Orleans county).....5.5 inches Hanksville (Chittenden county).....5.3 inches Brookfield (Orange county).....5.0 inches South Lincoln (Addison county).....4.9 inches Sutton (Caledonia county).....4.4 inches	N/A
ORLEANS (ZONE)	Winter Storm	1/3/1999	0	0	$5,000	$8,264	$0	$0	A complex storm system moved through the Great Lakes region during Sunday, January 3rd, and then into Canada Monday, January 4th. A weak secondary low pressure system moved north along the New England coast Sunday night and early Monday. Snow overspread the area early Sunday (January 3) and then mixed with or changed to sleet and freezing rain during the morning and afternoon. Some areas received significant accumulations of sleet and ice on top of several inches of snow. A few of the heavier accumulations of snow before the changeover included: Groton (Caledonia county).....8 inches White River Jct (Windsor county).....5 inches Sheldon Springs (Franklin county)...4 inches Montpelier (Washington county).....4 inches	N/A
ORLEANS (ZONE)	Winter Storm	1/8/1999	0	0	$5,000	$8,264	$0	$0	An area of low pressure over the Ohio Valley during Friday afternoon (January 8th) moved northeast across New England during Saturday (January 9th). Snow overspread the region with accumulations generally between 8 and 15 inches with the lesser amounts across windsor county. A few representative snowfall reports were: Craftsbury (orleans county)..... 15 inches Underhill (Chittenden county).....13 1/2 inches Cambridge (Lamoille county).....13 inches Shrewsbury (Rutland county).....9 inches Jay Peak (Franklin county).....14 inches Island Pond (Essex county).....13 inches Orwell (Addison county).....13 inches Sutton (Caledonia county).....12 inches Brookfield (Orange county).....9 inches Marshfield (Washington county).....8 1/2 inches Ludlow (Windsor county).....6.4 inches	N/A

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Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	1/13/1999	0	0	$5,000	$8,264	$0	$0	An area of low pressure moved from the Tennessee Valley Tuesday afternoon (January 12) into southern New England Wednesday (January 13). Light snow accumulating to between 3 and 6 inches and colder air accompanied this system. A few snowfall reports were: Springfield (Windsor county).....6 inches Orwell (Addison county).....4 inches East Berkshire (Franklin county)...3.5 inches Rutland (Rutland county).....3 inches Colchester (Chittenden county)....3 inches South Newbury (Orange county)...3 inches	N/A
ORLEANS (ZONE)	Winter Storm	1/14/1999	0	0	$5,000	$8,264	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	1/27/1999	0	0	$5,000	$8,264	$0	$0	During the period from late Wednesday (1/27/99) through early Friday (1/29/99) a series of low pressure systems moved to the south of New England. During this extended period of several episodes of snowfall, accumulations ultimately ranged from as little as 3 inches in northeast Vermont up to around 9 inches in Rutland county. A few specific accumulations were: Rutland (Rutland county).....9.0 inches Ludlow (Windsor county).....8.3 inches Waitsfield (Washington county)...8.0 inches Hanksville (Chittenden county).....7.9 inches Chelsea (Orange county).....7.5 inches So. Lincoln (Addison county).....6.6 inches W. Danville (Caledonia county).....6.5 inches St. Albans (Franklin county).....5.0 inches Morrisville (Lamoille county).....4.7 inches Albany (Orleans county).....4.0 inches Island Pond (Essex county).....3.0 inches	N/A
ORLEANS (ZONE)	Winter Storm	3/6/1999	0	0	$0	$0	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	10/4/1999	0	0	$5,000	$8,264	$0	$0	A weak area of low pressure moved along a frontal boundary from Pennsylvania across southern New England during Monday, October 4th. Rain changed to wet snow. Accumulations were generally 1 to 3 inches. However...across the highest mountains, locally higher snowfall amounts were reported (Jay Peak received around 8 inches). A few automobile accidents were reported as well as scattered power outages.	N/A
ORLEANS (ZONE)	Winter Weather	10/23/1999	0	0	$1,000	$1,653	$0	$0	An area of low pressure intensified over eastern New England during Saturday, October 23rd. The higher passes of the northern Green Mountains received between 1 and 3 inches of snow...with locally higher amounts at the summits. A few automobile accidents were reported on roads through the higher mountain passes.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Storm	11/15/1999	0	0	$10,000	$16,528	$0	$0	An area of stationary low pressure over New Brunswick resulted in snow across much of Vermont during Monday, November 15, 1999 and Tuesday, November 16, 1999. The snow accumulations were enhanced by the mountainous terrain of northern Vermont...and thus was considered an elevation snow event. Across Orleans county accumulations were generally 7 inches or more with 12 inches reported in the town of East Albany.	N/A
ORLEANS (ZONE)	Winter Weather	11/29/1999	0	0	$5,000	$8,264	$0	$0	A trough of low pressure moved across northern New York and Vermont with accumulating snow showers over the higher terrain. Around 3 inches of snow was reported in the higher terrain from Jay to Troy.	N/A
ORLEANS (ZONE)	Winter Weather	12/11/1999	0	0	$10,000	$16,528	$0	$0	An area of low pressure intensified over northern Maine Friday night (December 10, 1999) and moved into New Brunswick, Canada on Saturday (December 11, 1999). Moisture wrapped around this system with snow across the area. Heaviest snow fell in a north-south band along the spine of the Green Mountains. Rain Friday night mixed with and changed to snow early Saturday. The snow was wet with gusty winds, before tapering off by late Saturday afternoon and evening. Across Orleans county, around 6 inches fell.	N/A
ORLEANS (ZONE)	Winter Weather	12/14/1999	0	0	$1,000	$1,653	$0	$0	A complex storm system moved across the region Tuesday night, December 14th and into Quebec on Wednesday, December 15th. A mixture of rain, snow and sleet during the evening of December 14th changed to light snow overnight . Generally between 2 and 4 inches of snow fell across the area. A few reports included: 3 inches in Orwell (Addison county), 3 inches in Worcester (Washington county), 3 inches in St Albans (Franklin county) with around 2 inches reported in the Burlington area (Chittenden county). Throughout the state roads were reported slippery.	N/A
ORLEANS (ZONE)	Winter Weather	1/2/2000	0	0	$20,000	$32,094	$0	$0	A stationary front across northern portions of Vermont and New York during the morning of January 2nd resulted in areas of freezing rain which continued into the mid and late afternoon hours. Area roads were icy with cars off the road.	N/A
ORLEANS (ZONE)	Winter Weather	1/3/2000	0	0	$5,000	$8,024	$0	$0	A storm system moved through the eastern Great Lakes Monday night, January 3rd and then into Canada on Tuesday, January 4th. Across the area, generally between 2 and 3 inches of snow fell with up to 1/4 inch of ice in some areas from freezing rain. The precipitation changed to rain Tuesday.	N/A
ORLEANS (ZONE)	Winter Storm	1/16/2000	0	0	$30,000	$48,141	$0	$0	A storm system moved from the Great Lakes region across northern New York Saturday night, January 15th and then across northern Vermont on Sunday, January 16th. Across portions of north central and northeast Vermont, between 7 and 13 inches of snow fell. In Orleans county, Jay Peak reported 12.5 inches with Irasburg reporting around 13 inches. Numerous automobile accidents were reported.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Storm	1/25/2000	0	0	$15,000	$24,071	$0	$0	A storm system off the North Carolina coast Tuesday morning, January 25th, moved northeast through the state of Maine during Wednesday, January 26th. Snow spread across the area Tuesday afternoon and continued into Wednesday. While there were lull periods in the snow Tuesday afternoon, it was heavy at times Tuesday night and Wednesday. A few accidents were reported across the area. Generally, between 10 and 18 inches of snow fell. A few specific snowfall amounts included: Morrisville (Lamoille county) 14 inches, South Lincoln (Addison county) 13.9 inches, Burlington (Chittenden county) 13 inches, Enosburg Falls (Franklin county) 12 inches, Newport (Orleans county) 12 inches, Island Pond (Essex county) 11 inches, Sutton (Caledonia county) 11 inches and Worcester (Washington county) 10 inches. The greatest storm total in this area was 23 inches in Jay Peak (Orleans county).	N/A
ORLEANS (ZONE)	Winter Storm	1/30/2000	0	0	$15,000	$24,071	$0	$0	A complex storm pattern with one system over the Ohio Valley and another one over the southeast US Sunday, January 30th organized into one system off the mid-atlantic coast Sunday night, January 30th. It then moved northeast across southern New England on Monday, January 31st. Snowfall in these areas was generally between 7 and 14 inches. A few specific reports included: Eden (Lamoille county) 14 inches, Sutton (Caledonia county) 12.8 inches, Greensboro (Orleans county) 11.4 inches, Cornwall (Addison county) 10.1 inches, Waitsfield (Washington county) 10 inches, Brookfield (Orange county) 8 inches, Rutland (Rutland county) 7 inches with Island Pond in Essex county reporting 6 1/2 to 7 inches.	N/A
ORLEANS (ZONE)	Winter Weather	2/10/2000	0	0	$1,000	$1,605	$0	$0	A storm system moved from the Ohio Valley Thursday afternoon, February 10th and across eastern New York Friday morning, February 11th and then into the Gulf of Maine. Away from Lake Champlain, snowfall was generally 3 to 6 inches with a few locally higher amounts. A few specific reports included: Across Essex county, 7 inches in Island Pond and 4 inches in East Haven. In Sutton (Caledonia county) 5.1 inches, Ludlow (Windsor county) 4.8 inches, Worcester (Washington county) 4.4 inches, Eden (Lamoille county) 4.2 inches, Berkshire (Franklin county) 4 inches, Chelsea (Orange county) 4 inches and Greensboro (Orleans county) 3 inches. Elsewhere across Vermont in the counties of Addison, Chittenden, Grand Isle and Rutland between 1 and 3 inches fell.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Storm	2/13/2000	0	0	$10,000	$16,047	$0	$0	A storm system over the Ohio Valley Sunday night, February 13th, tracked across central New England during Monday, February 14th. Heavy snow fell across the area with accumulations generally between 7 and 14 inches. Numerous schools were closed. A few snowfall reports included: Morrisville (Lamoille county) 13.5 inches, St Albans (Franklin county) 13 inches, Barton (Orleans county) 12 inches, Bristol (Addison county) 10 inches, South Hero (Grand Isle county) 10 inches, Sheffield (Caledonia county) 7 inches.	N/A
ORLEANS (ZONE)	Winter Weather	2/16/2000	0	0	$1,000	$1,605	$0	$0	A storm system moved from the northern Great Lakes Tuesday evening, February 15th then into northern New York early Wednesday and then into northern Maine late Wednesday. Snow accumulations across the area was generally 3 to 6 inches, with the heaviest amounts in the mountains and along the Canadian border region. A few reports included: 6.8 inches in Sutton (Caledonia county), 6.4 inches in Eden (Lamoille county), 6 inches in Island Pond (Essex county) and 4 inches in East Albany (Orleans county) and Rutland (Rutland county).	N/A
ORLEANS (ZONE)	Winter Weather	2/18/2000	0	0	$1,000	$1,605	$0	$0	A storm system moved from the Ohio Valley Friday afternoon, February 18th and moved to the southern New England coast Saturday morning before reorganizing and moving out to sea. In general, between 3 and 6 inches fell across the area.	N/A
ORLEANS (ZONE)	Winter Weather	3/11/2000	0	0	$1,000	$1,605	$0	$0	A low pressure system over the Appalachians on Saturday, March 11th, moved northeast across southern New England on Sunday, March 12th. Snowfall across north central and northeast Vermont was generally 3 to 6 inches. A few reports ranged from 3.5 inches in Newport (Orleans county) to 4 inches in Eden (Lamoille county) and Canaan (Essex county). The snow mixed with sleet and freezing rain at times.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Storm	4/9/2000	0	0	$25,000	$40,118	$0	$0	A complex storm system over the Ohio Valley region Saturday, April 8th moved northeast and reorganized over central New England early Sunday (April 9th) and then moved into eastern Quebec later Sunday and Sunday night , April 9th. Periods of rain fell late Saturday (April 8th) into early Sunday (April 9th). The precipitation changed to sleet Sunday morning and then to snow. Up to 3/8 of an inch of ice accumulated in Newark (Essex county) and 1/8 inch ice in Sutton (Caledonia county) with branches bowed down and some small tree limbs broken before the change to snow. Up to 3/8 of an inch of ice also accumulated in portions of Rutland county. Heavy snow fell during Sunday (April 9th). Power outages were reported in Washington and Rutland counties. Numerous accidents occurred during Sunday. One accident resulted in the closure of Rte 2 near East Montpelier (Washington county) Sunday afternoon. Snow accumulations were generally between 8 and 15 inches, but locally higher amounts fell in the Mountains. A few reports included: 14 inches in East Albany (Orleans county), 13 inches in Morrisville (Lamoille county), 10 inches in Waitsfield (Washington county), 9.5 inches in Chittenden (Rutland county), 9.2 inches in Sutton (Caledonia county), and 7.5 inches in East Haven (Essex county). The greatest amounts reported were 25 inches in Eden (Lamoille county) and 22 inches at Jay Peak (Orleans county).	N/A
ORLEANS (ZONE)	Winter Weather	4/11/2000	0	0	$5,000	$8,024	$0	$0	An area of low pressure moved across central and southern New England Tuesday night (April 11th) and early Wednesday (April 12th) then into the Canadian Maritimes. Light snow fell across the area with accumulations generally 3 to 6 inches. Specifically, the following accumulations were reported: Sutton (Caledonia county) 6.3 inches, Greensboro (Orleans county) 5.8 inches, Morrisville (Lamoille county) 5.5 inches, Essex Jct (Chittenden county) 5.2 inches, Enosburg Falls (Franklin county) 5 inches, Brookfield (Orange county) 5 inches, Waitsfield (Washington county) 5 inches, South Lincoln (Addison county) 4.2 inches, East Haven (Essex county) 4 inches, and South Hero (Grand Isle county) 2.5 inches. There were a few higher amounts in the mountains, such as: Jay Peak (Orleans county) with 7 inches.	N/A
ORLEANS (ZONE)	Winter Weather	10/29/2000	0	0	$1,000	$1,605	$0	$0	A storm system over the Canadian Maritimes resulted in wrap around moisture with precipitation falling in the form of snow. Generally, between 2 and 4 inches of snow fell in these areas. The greatest amounts reported were 4.6 inches in Jericho (Chittenden county) and 4.2 inches in Greensboro (Orleans county).	N/A

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Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	11/26/2000	0	0	$5,000	$8,024	$0	$0	A complex area of low pressure with one center that moved along the New England coast and the other center through the Great Lakes region spread freezing rain, mixed with sleet at times, across the area. Roads became slippery with a number of automobile accidents reported.	N/A
ORLEANS (ZONE)	Winter Weather	12/14/2000	0	0	$1,000	$1,605	$0	$0	A storm system moved from the Ohio Valley Late Wednesday night, December 13th and across New England by the afternoon of Thursday, December 14th. Snowfall across the area early Thursday resulted in generally 3 to 6 inches. A few reports were as follows: 6 inches in Springfield (Windsor county), 4.8 inches in St Johnsbury (Caledonia county), 4.5 inches in Bridport (Addison county), with 4 inches in the locations of Canaan (Essex county), Chelsea (Orange county), Jay Peak (Orleans county) and East Wallingford (Rutland county). In addition, Worcester (Washington county) received 3.8 inches, with 3 inches in Eden (Lamoille county), while 2.7 inches fell in Burlington (Chittenden county).	N/A
ORLEANS (ZONE)	Winter Weather	12/16/2000	0	0	$1,000	$1,605	$0	$0	A storm system moved from the Ohio Valley into Canada Saturday night, December 16, 2000. Light freezing rain fell across areas east of the Green Mountains. A weather spotter in Springfield, Vt reported up to a quarter of an inch of ice accumulation.	N/A
ORLEANS (ZONE)	Winter Storm	12/19/2000	0	0	$10,000	$16,047	$0	$0	A storm system developed along the mid atlantic coast Tuesday night, December 19th and moved northeast to Cape Cod Wednesday morning, December 20th. Snow developed across the area Tuesday evening, and became steady overnight before tapering off Wednesday morning. Amounts were generally between 7 and 10 inches. A few reports included: Berkshire in Franklin county...9.7 inches, Eden in Lamoille county...8.2 inches, Jay Peak in Orleans county 8 inches, St. Johnsbury in Caledonia county...7.1 inches, and Worcester in Washington county...7 inches.	N/A
ORLEANS (ZONE)	Winter Storm	12/31/2000	0	0	$20,000	$32,094	$0	$0	A storm system moved north along the east coast during Saturday (December 30, 2000) and reached eastern Maine Sunday, December 31, 2000. Snow became steady the evening of the 30th and continued overnight...into Sunday, before the snow tapered off late Sunday. Significant accumulations were reported by early Sunday, December 31. Storm total accumulations generally ranged from 8 to 15 inches with higher amounts in the Mountains. A few specific reports included: In Washington county 10 inches at Worcester and 17 inches at Waitsfield while in Orleans county Greensboro reported 11 inches. In Essex county, Island Pond received 8 1/2 inches. In Addison county, 8 inches fell at Orwell with the greatest amounts being 19 inches at New Haven and 20 inches at South Lincoln. A few automobile accidents were reported.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	1/15/2001	0	0	$1,000	$1,558	$0	$0	A weak but complex area of low pressure and frontal boundaries resulted in light snow across much of Vermont...but especially the north portion. Snowfall was generally around 4 inches. A few reports included 4 inches at Mt Mansfield (Lamoille county) and Sutton (Caledonia county) with 3.2 inches in Worcester (Washington county).	N/A
ORLEANS (ZONE)	Winter Weather	1/19/2001	0	0	$1,000	$1,558	$0	$0	A cold front moved across the area triggering light snow. Accumulations were generally 3 to 5 inches. However, there was a local report of 8 inches at Jay Peak (Orleans county) due to upslope. A few other reports were Eden (Lamoille county) with 4.5 inches...Island Pond (Essex county) with 3.5 inches...and 3.2 inches in Worcester (Washington county).	N/A
ORLEANS (ZONE)	Winter Weather	1/30/2001	0	0	$1,000	$1,558	$0	$0	A large sprawling area of low pressure over the Great Lakes region spread moisture across the area. The low level temperatures were at or below freezing. Thus there was a mixture of light freezing rain, snow and sleet. Roads were reported as slippery by Vermont State Police and weather spotters. Up to 1/4 inch of ice accumulated in Bethel, Vt (Windsor county) with icing reported in Groton (Caledonia county) and Springfield (Windsor county) areas. In Sutton (Caledonia county) about 3.5 inches of snow fell along with some freezing rain.	N/A
ORLEANS (ZONE)	Winter Weather	1/31/2001	0	0	$1,000	$1,558	$0	$0	An area of low pressure moved from the Great Lakes region along a frontal boundary through northern New England Wednesday afternoon and evening, January 31. Snowfall was generally 3 to 6 inches with slippery roads reported. A few snowfall reports included: Jericho (Chittenden county) with 5 1/2 inches...Sheldon Springs (Franklin county) with 5 inches and Montpelier (Washington county) with 4 inches.	N/A
ORLEANS (ZONE)	Winter Storm	2/5/2001	0	0	$75,000	$116,848	$0	$0	A storm system developed off the coast of Virginia early Monday, February 5, 2001 and moved northeast . It moved across extreme southeast coastal New England late Monday night and into the Gulf of Maine early Tuesday, February 6th. Steady snow spread across the area by the afternoon of Monday, February 5th and continued overnight and was heavy at times. The snow tapered off to flurries Tuesday morning, February 6th. Some minor automobile accidents were reported. Barn roofs collapsed in the Towns of Craftsbury and Holland (Orleans county), apparently due to the weight of the snow after the storm ended. Across the counties, generally 10 to 14 inches of snow fell, with Sutton (Caledonia county) reporting 14.4 inches, Chelsea (Orange county) with 12 inches, and Greensboro (Orleans county) with 10 inches.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	2/9/2001	0	0	$15,000	$23,370	$0	$0	An area of low pressure moved from the Great Lakes region along a frontal boundary through northern New England Wednesday afternoon and evening, January 31. Snowfall was generally 3 to 6 inches with slippery roads reported. A few snowfall reports included: Jericho (Chittenden county) with 5 1/2 inches...Sheldon Springs (Franklin county) with 5 inches and Montpelier (Washington county) with 4 inches.	N/A
ORLEANS (ZONE)	Winter Weather	2/14/2001	0	0	$10,000	$15,580	$0	$0	A storm system moved from the Great Lakes region early Wednesday, February 14th into the Gulf of Maine late Wednesday night (2/14/01) and early Thursday (2/15/01). Light snow accumulated to between 3 and 6 inches...with some sleet and freezing rain mixed in at times. A few reports were: Eden (Lamoille county) 6 inches, Topsham (Orange county) 5 inches and Worcester (Washington county) with 5 inches.	N/A
ORLEANS (ZONE)	Winter Weather	2/25/2001	0	0	$5,000	$7,790	$0	$0	A storm system moved from the northern Great Lakes into and across southern Canada during Sunday, February 25th. Snow spread across the area during the early morning then mixed with and changed to sleet, freezing rain and just plain rain. Roads did become icy after between 1 and 3 inches of snow generally fell...with a few higher amounts.	N/A
ORLEANS (ZONE)	Winter Storm	3/5/2001	0	0	$75,000	$116,848	$0	$0	A storm system developed off the Virginia coast early Monday, March 5th. It moved slowly northeast to near Cape Cod, Ma during late Monday night, March 5th and Tuesday morning, March 6th. The storm then moved slowly away from New England during Tuesday, March 6th. Snow overspread Vermont Monday morning (March 5th) and became steady and heavier by afternoon and continued through the night before tapering off late Tuesday, March 6th. The snow was heavy at times. Some impacts included: Many schools were closed and many towns postponed their Town meeting day. A number of accidents were reported including some on I-89. Generally, between 12 and 30 inches of snow fell, with the least in the extreme north and in the shadow effect area of eastern Orleans county. A few snowfall reports included: In Franklin county, Enosburg Falls reported 16 inches while in Orleans county, Newport reported 19 inches.	N/A
ORLEANS (ZONE)	Winter Weather	3/9/2001	0	0	$5,000	$7,790	$0	$0	A low pressure system reorganized off New England during Friday, March 9th. It then moved northeast away from the area on Saturday, March 10th. Snowfall accumulations were generally 2 to 4 inches with locally higher amounts in the mountains. Slippery roads were reported.	N/A
ORLEANS (ZONE)	Winter Weather	3/13/2001	0	0	$5,000	$7,790	$0	$0	Cold air allowed mixed precipitation to spread across the area during March 13th. This was especially the case along and east of the Green Mountains. Accumulations were generally in the 2 to 5 inch range with slippery roads reported.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Storm	3/22/2001	0	0	$50,000	$77,898	$0	$0	A storm system moved northeast from coastal New Jersey Thursday, March 22nd into the Gulf of Maine during Friday, March 23rd. Significant snow fell across the area. The snow was heavy and wet with power outages reported and a number of accidents. Snowfall was generally 10 to 30 inches with the greatest amounts in the mountains...with lesser amounts due to the shadow effect of mountains. A few reports included: Caledonia county...Sutton 11.1 inches. Essex county...Island Pond 10.5 inches. Lamoille county...Eden 26.4 inches while Morrisville received 12.5 inches. Orange county...Brookfield 23 inches. Orleans county...East Albany 24 inches and Greensboro 16.2 inches.	N/A
ORLEANS (ZONE)	Winter Storm	3/30/2001	0	0	$50,000	$77,898	$0	$0	A storm system moved slowly northeast along the New England coast Friday, March 30th and Friday night. Significant snow fell across the area, especially across the elevated terrain. Lesser amounts fell in valley areas. In general between 6 and 15 inches of snow fell. A few snowfall reports by county included: Caledonia county...West Danville 18.5 inches with 9.8 inches in Sutton. Essex county...9 inches in Island Pond. Lamoille county...Morrisville reported 9.5 inches. The snow that fell was heavy and wet with some power outages and slippery roads with some accidents.	N/A
ORLEANS (ZONE)	Winter Weather	10/8/2001	0	0	$5,000	$7,790	$0	$0	Rain changed to snow across northern Vermont with accumulations in general between 3 and 5 inches. This was especially true in the higher terrain. The snow was of a very wet variety.	N/A
ORLEANS (ZONE)	Winter Weather	11/5/2001	0	0	$0	$0	$0	$0	An area of low pressure moved across New England on Monday, November 5, 2001. Rain changed to snow with around 2 inches of snow in the higher elevations.	N/A
ORLEANS (ZONE)	Winter Weather	11/11/2001	0	0	$0	$0	$0	$0	Light snow fell across the region with many areas reporting between 1 and 4 inches of snowfall. The greatest amounts were in the higher terrain of the Green Mountains. A few minor automobile accidents were reported in Franklin and Washington counties.	N/A
ORLEANS (ZONE)	Winter Weather	11/29/2001	0	0	$0	$0	$0	$0	A mixture of light snow, sleet and freezing rain changed to all light freezing rain. There were slippery spots reported across the area. Across the northern third of Vermont, 1 to 3 inches of snow fell before the changeover...with the greatest snowfall in the mountains.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	12/14/2001	0	0	$0	$0	$0	$0	An area of low pressure over the Ohio Valley Friday morning, December 14th, moved northeast and reorganized over southern New England the night of the 14th. The storm system then continued east and moved offshore by Saturday morning, December 15th. Light rain quickly changed to wet snow across the area Friday evening (December 14th) and tapered off to flurries early Saturday morning. Accumulations were generally around 6 inches, with isolated higher amounts in the mountains. A few of the highest amounts were: In Chittenden county, Burlington Airport (NWS) reported 4.5 inches while Underhill reported 6.7 inches. In Essex county, Island Pond reported 6.5 inches while East Haven reported 5 inches. In Orleans county, East Albany reported 7 inches, while Greensboro received 4.5 inches. In Lamoille county, Eden received 6.1 inches. It was a very wet snow.	N/A
ORLEANS (ZONE)	Winter Weather	12/17/2001	0	0	$5,000	$7,790	$0	$0	An area of low pressure over the Ohio Valley Monday, December 17th moved to the New Jersey coast the night of the 17th and then to off the southern New England coast Tuesday morning, December 18th. Light snow spread north across the area during the afternoon...mixing with freezing rain during the evening hours then back to all snow. Accumulations were generally 3 to 6 inches. A few reports included: In Addison county, Cornwall reported 5.8 inches while in Chittenden county, Hanksville reported 4.8 inches. In Orleans county, Newport reported 5.5 inches with 5 inches in Waitsfield (Washington county). Numerous minor automobile accidents were reported across the entire area.	N/A
ORLEANS (ZONE)	Winter Weather	12/24/2001	0	0	$5,000	$7,790	$0	$0	A storm system moved into the Great Lakes region Sunday night, December 23rd. Another storm system organized over southern New England and moved east on Monday, December 24th. Light freezing rain and freezing drizzle fell during the night and early morning hours. Slippery spots developed. A number of automobile accidents were reported, with the most being in Caledonia county.	N/A
ORLEANS (ZONE)	Winter Weather	12/30/2001	0	0	$0	$0	$0	$0	A storm system over the Province of Quebec, coupled with an air flow across the eastern Great Lakes region, enhanced the flow of moisture across the northern Green Mountains of Vermont. Light snow fell across north central and northeast Vermont, with accumulations generally 3 to 6 inches. A few reports included: In Caledonia county, Sutton received 7 inches while West Danville got 4 inches. In Orleans county, East Albany reported 7 inches while Newport received 4 inches.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	1/13/2002	0	0	$5,000	$7,563	$0	$0	A storm system off the New Jersey coast early Sunday, January 13th, moved northeast away from New England during the afternoon and evening of January 13th. Snow fell across the area during the morning and afternoon. Accumulations were generally 2 to 5 inches, with the heaviest snow in Essex county. Lesser amounts fell across the remainder of Vermont. A few reports included: Island Pond (Essex county) 5 inches...Lyndonville (Caledonia county) 3 inches and South Newbury (Orange county) 2 1/2 inches. Across Orleans county State Police reported roads very slippery.	N/A
ORLEANS (ZONE)	Heavy Snow	1/24/2002	0	0	$1,000	$1,513	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	1/25/2002	0	0	$0	$0	$0	$0	A weak upper level disturbance resulted in light snow and snow squalls across far northern Vermont. Generally 3 to 5 inches fell in a short period of time. In East Albany (Orleans county) 4 inches fell while Sutton (Caledonia county) reported 4.2 inches.	N/A
ORLEANS (ZONE)	Winter Storm	1/31/2002	0	0	$10,000	$15,126	$0	$0	Low pressure over the Ohio valley Thursday evening, January 31st moved northeast into southern Canada during Friday, February 1st. Snow overspread the area during the afternoon of January 31st. The snow mixed with sleet during the late night of the 31st. The mixed precipitation continued into February 1st as sleet and freezing rain changing to freezing rain then just rain by the afternoon of February 1st. Snow accumulations were generally 5 to 8 inches with 1/4 of an inch of ice on top of the snow creating dangerous winter conditions. In Worcester (Washington county) 1 to 3 inches of sleet was reported. A few accumulation reports of snowfall were: Both Groton (Caledonia county) and Waitsfield (Washington county) reported 8 inches. Morrisville (Lamoille county) reported 7 inches while Greensboro in Orleans county received 6 inches.	N/A
ORLEANS (ZONE)	Winter Storm	2/1/2002	0	0	$5,000	$7,563	$0	$0	Winter storm conditions continued from January 31, 2002 through the morning of February 1, 2002 into the early afternoon. During February 1, the precipitation was a mixture of freezing rain and sleet changing to rain. These conditions resulted in difficult travel conditions. Details of the snowfall are included in the January 31, 2002 stormdata.	N/A
ORLEANS (ZONE)	Winter Weather	2/17/2002	0	0	$5,000	$7,563	$0	$0	A storm system over western New York combined with another system which reorganized off the southern New England coast and then moved east. These systems spread light snow across the area from the early morning hours into the afternoon of February 17th. Accumulations were generally 3 to 6 inches regionwide. There were a few isolated higher amounts with : Jay Peak 11.8 inches, and 7 inches locally reported in the towns of Springfield, East Albany and Brookfield. A number of automobile accidents were reported in both Chittenden and Washington counties.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Heavy Snow	2/27/2002	0	0	$1,000	$1,513	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	3/18/2002	0	0	$1,000	$1,513	$0	$0	An area of low pressure moved from the Great Lakes region across New England during the day of March 18th. Light snow fell across the area with accumulations generally 3 to 6 inches of wet snow. The greatest accumulations were in the higher terrain. Several automobile accidents were reported due to the slippery roads.	N/A
ORLEANS (ZONE)	Winter Storm	3/20/2002	0	0	$10,000	$15,126	$0	$0	A late season winter storm moved northeast from the Tennessee Valley early Wednesday, March 20th passing across southern New England Wednesday night. Snow spread across the area during the morning and became steadier and heavier during the afternoon and first part of the night, before tapering off to flurries. Accumulations of the heavy wet snow ranged from 6 to 12 inches, with greater than 7 inches generally falling by about 6 PM on the 20th. Numerous accidents were reported, especially in the counties of Rutland, Washington, Orange and Orleans. Portions of I-89 were closed for a short time in Washington county. A few specific accumulations included: In Caledonia county, Groton had 12 inches while East Burke had 7.7 inches. In Orleans county, East Albany had 9 inches as well as Eden in Lamoille county. In East Wallingford (Rutland county) and Worcester (Washington county) received 8 inches. In Orange county, Brookfield reported 10 inches. In Windsor county, Springfield had 12 inches while Ludlow had 8 inches.	N/A
ORLEANS (ZONE)	Winter Storm	3/26/2002	0	0	$10,000	$15,126	$0	$0	A late season storm system moved northeast from the Tennessee Valley on the morning of Tuesday, March 26th and passed across New England during the night of March 26th and early Wednesday morning, March 27th. Snow overspread the area during the afternoon of the 26th, becoming steadier and heavier during the late afternoon and early night hours. The snow mixed with or changed to sleet and freezing rain late at night. Travel conditions were hazardous with the wet snow. Numerous accidents were reported, especially in Washington county. In general, across Caledonia and Washington counties, between 6 and 12 inches of snow fell. In the counties of Essex, Orleans and Lamoille generally 6 to 8 inches fell with some ice accumulation. A few specific accumulations included: In Caledonia county, Groton received 12 inches while West Burke had 10 inches. Eden (Lamoille county) and East Albany (Orleans county) both received 6 inches of snow with ice. In Washington county, Waitsfield had 10 inches.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	4/28/2002	0	0	$0	$0	$0	$0	An area of low pressure moved across New York State during Sunday and across New England Sunday night. A mixture of rain and snow spread across the area Sunday and Sunday night. The precipitation was mostly a wet snow in the higher elevations. Accumulations were generally 1 to 4 inches with accumulations terrain dependent.	N/A
ORLEANS (ZONE)	Winter Weather	11/6/2002	0	0	$1,000	$1,513	$0	$0	An area of low pressure over the Ohio Valley weakened Tuesday evening (November 5th) as a new storm system organized along the Virginia coast. This new storm system moved northeast overnight, and passed across south coastal New England Wednesday morning (November 6th). Across north central and northeast Vermont, generally 3 to 6 inches of snow fell. In Orange county, there were locally higher amounts in the mountains with 8 inches reported in Brookfield. The wet snow took down a tree in Randolph, VT.	N/A
ORLEANS (ZONE)	Winter Storm	11/17/2002	0	0	$5,000	$7,563	$0	$0	A complex storm system which extended along the east coast of the US from Cape Cod south to Cape Hatteras spread a mixture of sleet, freezing rain and light snow across much of Vermont during Sunday, November 17th. Colder air moved in as the storm system reorganized and intensified near Cape Cod Sunday night (November 17th). Heavy snow fell Sunday night into Monday morning (November 17-18th) with accumulations generally between 6 and 10 inches. Numerous power outages were reported across the Vermont counties of Addison, Rutland and Washington. In Orange county there were a few power outages. The power outages were due to the weight of the heavy wet snow on tree limbs and power lines.	N/A
ORLEANS (ZONE)	Winter Storm	11/23/2002	0	0	$5,000	$7,563	$0	$0	Low pressure over western New York Friday afternoon (November 22nd) consolidated with a storm off the east coast Friday night. This system moved through Maine Saturday, November 23rd. Heavy snow fell across Lamoille and Orleans counties with accumulations generally between 5 and 9 inches.	N/A
ORLEANS (ZONE)	Winter Storm	1/4/2003	0	0	$20,000	$29,371	$0	$0	A storm system over Virginia Friday morning (1/3/03) moved to coastal New Jersey Friday evening and then to near Cape Cod Saturday morning (1/4/03). Snow spread across the area late Friday afternoon, and was heavy at times late Friday night into Saturday morning. Accumulations were generally between 8 and 14 inches. Island Pond (Essex county) received 9 inches, with 12 inches reported in both East Burke (Caledonia county) and East Albany (Orleans county). Roads were treacherous.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	2/4/2003	0	0	$1,000	$1,469	$0	$0	A storm system moved from Lake Huron early Tuesday morning, February 4th and across southern Canada during the day. Mixed precipitation fell across the north country but generally changed to rain during the morning. However in the northeast Vermont counties of Caledonia, Essex, Orleans, Lamoille and Washington, the mixed precipitation did not change to rain until the afternoon. Light icing was reported in northeast Vermont.	N/A
ORLEANS (ZONE)	Winter Weather	2/17/2003	0	0	$5,000	$7,343	$0	$0	An area of low pressure off the mid Atlantic coast early Monday afternoon (2/17/03), moved northeast and passed south of Cape Cod early Tuesday morning (2/18/03) before it moved out to sea. This resulted in a tight gradient of snowfall across central and northern Vermont. Light snow overspread central and northern Vermont during the night of February 17th and ended during the early morning of the 18th. Snow accumulations across central Vermont were generally 2 to 5 inches, with generally less than 2 inches across northern Vermont.	N/A
ORLEANS (ZONE)	Winter Weather	2/22/2003	0	0	$5,000	$7,343	$0	$0	An area of low pressure over the Tennessee Valley Saturday morning, February 22nd, moved northeast. The primary storm center of this complex low pressure system moved across central New York on Sunday, February 23rd and then into the Canadian Maritimes. Across this portion of Vermont, snow Saturday (Feb 22nd) afternoon and evening, mixed with and changed to freezing rain and or rain by Sunday, Feb 23rd. Snow accumulations were generally around 3 inches with some difficult travel reported.	N/A
ORLEANS (ZONE)	Winter Weather	3/5/2003	0	0	$1,000	$1,469	$0	$0	An area of weak low pressure along a cold front in the Ohio valley moved east across New York and Vermont late on the 5th of March. Light snow spread across the area in the early morning hours of the 5th and continued through the day before it gradually ended during the afternoon of the 5th. Accumulations were generally 3 to 6 inches, but locally higher in the mountains.	N/A
ORLEANS (ZONE)	Winter Storm	3/30/2003	0	0	$5,000	$7,343	$0	$0	An area of low pressure off the mid Atlantic coast Sunday morning, March 30th, moved northeast Sunday night, east of New England and into Nova Scotia on the morning of March 31st. Snow overspread the area by the afternoon of March 30th and became heavy at times during the night before it tapered off to flurries on the morning of March 31st. Snowfall was generally between 6 and 8 inches. A few reports included: 7 inches in Eden (Lamoille county) and 6.3 inches in Greensboro (Orleans county).	N/A
ORLEANS (ZONE)	Winter Weather	4/23/2003	0	0	$1,000	$1,469	$0	$0	A storm system moved north just to the east of New England during April 23rd and 24th. This system spread wet snow across portions of the area. Accumulations of snow were 3 to 6 inches, especially in the hilly terrain, with locally higher amounts in the mountains.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Storm	11/14/2003	0	0	$10,000	$14,685	$0	$0	A strong low pressure system moved into Canada Thursday morning, November 13th, with the associated cold front ushering in colder air during the afternoon and evening of November 13th. Rain changed to snow, and the snow became heavy during the night of the 13th and early morning of the 14th. Snow accumulations by the morning of the 14th were generally between 7 and 14 inches. It was a very wet early season snowfall, and accumulations were elevation dependent.	N/A
ORLEANS (ZONE)	Winter Storm	12/6/2003	0	0	$20,000	$29,371	$0	$0	A storm system organized off the North Carolina coast Friday, December 5th and moved northeast to coastal Delaware Saturday, December 6th. The storm then intensified as it moved to near Cape Cod Sunday morning, December 7th, then moved out to sea south of Nova Scotia Sunday night. Snow developed across the area by late morning on December 6th, and became steady and heavy during the afternoon and evening. Another burst of heavy snow occurred overnight of December 6th into Sunday, December 7th. Snow accumulations were generally: between 14 and 24 inches in Orleans county.	N/A
ORLEANS (ZONE)	Winter Storm	12/15/2003	0	0	$20,000	$29,371	$0	$0	A storm system organized along the coastal area of the Carolinas early Sunday, December 14th. This system intensified and moved northeast to Cape Cod by early Monday, December 15th. The storm then moved into the Canadian Maritimes by Tuesday, December 16th. Snow developed Sunday afternoon, December 14th, and became heavy Sunday night into Monday morning, December 15th. Across Orleans county, snowfall accumulations were generally 12 to 20 inches.	N/A
ORLEANS (ZONE)	Winter Storm	12/18/2003	0	0	$10,000	$14,685	$0	$0	A storm system moved north along the New England coast Wednesday night, December 17th and into eastern Canada early Thursday, December 18th. Rain and freezing rain during the day of December 17th, changed to snow in the evening and was heavy at times overnight before it tapered off to snow flurries early Thursday, December 18th. Snow accumulations in Essex, Lamoille, Orleans and Washington counties was generally 6 to 10 inches, except around 12 inches in Lamoille county.	N/A
ORLEANS (ZONE)	Winter Storm	12/26/2003	0	0	$5,000	$7,343	$0	$0	A storm system deepened as it moved through eastern Quebec on the 25th and 26th of December. Cold air moved into northern Vermont changing rain to snow in the afternoon of December 25th. The snow became heavy at times the night of the 25th and tapered off to flurries on the 26th. Accumulations ranged from 10 to 20 inches in Franklin county, 8 to 16 inches in Orleans county and in eastern Chittenden county, around 7 inches in Essex county, and between 7 and 9 inches in Lamoille and Caledonia counties.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Storm	2/4/2004	0	0	$10,000	$14,258	$0	$0	A low pressure system developed over the mid-Atlantic coastal area on Tuesday, February 3rd and moved northeast across southern New England the night of the 3rd and then into the Canadian Maritimes during Wednesday, February 4th. Snow developed across the area during the evening of February 3rd, and became heavy at times during the overnight period before tapering off to flurries during February 4th. Snow accumulations were generally around 6 inches with slippery traveling conditions.	N/A
ORLEANS (ZONE)	Winter Weather	2/6/2004	0	0	$5,000	$7,129	$0	$0	A complex storm system with centers over the Great Lakes region and the mid-Atlantic coast early Friday, February 6th, moved across New England Friday night (February 6). Snow developed during the morning of February 6th and mixed with sleet and freezing rain in the afternoon. Accumulations of snow were generally between 2 to 4 inches in these areas.	N/A
ORLEANS (ZONE)	Winter Weather	3/21/2004	0	0	$10,000	$14,258	$0	$0	A complex area of low pressure moved across New England and southern Canada during Sunday, March 21st with cold air moving into the region during the afternoon and evening. Snow and rain changed to snow with water freezing on the roads. Travel became treacherous, with numerous accidents.	N/A
ORLEANS (ZONE)	Winter Storm	4/5/2004	0	0	$5,000	$7,129	$0	$0	A spring storm system to the east of New England on April 4th and 5th, resulted in extensive moisture across the area. Precipitation was enhanced by an upslope northwest airflow. Wet snow accumulated to between 4 and 7 inches, with up to 10 inches in portions of Orleans county.	N/A
ORLEANS (ZONE)	Winter Weather	5/3/2004	0	0	$1,000	$1,426	$0	$0	An area of low pressure developed along a cold front in eastern New England. The low moved through Maine the evening of May 3rd and into eastern Canada early on May 4th. Light snow fell across northeast Vermont. The following snowfall amounts were noted: in Caledonia county, generally between 1 and 3 inches fell, in Essex and Orleans counties between 2 and 4 inches fell, while in Lamoille county generally 2 inches fell. Higher amounts were reported on the mountain tops.	N/A
ORLEANS (ZONE)	Winter Weather	11/5/2004	0	0	$0	$0	$0	$0	A strong low pressure system over northern Maine the morning of Friday, November 5th moved northeast across the mouth of the St Lawrence River in eastern Canada the evening of November 5th. Gusty northwest winds resulted in upslope snow along the western slopes of the Green Mountains and across north central and northeast Vermont. In Vermont, generally between 2 and 6 inches fell with a few locally higher amounts in the mountains. Specifically, a few reports included; the greatest amount of 8.7 inches in the elevated town of Sutton (Caledonia county), with 6.5 inches in East Albany (Orleans county), 4 inches in Eden (Lamoille county) and 2 inches in East Haven (Essex county).	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Storm	12/11/2004	0	0	$10,000	$14,258	$0	$0	A storm system over western Virginia Friday morning, December 10th moved northeast across northern New York Saturday morning, December 11th. A mixture of snow, sleet and rain developed across the area the evening of December 10th and changed to a steady wet snow overnight. By the morning of December 11th, accumulations were around 6 inches in the western portion of Orleans county with 3 to 5 inches elsewhere in the county.	N/A
ORLEANS (ZONE)	Winter Weather	1/2/2005	0	0	$10,000	$13,842	$0	$0	An area of low pressure over the northern Great Lakes region early Sunday, January 2, 2005 moved northeast into southern Canada. It reached the James Bay area of Canada the night of January 2nd. High pressure across southern and eastern Canada resulted in a low level flow of cold air. Freezing rain and sleet spread across the eastern half of Vermont by late afternoon, and continued into the first part of the night. Roads became very slippery with some accidents reported.	N/A
ORLEANS (ZONE)	Winter Weather	1/6/2005	0	0	$5,000	$6,921	$0	$0	An area of low pressure moved across western New York during the afternoon of Thursday, January 6, 2005. This system continued to move northeast down the St Lawrence Valley and into southern Canada the night of January 6th. Light snow overspread these counties by around noon and continued through the evening. Accumulations were generally 3 to 5 inches with one report of 6 inches at Jay Peak in Orleans county.	N/A
ORLEANS (ZONE)	Winter Weather	1/12/2005	0	0	$5,000	$6,921	$0	$0	Warm air associated with a warm front gradually over ran a shallow layer of cold surface air. This resulted in light snow during the late morning and early afternoon of January 12th changing to light freezing rain and sleet during the afternoon. The precipitation gradually ended late at night.	N/A
ORLEANS (ZONE)	Winter Storm	2/10/2005	0	0	$20,000	$27,685	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	3/1/2005	0	0	$10,000	$13,842	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	3/8/2005	0	0	$10,000	$13,842	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	3/12/2005	0	0	$10,000	$13,842	$0	$0	N/A	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	10/23/2005	0	0	$5,000	$6,921	$0	$0	A storm system near Delaware early on October 22nd, moved northeast across east coastal portions of New England on Sunday, October 23rd. Rain on the evening of the 22nd changed to snow during the overnight period and continued into Sunday morning, October 23rd. The greatest accumulations of snow occurred in the higher terrain. Power outages were reported. Specifically, in Caledonia county 5 inches was reported in Walden, in Orleans county 5 inches fell in East Albany while Jay had 4 inches. In Berlin (Washington county), 4 inches was reported. The town of Chelsea (Orange county) reported 3 inches while in Lamoille county the town of Morrisville reported 2.9 inches. Lesser amounts were reported elsewhere in Vermont.	N/A
ORLEANS (ZONE)	Winter Storm	10/25/2005	0	0	$100,000	$138,423	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	11/22/2005	0	0	$20,000	$27,685	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	11/24/2005	0	0	$30,000	$41,527	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	12/2/2005	0	0	$1,000	$1,384	$0	$0	A storm system over the Canadian Maritimes resulted in a moist cyclonic flow across the area. Periods of snow and snowshowers resulted, with accumulations generally between 3 and 6 inches. Localized heavier amounts were reported on west facing mountain slopes. Roads were slippery with a few automobile accidents.	N/A
ORLEANS (ZONE)	Winter Weather	12/9/2005	0	0	$5,000	$6,921	$0	$0	A storm system over the Canadian Maritimes resulted in a moist cyclonic flow across the area. Periods of snow and snowshowers resulted, with accumulations generally between 3 and 6 inches. Localized heavier amounts were reported on west facing mountain slopes. Roads were slippery with a few automobile accidents.	N/A
ORLEANS (ZONE)	Winter Storm	12/16/2005	0	0	$10,000	$13,842	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	12/20/2005	0	0	$5,000	$6,921	$0	$0	A cold front moved southeast from Canada and triggered snow showers across northern VT. Steadiest snow was along the western slopes of the Green Mountains, and west facing slopes of other hilly terrain. Snowfall in these areas was generally between 3 and 5 inches. The heaviest localized snowfall reported was 6.2 inches in Sutton (Caledonia county) and 5.5 inches in Richford (eastern Franklin county).	N/A
ORLEANS (ZONE)	Winter Weather	12/23/2005	0	0	$5,000	$6,921	$0	$0	A area of weak low pressure moved along an east-west frontal boundary along the New York and Canada border regions the night of December 23rd and the early morning of December 24th. Light snow mixed at times with sleet and freezing rain. Accumulations of snow and sleet across this area was generally 2 1/2 to 3 1/2 inches.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	12/29/2005	0	0	$5,000	$6,921	$0	$0	An area of low pressure in the Ohio Valley the evening of December 28th moved northeast across southern New England during the day of December 29. Light freezing rain spread across the area during the very early morning of December 29th, and finally changed to plain rain by mid morning of December 29th. Difficult travel resulted.	N/A
ORLEANS (ZONE)	Winter Weather	1/11/2006	0	0	$5,000	$6,720	$0	$0	An area of low pressure moving through the Great Lakes on the morning of January 11th allowed mild, moist air to override a shallow cold layer at the surface. This resulted in a period of light freezing rain during the morning commute across northeast Vermont. Roads were slippery and several accidents were reported. School buses with students on-board slid off the road in Woodbury and Barton, but no reported injurues with these incidents	N/A
ORLEANS (ZONE)	Winter Weather	1/15/2006	0	0	$5,000	$6,720	$0	$0	An arctic cold front moved across Vermont during the night of the 14th and early morning of the 15th. Record warm temperatures in the 40s and 50s on Saturday (14th), were replaced with temperatures in the single numbers and teens Sunday. Low pressure moved along this arctic front and across eastern New England with rain changing to snow across the region late Saturday night through Sunday morning. It was quite blustery with Northwest winds 20 to 30 mph and gusts to 40 mph causing blowing and drifting snow. Snowfall amounts of 2 to 4 inches were common across northern Vermont.	N/A
ORLEANS (ZONE)	Winter Weather	1/25/2006	0	0	$5,000	$6,720	$0	$0	An Alberta Clipper moved across northern Vermont during the early morning hours of the 25th depositing a dusting to locally up to 2 inches of snow. A significant upper level disturbance and cold, unstable air aloft redeveloped snow showers and localized snow squalls during the evening and continued until midday on the 26th across the northern Green Mountains,north central and northeast Vermont. Total snowfall was 2 to 4 inches across much of the area with localized amounts exceeding 6 inches along the immediate eastern slopes of the Green Mountains. Snowfall amounts included: Montpelier with 2 inches, Eden...Marshfield and Sutton with 3 inches, Jeffersonville and Newport with 4 inches, Waitsfield with 6 inches and Jay Peak with 9 inches.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	1/29/2006	0	0	$5,000	$6,720	$0	$0	A stationary front was draped across southern New England on the 29th and slowly moved to the Canadian border during the 30th. At the same time, low pressure across the Great Lakes primarily stayed stationary, delivering rounds of light mixed wintry precipitation on the 29th and 30th. On Sunday night (29th) slick roads caused numerous accidents across the region including Interstate 89 in Middlesex (Washington county). Snowfall amounts were generally 1 to 3 inches in the valley with 2 to 4 inches in the higher elevations with some light freezing rain early Monday morning (30th) before changing to rain. Some snowfall reports include: 1 inch at Waitsfield, Northfield and East Haven...2 inches at Eden, Worcester and St. Johnsbury...3 inches in Sutton and Chelsea and 4 inches in Brookfield.	N/A
ORLEANS (ZONE)	Winter Weather	2/6/2006	0	0	$5,000	$6,720	$0	$0	Low pressure moved into the eastern Great Lakes on the 5th and then moved northeast across Quebec province on the 6th. On the 6th, a cold polar vortex located across Quebec created a persistent west-southwest cold flow over the relatively mild lake waters of the eastern Great Lakes. A series of Lake effect snowbands developed off Lake Ontario during the evening of the 5th, reaching northern Vermont overnight and continued until the late evening of the 6th. Some of the heaviest snowbands moved across Grand Isle and Franklin counties around 3 pm on the 6th of February. An 18 vehicle accident occurred on Interstate 89 near Exit 21 (Highgate) due to the slippery roads. General snowfall was 1 to 3 inches in the valleys, but favored upslope regions witnessed 4 to 6 inches. Snowfall amounts included: 2 inches in South Burlington (Chittenden county), East Haven (Essex county), St. Albans (Franklin county), Waitsfield (Washington county), while 3 inches of snow fell in Newport (Orleans county), Waterbury Center (Washington county) and Island Pond (Essex county). Snowfall of 4 inches was reported in Jericho (Chittenden county), Morrisville (Lamoille county), and Greensboro (Orleans county), while 5 inches accumulated in Westford (Chittenden county), Sutton (Caledonia county), and 6 inches was reported in North Underhill (Chittenden county), Jeffersonville and Eden (Lamoille county) and a localized 12 inches at Jay Peak.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	2/24/2006	0	0	$5,000	$6,720	$0	$0	An upper level disturbance and cold front raced east across the region just after midnight on the 24th delivering light widespread snow accumulations. Meanwhile, just before daybreak on the 24th, a climatologically favored upslope event developed across the western slopes of the northern Green Mountains of Vermont and continued into late afternoon. Snowfall across the counties encompassing the northern Green Mountains was 2 to 5 inches, with some very localized higher amounts. Some specific snowfall totals included: 2 inches in Worcester, 3 inches in Morrisville and Newport, 4 inches in East Albany, 5 inches in Cambridge, 6 inches in the towns of Jericho, Waitsfield and Eden, with a localized 10 inches at Jay Peak. There were numerous traffic accidents across the region, especially in Chittenden and Washington counties, including the localities of Jericho, Huntington, Fayston, Warren and Middlesex with several portions of Interstate 89 shut down at various times.	N/A
ORLEANS (ZONE)	Winter Weather	2/25/2006	0	0	$5,000	$6,720	$0	$0	An unusually strong Alberta clipper moved across southern Vermont during the afternoon of the 25th. Snow started across northern Vermont by midday and continued into the evening, then tapered off before midnight. Snowfall was much more limited, the further away from the storm track. Snowfall amounts ranged from an inch to 4 inches across portions of northern Vermont. Some specific snowfall totals included: 1 inch in Underhill (Chittenden county), Island Pond (Essex county) and Newport (Orleans county)...2 inches in Greensboro (Orleans county) and Sutton (Caledonia county)...3 inches in South Burlington (Chittenden county), Morrisville (Lamoille county) and East Albany (Orleans county) with 4 inches in Enosburg Falls (Franklin county). A number of traffic accidents were reported due to slippery roads.	N/A
ORLEANS (ZONE)	Winter Storm	3/4/2006	0	0	$5,000		$0	$0	N/A	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	3/14/2006	0	0	$5,000	$6,720	$0	$0	A strong blocking pattern in the upper levels across Greenland maintained a strong upper level low across Newfoundland with several disturbances rotating into Quebec and northern New England. This feature combined with a persistent northwest upslope flow caused widespread snow showers to develop Tuesday afternoon (14th) and continue through midday Thursday (16th). The most persistent and heaviest snow showers occurred across the western slopes of the northern Green Mountains occurred from the afternoon of the 15th to midday on the 16th. Snowfall accumulations were generally 2 inches or less in the valleys with localized amounts exceeding 6 inches in favored upslope regions. Snowfall accumulations include: 3 inches in East Montpelier, East Haven, Hanksville, East Burke and Morrisville, 4 inches in Eden and Enosburg Falls, 5 inches in North Underhill, Highgate, Waitsfield and Jeffersonville, while 8 inches fell in Jericho and Montgomery Center and 10 inches at Jay Peak.	N/A
ORLEANS (ZONE)	Winter Storm	4/4/2006	0	0	$5,000	$6,720	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	12/7/2006	0	0	$5,000	$6,720	$0	$0	An arctic cold front and strong mid-level disturbance moved across northern Vermont on the afternoon of the 7th. Rain showers quickly changed to snow showers and snow squalls during the afternoon and remained persistent through the early morning hours of the 8th across northern Vermont, especially the western slopes of the Green Mountains. Snowfall accumulations across the region were generally 2 to 4 inches in the northern valleys, with 3 to 6 inches along the western slopes of the Green Mountains and hilly terrain in north-central and northeast Vermont. Some specific snowfall totals included: 2 inches in St. Johnsbury (Caledonia), Milton (Chittenden), Morrisville (Lamoille), Topsham (Orange), Rutland and Danby (Rutland), Waterbury, Montpelier and Plainfield (Washington) and Woodstock (Windsor)...3 inches in Worcester and Waitsfield (Washington), East Albany and Newport (Orleans), St. Albans (Franklin), Essex Junction (Chittenden) and Cornwall (Addison)...4 inches in South Lincoln (Addison), South Burlington (Chittenden), Enosburg Falls (Franklin) with 5 inches in Waterford (Caledonia), Westford (Chittenden), Island Pond (Essex), Jeffersonville (Lamoille)...6 inches in Stannard (Caledonia), Underhill, Jericho (Chittenden), Greensboro (Orleans) and 9 inches at Jay Peak Ski resort (Orleans). The sharply falling temperatures and accumulating snow led to numerous vehicle accidents throughout the state from the afternoon of the 7th through the morning commute on the 8th.	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	1/1/2007	0	0	$3,000	$3,914	$0	$0	A weak area of low pressure moved across Ontario and Quebec provinces in Canada during the morning and afternoon of the 1st. Mild, moist air traveled over a seasonably cool airmass across Vermont and this resulted in a period of freezing rain from shortly after Midnight to mid-morning on the 1st. Freezing rain accumulated to between 1/4 to 3/8 of an inch across Vermont, resulting in slick roads and several vehicle accidents.	N/A
ORLEANS (ZONE)	Winter Storm	1/15/2007	0	0	$5,000	$6,524	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	1/19/2007	0	0	$2,000	$2,610	$0	$0	A powerful and large storm in New Brunswick and the Canadian Maritimes on the 19th and 20th, delivered a cold and unstable air flow into the northern Green Mountains of Vermont. This unstable northwest flow accounted for upslope snow conditions to develop on the west-northwest slopes of the Green Mountains and travel downwind into eastern Vermont during the evening of the 19th and into the morning hours of the 20th. Snowfall amounts of 4 to 6 inches were common. Some specific amounts include 4 inches at South Lincoln (Addison), Brookfield and Chelsea (Orange)...5 inches in Bethel (Windsor), Canaan and Island Pond (Essex), Jay, Greensboro and Newport (Orleans) with 6 inches in Rochester (Windsor).	N/A
ORLEANS (ZONE)	Winter Weather	2/2/2007	0	0	$3,000	$3,914	$0	$0	A significant surface low traveled along an arctic cold front that moved across northern Vermont during the late night of the 2nd and into the early morning hours of the 3rd. This clipper system delivered snow to Vermont by late afternoon/evening on the 2nd and continued at night, before it tapered off to snow showers early morning of the 3rd. Snowfall accumulations ranged from 2 to 6 inches, with the lighter amounts within the Champlain Valley and the heaviest amounts in the hilly terrain of North Central and Northeast Vermont. Some specific snowfall totals included; 6 inches in Sutton (Caledonia), Island Pond (Essex) and Eden (Lamoille), 5 inches in Walden (Caledonia), Canaan (Essex), Corinth (Orange), Newport (Orleans) and Springfield (Windsor), 4 inches in Jerusalem and South Lincoln (Addison), North Underhill (Chittenden), Highgate (Franklin), Rutland (Rutland), Waitsfield and Northfield (Washington) and Chester (Windsor).	N/A
ORLEANS (ZONE)	Heavy Snow	2/14/2007	0	0	$200,000	$260,955	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	3/2/2007	0	0	$5,000	$6,524	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	3/5/2007	0	0	$3,000	$3,914	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	3/16/2007	0	0	$5,000	$6,524	$0	$0	N/A	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Storm	4/4/2007	0	0	$10,000	$13,048	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	4/12/2007	0	0	$10,000	$13,048	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	4/15/2007	0	0	$15,000	$19,572	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	11/16/2007	0	0	$5,000	$6,524	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	12/2/2007	0	0	$10,000	$13,048	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	12/11/2007	0	0	$5,000	$6,524	$0	$0	An upper level disturbance helped initiate the development of a weak surface low along a frontal boundary, all of which moved across Vermont during the night of December 11th and into the morning hours of the 12th. A wintry mix of snow, sleet and freezing rain overspread Vermont during the evening hours of the 11th but changed to accumulating snow during the early morning hours of the 12th before ending by mid-morning. Combined snow and sleet accumulations across Vermont were 2 to 5 inches. Some specific accumulations included; 5 inches in North Underhill (Chittenden county), 4 inches in Wheelock (Caledonia county), St. Albans (Franklin county), Morrisville (Lamoille county) and East Albany (Orleans county) with 3 inches in Marshfield (Washington county), West Topsham (Orange county) and South Lincoln (Addison county).	N/A
ORLEANS (ZONE)	Winter Weather	12/13/2007	0	0	$3,000	$3,914	$0	$0	An upper level disturbance moved across northern New York and southeast Canada, while a weak surface low moved across southeast Canada during the evening of December 13th. Meanwhile, a surface low tracked from the southeast United States to just south of southern New England on the night of the 13th. Snow overspread Vermont during the early to mid afternoon of the 13th and ended prior to midnight. Snow accumulations across Vermont were 3 to 6 inches. Some specific snowfall accumulations included; 5 inches in Eden (Lamoille county), Newport (Orleans county), Brookfield (Orange county) and Springfield (Windsor county) with 4 inches in New Haven (Addison county), St. Johnsbury (Caledonia county), North Underhill (Chittenden county), Morrisville (Lamoille county), Rutland (Rutland county), Northfield (Washington county) and Woodstock (Windsor county).	N/A
ORLEANS (ZONE)	Winter Storm	12/16/2007	0	0	$15,000	$19,572	$0	$0	N/A	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	12/19/2007	0	0	$2,000	$2,610	$0	$0	An upper level disturbance and weak area of low pressure moved east from the Great Lakes and then across Vermont during the night of December 19th into the morning hours of the 20th. Light snow overspread Vermont by late afternoon on the 19th and exited the region by early afternoon on the 20th. Snowfall accumulations from this system was generally 2 to 4 inches across Vermont.	N/A
ORLEANS (ZONE)	Winter Weather	12/29/2007	0	0	$2,000	$2,610	$0	$0	An upper level disturbance coupled with surface low pressure across Ontario on December 28th moved across Quebec during the early morning hours of the 29th. Snow overspread Vermont just after midnight on the 29th and continued through daybreak. Accumulating snow mainly fell across north central and northeast Vermont, including the western slopes of the northern Green Mountains, where 2 to 5 inches of snow fell. Some specific snowfall totals included; 5 inches in Canaan (Essex county), 4 inches in Island Pond (Essex county) and Newport (Orleans county) with 3 inches in Sutton and Wheelock (Caledonia county), Hanksville (eastern Chittenden county), Eden (Lamoille county) and Worcester (Washington county).	N/A
ORLEANS (ZONE)	Winter Weather	12/31/2007	0	0	$5,000	$6,524	$0	$0	An upper level disturbance moved across northern New York and Quebec during the early morning hours of December 31st. At the same time, a surface low moved north along the mid-Atlantic coast to southeast of Cape Cod by daybreak on the 31st. Snow overspread Vermont around Midnight on the 31st and ended around daybreak on the 31st, with snowfall amounts 3 to 6 inches across the region. Some specific snowfall totals included; 7 inches in South Burlington (Chittenden county) 6 inches in Jericho (eastern Chittenden county), Corinth (Orange county)...5 inches in Bridport (Addison county), Essex (Chittenden county), Chelsea (Orange county), Moretown (Washington county) and 4 inches in Berkshire (Franklin county), Eden (Lamoille county), Sutton (Caledonia county) and Island Pond (Essex county).	N/A
ORLEANS (ZONE)	Winter Storm	1/1/2008	0	0	$5,000	$6,334	$0	$0	N/A	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	1/11/2008	0	0	$25,000	$31,669	$0	$0	An upper level disturbance moved across northern New York and Quebec during the early morning hours of December 31st. At the same time, a surface low moved north along the mid-Atlantic coast to southeast of Cape Cod by daybreak on the 31st. Snow overspread Vermont around Midnight on the 31st and ended around daybreak on the 31st, with snowfall amounts 3 to 6 inches across the region. Some specific snowfall totals included; 7 inches in South Burlington (Chittenden county) 6 inches in Jericho (eastern Chittenden county), Corinth (Orange county)...5 inches in Bridport (Addison county), Essex (Chittenden county), Chelsea (Orange county), Moretown (Washington county) and 4 inches in Berkshire (Franklin county), Eden (Lamoille county), Sutton (Caledonia county) and Island Pond (Essex county).	N/A
ORLEANS (ZONE)	Winter Weather	1/14/2008	0	0	$5,000	$6,334	$0	$0	An upper atmospheric disturbance moved across northern New York, while a developing surface low moved well southeast of southern New England and Cape Cod during the morning hours of January 14th. Snow overspread Vermont during the early morning hours of the 14th and continued until the early afternoon. Snowfall amounts ranged from 2 inches along the Canadian border to 4 to 6 inches in the Connecticut River Valley.	N/A
ORLEANS (ZONE)	Winter Storm	2/1/2008	0	0	$10,000	$12,668	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	2/6/2008	0	0	$10,000	$12,668	$0	$0	N/A	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	2/9/2008	0	0	$5,000	$6,334	$0	$0	A storm system moved across New England on the night of February 9th which delivered 2 to 5 inches of snow to portions of Vermont, especially central and eastern Vermont. In addition, a favorable southwest flow of arctic air across Lake Ontario ahead and along an approaching cold front accounted for numerous snow showers and heavy snow squalls, mainly across the northern Vermont mountains during the afternoon of the 10th. The combination of these two events delivered 4 to 7 inches of snow across much of Vermont, except for the northern Champlain Valley. A few specific snowfall totals include: 7 inches in Underhill (eastern Chittenden county), Jeffersonville (Lamoille county) and Worcester (Washington county) with 6 inches in Bethel and Rochester (Windsor county), Rutland (Rutland county), East Albany (Orleans county), Chelsea (Orange county) and Sutton (Caledonia county) and 5 inches in Island Pond (Essex county), Northfield (Washington county) and North Springfield (Windsor county). Numerous vehicle accidents occurred during the 9th across Vermont and blowing snow extended these hazardous road conditions into the morning hours of the 10th, which contributed to a fatal accident in Concord (Essex county).	N/A
ORLEANS (ZONE)	Winter Storm	2/12/2008	0	0	$10,000	$12,668	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	2/26/2008	0	0	$10,000	$12,668	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	3/1/2008	0	0	$5,000	$6,334	$0	$0	A fast moving storm system raced across the eastern Great Lakes on February 29th and New England on March 1st. Snow overspread Vermont just after midnight on March 1st and continued until midday. Snowfall accumulations of 3 to 7 inches were observed throughout much of western Vermont.	N/A
ORLEANS (ZONE)	Winter Weather	3/4/2008	0	0	$5,000	$6,334	$0	$0	A powerful winter storm moved from the lower Mississippi River Valley on the morning of March 4th, into the Ohio River Valley during the night and then across New England on the 5th. Snow and sleet overspread Vermont during the night of March 4th and accumulated a few inches inches prior to changing to freezing rain during the early morning hours of the 5th. Freezing rain accumulated around 1/4 of an inch across portions of Vermont, prior to it ended around noon. In addition, strong winds which gusted to near 50 mph combined with accumulated ice on trees that resulted in scattered downed tree branches and limbs. School cancellations, scattered power outages and numerous vehicle accidents resulted from the very hazardous conditions.	N/A

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ORLEANS (ZONE)	Winter Storm	3/20/2008	0	0	$10,000	$12,668	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	10/28/2008	0	0	$10,000	$12,668	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	12/11/2008	0	0	$10,000	$12,668	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	12/17/2008	0	0	$5,000	$6,334	$0	$0	A weak surface low developed across the Great Lakes on December 16th and moved into northern New York by the morning of December 17th. A secondary low formed south of New England during the early morning hours of December 17th and moved east of New England by the evening. Snow overspread Vermont after midnight on the 17th and accumulated 3 to 6 inches before tapering to snow showers and ending by early afternoon.	N/A
ORLEANS (ZONE)	Winter Weather	12/19/2008	0	0	$5,000	$6,334	$0	$0	On the morning of December 19th, low pressure was located across the mid-Mississippi River Valley. This low moved across the Ohio River Valley during the afternoon of the 19th and then offshore south of New England during the evening. Snow overspread Vermont by early afternoon on December 19th and ended just after midnight on the 20th. Snowfall accumulations of 3 to 6 inches were common across the Vermont counties along the Canadian border.	N/A
ORLEANS (ZONE)	Winter Storm	12/21/2008	0	0	$10,000	$12,668	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	1/7/2009	0	0	$10,000	$12,299	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	1/28/2009	0	0	$5,000	$6,149	$0	$0	N/A	N/A

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Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	2/19/2009	0	0	$0	$0	$0	$0	An elongated surface low across New England on February 19th exited the region into the Canadian Maritimes on February 20th and 21st. In addition, a strong, closed upper level low moved across New England on February 20th into the Canadian Maritimes on February 21st. This resulted in a prolonged favorable westerly flow of cool, moist and unstable air across the higher terrain of Vermont. Persistent snow showers developed across higher elevations of west-northwest facing slopes of Vermont during the afternoon of February 20th and continued til the early morning hours of February 21st. Localized upslope enhancement resulted in very localized significant snowfall amounts (more than 12 inches) observed at various ski resorts. Some of these higher amounts included; 31 inches in Bolton (Chittenden county), 30 inches in Warren (Washington county), 25 inches in Fayston (Washington county), 20 inches in Jay Peak (Orleans county), 17 inches in Stowe (Lamoille county) and 16 inches in Killington (Rutland county), 9 inches in Ludlow and West Windsor (Windsor county) and 8 inches in Burke (Caledonia county). Meanwhile in the valleys, 3 to 8 inches of snowfall was observed during this two-day period.	N/A
ORLEANS (ZONE)	Winter Storm	2/22/2009	0	0	$10,000	$12,299	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	3/2/2009	0	0	$2,000	$2,460	$0	$0	A vigorous closed low located over the Southeast United States on March 1st moved north and offshore of the eastern seaboard and New England on March 2nd. The heaviest snowfall remained along coastal New England on March 2nd. However a deep trough, wraparound moisture and favorable upslope produced 3 to 7 inches of snow across portions of northern Vermont on March 2nd into the early morning hours of March 3rd.	N/A

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ORLEANS (ZONE)	Winter Weather	11/27/2009	0	0	$3,000	$3,690	$0	$0	A strong area of low pressure moved from Cape Cod into the Gulf of Maine on November 27th and 28th. Meanwhile, a cold upper atmospheric low moved across New England which delivered cold air aloft to the region. The combination accounted for a substantial elevated terrain snow event across Vermont as well as strong gusty winds with the arrival of colder air. Snowfall across elevations mainly above 1000-1500 feet along and east of the spine of the Green Mountains in Vermont on the night of the 27th into the morning of the 28th ranged from 3 to 7 inches with localized higher amounts in elevations above 2000 feet. Some specific snowfall totals include; 8 inches in Jay (Orleans county) and Walden (Caledonia county), 6 inches in Canaan (Essex county) and Barton (Orleans county), 4 inches in Mendon (Rutland county), Weston (Windsor county), Danville and Sutton (Caledonia county). In addition, brisk to strong wind gusts in excess of 40 mph ushered in colder air during the early morning hours of the 28th and caused scattered power outages that affected nearly 8000 people. Some observed wind gusts included; 52 mph in Stowe (Lamoille county), 48 mph in Waltham (Addison county) and South Burlington (Chittenden county), 45 mph in Mount Holly (Rutland county) and Springfield (Windsor county).	N/A
ORLEANS (ZONE)	Winter Storm	12/9/2009	0	0	$5,000	$6,149	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	12/10/2009	0	0	$1,000	$1,230	$0	$0	A favorable cold, unstable air flow over the relatively mild waters of Lake Ontario developed a nearly stationary fetch of lake effect snow bands from Lake Ontario into portions of northern New York, which extrapolated into portions of Vermont, especially the higher elevations during the afternoon of December 10th into the morning of December 11th. Snowfall amounts across northern Vermont ranged from 2 to 7 inches with some specific amounts included; 8 inches in Groton (Caledonia), 7 inches in Waitsfield and Groton (Washington county), 6 inches in Hanksville (Chittenden) and Plainfield (Washington county), 4 inches in Jay Peak (Orleans county), Montgomery (Franklin county), South Lincoln (Addison county), Berlin (Washington county) and St. Johnsbury (Caledonia county).	N/A

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Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	12/28/2009	0	0	$5,000	$6,149	$0	$0	An upper atmospheric area of low pressure and weak surface low moved across Vermont on the morning of December 28th. Periods of light snow occurred from daybreak through the late afternoon hours on December 28th which resulted in 2 to 4 inches of snow accumulation with localized higher amounts. An arctic cold front and upper atmospheric disturbance moved across Vermont during the morning commute of December 29th with snow showers and localized snow squalls. Widespread snowfall accumulations of 1 to 3 inches occurred with localized amounts up to 4 inches. Two-day storm totals were 4 to 12 inches across much of Vermont. Some specific higher snowfall totals included; 12 inches in Killington (Rutland county), 11 inches in Westfield (Orleans county) and North Underhill (Chittenden county), 10 inches in Lincoln (Addison county), 9 inches in Jay (Orleans county) and Richmond (Chittenden county), 7 inches in Sutton (Caledonia county), South Burlington (Chittenden county), Eden (Lamoille county), Rutland (Rutland county), Northfield (Washington county) and Sheldon Springs (Franklin county) with 6 inches in Stowe (Lamoille county), Newport (Orleans county), Waterbury (Washington county) and Bethel (Windsor county). Rapidly falling temperatures to the single digits above zero degrees along with falling and blowing snow during the morning commute of December 29th accounted for roads to flash freeze that resulted in numerous vehicle accidents, especially along Interstate 89 between Montpelier and St. Albans.	N/A
ORLEANS (ZONE)	Winter Storm	1/2/2010	0	0	$15,000	$17,911	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	2/23/2010	0	0	$10,000	$11,941	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	4/27/2010	0	0	$10,000	$11,941	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	12/6/2010	0	0	$10,000	$11,941	$0	$0	N/A	N/A

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Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	12/13/2010	0	0	$10,000	$11,941	$0	$0	A deep and strong low pressure system traveled across the central United States into the lower Great Lakes on December 12th. Meanwhile, low pressure developed along the frontal boundary of the Great Lakes storm in the mid-Atlantic states and strengthened as it moved north across New York and western New England late on the 12th and 13th. Rain that had fallen on December 12th changed to snow during the afternoon on the 13th as the cold front swept across Vermont accounting for rapidly falling temperatures and a quick freeze. Numerous vehicle accidents occurred due to wet roads that quickly became snow covered and icy. Snowfall accumulations across Vermont were generally 3 to 7 inches with localized higher amounts in the mountains. Some specific snowfall amounts include; 8 inches in Cornwall (Addison county), Jericho (Chittenden county) Pittsford (Rutland county), 7 inches in Westford (Chittenden county), Morses Mills (Lamoille county), 6 inches in Georgia Center (Franklin county), 5 inches in Eden (Lamoille county) and Cabot (Washington county).	Two to four inches of snow fell in Orleans county.
ORLEANS (ZONE)	Winter Storm	12/26/2010	0	0	$10,000	$11,941	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	1/9/2011	0	0	$3,000	$3,478	$0	$0	A large, powerful storm system offshore of Nova Scotia and New Brunswick delivered abundant moisture from the Atlantic, New Brunswick and eastern Quebec southwest across the St. Lawrence River Valley back across portions of Vermont and the northern Adirondacks of New York on January 9th. Widespread 3 to 6 inches of snow fell across much of western Vermont, away from Lake Champlain, and along the spine of the Green Mountains with some 8 to 15+ inches in the foothills of eastern Chittenden county.	Snowfall amounts ranged from 3 to 7 inches in Orleans county, including 7 inches in Westfield and Morgan, 4 inches in Craftsbury and 3 inches in Stannard.
ORLEANS (ZONE)	Winter Storm	1/12/2011	0	0	$5,000	$5,796	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	2/2/2011	0	0	$10,000	$11,593	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	2/5/2011	0	0	$10,000	$11,593	$0	$0	N/A	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	2/7/2011	0	0	$5,000	$5,796	$0	$0	A weak surface low across the Great Lakes moved across New York and New England on the night of February 7th and morning of February 8th. At the same time, a coastal low that originated in the lower Mississippi, moved well southeast of Cape Cod. Snow overspread the region during the late evening of February 7th and tapered off during the midday hours of February 8th. Snowfall amounts across Vermont were generally 4 to 7 inches with locally 8 inches along some communities immediately along the western slopes of the Green Mountains like Lincoln, Underhill and Jericho.	N/A
ORLEANS (ZONE)	Winter Storm	2/25/2011	0	0	$10,000	$11,593	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	3/6/2011	0	0	$15,000	$17,389	$10,000	$11,593	N/A	N/A
ORLEANS (ZONE)	Winter Storm	4/1/2011	0	0	$10,000	$11,593	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	11/23/2011	0	0	$5,000	$5,796	$0	$0	A storm system in the Mid-Mississippi Valley on November 22nd tracked just south of the New England shoreline on November 23rd. Snow began across Vermont before midnight on the 23rd and reached its maximum intensity prior and during the morning commute, then dissipated by midday. Snow mixed with freezing rain and rain at times, accounting for a heavy, wet accumulation. Snowfall accumulations in Vermont ranged from several inches in the Champlain Valley to 6 to 12 inches across central and eastern Vermont. This snowfall accounted for numerous vehicle accidents during the morning commute as well as isolated to scattered power outages due to wet, heavy snow bending or breaking tree limbs onto power lines.	A heavy wet snowfall of 3 to 6 inches fell across the region.
ORLEANS (ZONE)	Winter Storm	2/24/2012	0	0	$10,000	$11,255	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	2/29/2012	0	0	$0	$0	$0	$0	A powerful winter storm that brought blizzard conditions to portions of Wisconsin and Minnesota and severe weather to portions of the Tennessee River Valley on February 29th weakened as it moved across the Northeast on March 1st. There were two rounds of snowfall that moved across the North Country, the first during the evening and overnight of February 29th and the second during the daylight hours of March 1st. The first round delivered widespread 1-3 inches across much of Vermont with 6 to 10 inches along the east slopes of the central and southern Green Mountains. The second round delivered another 1-3 inches with some areas that witnessed 3 to 5 inches additional accumulation.	Snow began during the evening hours of February 29th and continued through March 1st. Snowfall accumulations are included in March storm data.

NCDC Severe Winter Storm Events for all Orleans County

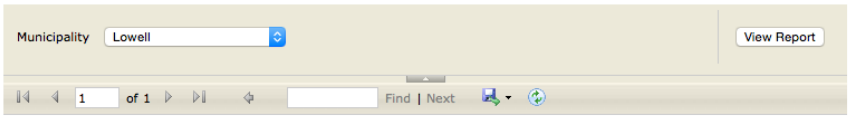
Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Weather	3/1/2012	0	0	$2,000	$2,251	$0	$0	A powerful winter storm that brought blizzard conditions to portions of Wisconsin and Minnesota and severe weather to portions of the Tennessee River Valley on February 29th weakened as it moved across the Northeast on March 1st. There were two rounds of snowfall that moved across the North Country, the first during the evening and overnight of February 29th and the second during the daylight hours of March 1st. The first round delivered widespread 1-3 inches across much of Vermont with 6 to 10 inches along the east slopes of the central and southern Green Mountains. The second round delivered another 1-3 inches with some areas that witnessed 3 to 5 inches additional accumulation.	Total snowfall ranged from 3 to 6 inches across the region.
ORLEANS (ZONE)	Winter Storm	12/26/2012	0	0	$15,000	$16,883	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	2/8/2013	0	0	$7,500	$8,195	$0	$0	This snowfall event was a two-part system across Vermont. The first part was largely confined to the northern half of Vermont and occurred during the morning and afternoon hours of February 8th. This event was caused by a relatively strong, but slowly dissipating storm from the Great Lakes into northern New York. Snowfall totals from this event were 4 to 10 inches across the northern half of Vermont with very little across southern Vermont. The second event was a large, powerful Nor'easter that moved south of Long Island and Cape Cod during the night of February 8th. Snow from this system reached southern Vermont during the evening and continued until mid-morning of February 9th. Snowfall from this event ranged from 4 to 16 inches with the greatest across the higher terrain of southeast Vermont.	Four to eight inches of snow fell across Orleans county.
ORLEANS (ZONE)	Winter Storm	2/20/2013	0	0	$7,500	$8,195	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	3/19/2013	0	0	$10,000	$10,927	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	12/14/2013	0	0	$10,000	$10,927	$0	$0	N/A	N/A
ORLEANS (ZONE)	Ice Storm	12/21/2013	0	0	$750,000	$819,545	$0	$0	N/A	N/A
ORLEANS (ZONE)	Heavy Snow	2/5/2014	0	0	$10,000	$10,609	$0	$0	N/A	N/A
ORLEANS (ZONE)	Heavy Snow	2/13/2014	0	0	$15,000	$15,914	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	3/12/2014	0	0	$25,000	$26,523	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	11/26/2014	0	0	$15,000	$15,914	$0	$0	N/A	N/A

NCDC Severe Winter Storm Events for all Orleans County

Impacted Jurisdiction	Hazard Type	Date	Deaths	Injuries	Property Damage (actual $)	Property Damage ($2016)	Crop Damage (actual $)	Crop Damage (2016)	Episode Narrative	Event Narrative
ORLEANS (ZONE)	Winter Storm	12/9/2014	0	0	$150,000	$159,135	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	1/3/2015	0	0	$10,000	$10,300	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	1/18/2015	0	0	$15,000	$15,450	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Weather	1/27/2015	0	0	$5,000	$5,150	$0	$0	A powerful nor'easter brought blizzard conditions to much of southern and eastern New England on January 26-27th. However in Vermont, snowfall was moderate across the region with snowfall totals ranging from a few inches in much of western and northern Vermont to 6 to 10 inches in southeast Vermont.	Snowfall across Orleans county was 3 to 7 inches.
ORLEANS (ZONE)	Winter Weather	1/30/2015	0	0	$10,000	$10,300	$0	$0	A vigorous clipper with decent snowfall followed by an deep arctic air mass moved across Vermont during the early morning hours of January 30th and ended by early afternoon. Snowfall amounts across Vermont were generally 2 to 6 inches with some isolated higher amounts in northern Vermont.	Snowfall reports for Orleans county were generally 2 to 4 inches.
ORLEANS (ZONE)	Winter Storm	2/2/2015	0	0	$15,000	$15,450	$0	$0	N/A	N/A
ORLEANS (ZONE)	Winter Storm	12/29/2015	0	0	$15,000	$15,450	$0	$0	N/A	N/A
Total			**0**	**0**	**$3,196,000**	**$4,276,957**	**$10,000**	**$11,593**		

APPENDIX C: STATE REPORTS

EXPANDED COMMUNITY REPORT



Expanded Community Report for Lowell

12/22/2015
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Emergency Relief and Assistance Fund (ERAF) - State Post-Disaster Funding

Flood Hazard Mitigation Actions	Action Dates		Responsible	ERAF Status
1. 2013 Road and Bridge Standards	04/09/2013		Lowell	Yes
2. Local Emergency Operations Plan	04/14/2015		Lowell	Yes
3. National Flood Insurance Program	12/04/1985		Lowell	Yes
4. Local Hazard Mitigation Plan	Expired		Lowell	No
5. River Corridor Protection				No
ERAF Rate for Actions 1 - 4:12.5%,	Actions 1 - 5: 17.5%	**ERAF Rate for:**	**Lowell**	**7.5%**

?	Buildings in the Special Flood Hazard Area (SFHA) (estimated from e911 sites).
3	Flood Insurance Policies in SFHA (Zone A, AE, AO, A 1- 30)
?	Percent of buildings in the SFHA with flood insurance in force.
?	Critical or public structures in SFHA or 0.2% flood hazard area (est. from e911 sites.)
?	Percent of buildings in the SFHA.
12/04/1985	National Flood Insurance Program (NFIP) (Enrollment Date)
FIRM	Flood Insurance Rate Map Standard (Digital FIRM (DFIRM), Rough Digital, Paper)
Lowell	NFIP Status: Regular Program
	Community Rating System (CRS)
Yes	Local Emergency Operations Plan (LEOP) ERAF Status valid for Lowell?
04/14/2015	LEOP - annual update after Town Meeting and before May 1.
No	Local Hazard Mitigation Plan (LHMP) ERAF Status valid for Lowell?
10/21/2005	LHMP - Valid for 5 years from FEMA final approval date
	LHMP - Status of review (Plans currently in review are valid for ERAF).
No	River Corridor Protection in Lowell?
	River Corridor Interim Protection Status for ERAF valid for Lowell?
04/14/2009	Municipal Plan - Valid for 5 years from adoption date
03/04/2003	Zoning Adoption / Amendment Date
	Hazard Area Regulation Adoption / Amendment Date
Yes	2013 Road and Bridge Standards
50.790	Town Highway Mileage in Lowell
04/09/2013	Lowell_Road and Bridge Standards and Adoption Date
3/31/2015	Lowell_Certificate of Compliance with Road and Bridge Standards and Date
3/31/2015 12:00:00 AM	Town Highway Network Inventory Date
90%	Town Highway Structures Grant Rate (State match 80% or 90%)
80%	Class 2 Roadways Grant Rate (State match 70% or 80%)
District 9	Project Manager email for VTrans Maintenance District 9

Note: if you have updated information - please let us know:

1. Road Standards and Certificates - contact your VTrans District Project Manager: District 9
2. Local Emergency Operations Plans or Local Hazard Mitigation Plans contact your Regional Planner
3. For other questions please contact VT DEC **Flood Ready Atlas**- River Corridor and Flood Hazard Maps

FLOOD READY VERMONT

FLOOD HAZARD SUMMARY REPORT

Flood Hazard Summary Report

12/22/2015 Summary of Flood Hazard Mitigation Actions for:

County = Orleans
Region = Northeastern Vermont Development Association
Community = Lowell
Show All = N

Community	ERAF Rate	(1) NFIP	(2) Rd Stds	(3) LEOP	(4) LHMP	(5) RC	(a) # In SFHA	(b) % Insured	(c) # critical or public	(d) % of all
Lowell	7.5%	Yes	Yes	Yes	No	No	?	?	?	?

(1) National Flood Insurance Program access
(2) Municipal Road Standards Meet or Exceed 2013 Standards
(3) Local Emergency Operations Plan Valid (updated annually after Town Meeting and before May 1)
(4) Local Hazard Mitigation Plan (valid within five years of FEMA approval or in review by FEMA)
(5) River Corridors (protects Statewide River Corridors or Interim Protections (valid to 2016)
(a) E911 Structures in the Special Flood Hazard Area (SFHA)
(b) Percentage of structures in SFHA with flood insurance
(c) Number of critical or public structures in mapped flood hazard areas
(d) Percentage of community structures in SFHA

FLOOD READY VERMONT

ERAF SUMMARY REPORT

ERAF Summary Report

12/22/2015

Summary of Flood Hazard Mitigations Actions for:

County = Orleans
Region = Northeastern Vermont Development Association
Community= Lowell
Show All = N

Community	ERAF Rate	(1) NFIP	(2) Rd Stds	(3) LEOP	(4) LHMP	(5) RC	RC Interim	NFIP Enrolled	2013 Road Stds	LEOP (Current)	LHMP (Approved)	RC Bylaw
Lowell	7.5%	Yes	Yes	Yes	No	No		12/04/1985	04/09/2013	04/14/2015	Expired	

ERAF Criteria For State Post-Disaster Funding

12.5% Mitigation Actions 1 through 4;

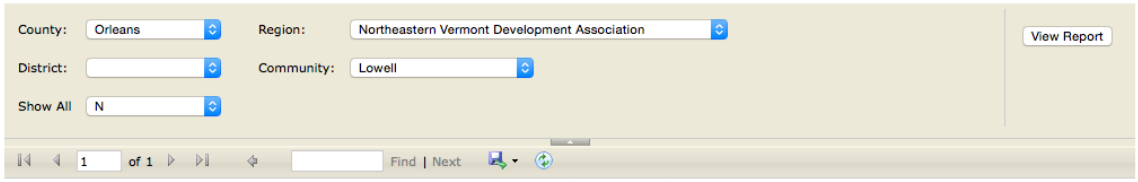
17.5% Mitigation Actions 1 through 5;

For More Information on ERAF Criteria

Emergency Relief And Assistance Fund (ERAF)	Local Emergency Operations Plan (LEOP)
National Flood Insurance Program (NFIP)	Local Hazard Mitigation Plan (LHMP)
Road And Bridge Standards 2013	River Corridor Protection

FLOOD READY VERMONT

MUNICIPAL ROAD AND BRIDGE STANDARDS SUMMARY REPORT



Municipal Road and Bridge Standards Summary Report

12/22/2015 1:34 PM

Display: County = Orleans VTrans District = 0 Region = NV Community = Lowell Show All = N

Community	Municipal Road and Bridge Standards and Date	Standards Template Used	Meet or Exceed 2013 Standards?	Certificate of Compliance and Date	Town Highway Network Inventory Date	State Match For Town Highway Structures (80% or 90%)	State Match For Class 2 Roadways (70% or 80%)	ERAF Rate (7.5%, 12.5%, 17.5%)	Town Highway Miles	VTrans District and Email Contact
Lowell	04/09/2013	2013	Yes	03/31/2015	03/31/2015	90%	80%	7.5%	50.790	District 9

Please note: If a recent update is missing please send a copy of the document to the VTrans District Project Manager (link above).

The Orange Book 2014 – 2016: A Handbook for Local Officials
Includes the 2013 Road and Bridge Standards Template on page 7 – 6VTrans Municipal Assistance Bureau
VTrans Better Back Roads Program
VTrans Local Roads Program
Vermont Online Bridge and Culvert Inventory Tool (VOBCIT)
VTrans Maintenance Districts

Emergency Relief and Assistance Fund (ERAF)
Flood Ready Vermont – Roads and Culverts, Rivers and Roads Training
Regional Planning Commissions

FLOOD READY VERMONT

FEMA COMMUNITY STATUS BOOK REPORT

Federal Emergency Management Agency
Community Status Book Report
VERMONT
Communities Participating in the National Flood Program

CID	Community Name	County	Init FHBM Identified	Init FIRM Identified	Curr Eff Map Date	Reg-Emer Date	Tribal
500027#	HARDWICK, TOWN AND VILLAGE OF INCLUDES THE VILLAGE OF HARDWICK	CALEDONIA COUNTY	06/28/74	06/15/84	07/17/02	06/15/84	No
500148#	HARTFORD, TOWN OF	WINDSOR COUNTY	11/22/74	07/02/79	09/28/07	07/02/79	No
500149#	HARTLAND, TOWN OF	WINDSOR COUNTY	12/24/76	06/15/88	09/28/07	06/03/93	No
500055#	HIGHGATE, TOWN OF	FRANKLIN COUNTY	05/31/74	04/04/83	04/04/83	04/04/83	No
500322#	HINESBURG, TOWN OF	CHITTENDEN COUNTY	01/31/75	09/27/85	08/04/14	09/27/85	No
500313#	HUBBARDTON, TOWN OF	RUTLAND COUNTY	12/13/74	12/01/90	08/28/08(M)	12/01/90	No
500036#	HUNTINGTON, TOWN OF	CHITTENDEN COUNTY	07/26/74	07/17/78	08/04/14	07/17/78	No
500230#	HYDE PARK, TOWN OF	LAMOILLE COUNTY	12/06/74	11/04/81	11/04/81	11/04/81	No
500231#	HYDE PARK, VILLAGE OF	LAMOILLE COUNTY	08/30/74	12/15/81	12/15/81	12/15/81	No
500260#	IRA, TOWN OF	RUTLAND COUNTY	12/06/74	09/18/85	08/28/08(M)	09/18/85	No
500224#	ISLE LA MOTTE, TOWN OF	GRAND ISLE COUNTY	11/01/74	04/15/80	04/15/80(M)	04/15/80	No
500131#	JAMAICA, TOWN OF	WINDHAM COUNTY	06/28/74	05/05/81	09/28/07	05/05/81	No
500253#	JAY, TOWN OF	ORLEANS COUNTY	09/13/74	08/23/00	08/23/00	08/23/00	No
500062#	JEFFERSONVILLE, VILLAGE OF	LAMOILLE COUNTY	08/09/74	06/15/83	06/15/83	06/15/83	No
500037#	JERICHO, TOWN OF	CHITTENDEN COUNTY	06/14/74	06/01/81	08/04/14	06/01/81	No
500063#	JOHNSON, TOWN OF	LAMOILLE COUNTY	06/21/74	02/01/79	04/17/87	02/01/79	No
500232#	JOHNSON, VILLAGE OF	LAMOILLE COUNTY	04/05/74	02/01/79	04/03/87	02/01/79	No
500188	KIRBY, TOWN OF	CALEDONIA COUNTY	12/13/74		12/13/74	02/13/13(E)	No
500178	LANDGROVE, TOWN OF	BENNINGTON COUNTY	01/03/75	09/18/85	09/18/85(M)	09/18/85	No
500006	LEICESTER, TOWN OF	ADDISON COUNTY	06/28/74	11/01/85	11/01/85(M)	11/01/85	No
500212#	LEMINGTON, TOWN OF	ESSEX COUNTY	12/13/73	06/03/91	06/03/91	06/03/91	No
500316	LEWIS, TOWN OF	ESSEX COUNTY				08/05/14(E)	No
500007#	LINCOLN, TOWN OF	ADDISON COUNTY	08/02/74	08/19/86	08/19/86	08/19/86	No
500132#	LONDONDERRY, TOWN OF	WINDHAM COUNTY	06/28/74	04/01/92	09/28/07	04/01/92	No
500254	LOWELL, TOWN OF	ORLEANS COUNTY	09/20/74	12/04/85	12/04/85(M)	12/04/85	No
500150#	LUDLOW, TOWN OF	WINDSOR COUNTY	03/11/77	09/01/78	09/28/07	09/01/78	No
500294#	LUDLOW, VILLAGE OF	WINDSOR COUNTY	11/15/74	09/01/78	09/28/07	09/01/78	No
500028#	LYNDON, TOWN OF	CALEDONIA COUNTY		06/18/80	05/17/88	06/18/80	No

NFIP INSURANCE REPORT

Federal Emergency Management Agency
NFIP Insurance Report
VERMONT

CID	Community Name	Total Premium	V-Zone	A-Zone	No. Policies	Total Coverage	Total Claims Since 1978	Total Paid Since 1978
500240	STRAFFORD, TOWN OF	$ 10,731	0	3	8	$ 1,927,600	4	$ 121,652
500075	THETFORD, TOWN OF	$ 47,956	0	26	33	$ 5,918,000	2	$ 26,876
500241	TOPSHAM, TOWN OF	$ 1,765	0	1	3	$ 486,700	4	$ 74,609
500076	TUNBRIDGE, TOWN OF	$ 6,215	0	2	7	$ 1,410,500	0	$ 0
500077	WASHINGTON, TOWN OF	$ 1,696	0	0	5	$ 173,500	1	$ 0
500079	WEST FAIRLEE, TOWN OF	$ 1,770	0	1	2	$ 315,900	1	$ 0
500080	WILLIAMSTOWN, TOWN OF	$ 15,265	0	8	13	$ 2,088,500	6	$ 51,716
	County Total :	$ 218,937	0	114	180	$ 33,112,600	55	$ 1,010,069
	[ORLEANS COUNTY]							
500081	BARTON, TOWN OF	$ 5,839	0	12	14	$ 945,500	7	$ 23,222
500082	BARTON, VILLAGE OF	$ 8,995	0	7	8	$ 864,700	4	$ 27,157
500246	COVENTRY, TOWN OF	$ 5,470	0	5	6	$ 475,900	1	$ 133,944
500247	CRAFTSBURY, TOWN OF	$ 1,388	0	2	2	$ 133,000	0	$ 0
500248	DERBY, TOWN OF	$ 14,708	0	8	25	$ 4,297,800	26	$ 335,316
500251	GLOVER, TOWN OF	$ 4,598	0	5	7	$ 705,100	7	$ 23,433
500085	GREENSBORO, TOWN OF	$ 1,158	0	1	3	$ 456,000	0	$ 0
500253	JAY, TOWN OF	$ 4,292	0	2	6	$ 1,329,500	1	$ 4,628
500254	LOWELL, TOWN OF	$ 5,129	0	3	6	$ 1,364,000	4	$ 42,081
500086	NEWPORT, CITY OF	$ 17,454	0	0	11	$ 3,542,000	4	$ 44,551
500256	NEWPORT, TOWN OF	$ 9,515	0	5	5	$ 765,800	0	$ 0
500087	NORTH TROY, VILLAGE OF	$ 359	0	1	1	$ 25,000	7	$ 92,205
500088	ORLEANS, VILLAGE OF	$ 28,463	0	6	8	$ 2,676,700	7	$ 24,722
500089	TROY, TOWN OF	$ 6,163	0	2	4	$ 950,000	5	$ 79,616
500257	WESTFIELD, TOWN OF	$ 1,724	0	0	4	$ 1,330,000	0	$ 0
	County Total :	$ 115,255	0	59	110	$ 19,861,000	73	$ 830,875

REPETITIVE LOSSES / BCX CLAIMS

Federal Emergency Management Agency
Repetitive Losses / BCX Claims
VERMONT

CID	Community Name	County	No Of Variances	No Of Rep Losses	CAC Date	CAV Date	No Of BCX Claims	Total Area Population	LOMCS	No Of Policies	FIRM Date	CRS
500251	GLOVER, TOWN OF	ORLEANS COUNTY	0	0	09/30/2013	01/16/2001	0	966	6	7	08/05/1991	
500084	GLOVER, VILLAGE OF	ORLEANS COUNTY	0	0			0	244	0	0		
500085	GREENSBORO, TOWN OF	ORLEANS COUNTY	0	0	09/26/2013	06/29/2000	0	771	0	3	09/27/1985	
500252	IRASBURG, TOWN OF	ORLEANS COUNTY	0	0			0	775	0	0	10/22/1976	
500253	JAY, TOWN OF	ORLEANS COUNTY	0	0	07/02/2013	09/06/2013	0	381	0	6	08/23/2000	
500254	LOWELL, TOWN OF	ORLEANS COUNTY	0	0	07/06/1992	08/15/1994	0	738	3	6	12/04/1985	
500255	MORGAN, TOWN OF	ORLEANS COUNTY	0	0		08/10/2011	0	286	39	0	01/31/1975	
500086	NEWPORT, CITY OF	ORLEANS COUNTY	0	4	10/04/1996	07/07/2000	4	5,015	3	11	06/18/1980	

APPENDIX D: NFIP COMPLIANCE CHECKLIST

The following are sample actions are: **related to continued compliance with the NFIP** (*§201.6(c)(3)(ii):B)*:

- ☐ Join the NFIP.
- ☐ Participate in NFIP training offered by the State and/or FEMA (or in other training) that addresses flood hazard planning and management.
- ☐ Establish mutual aid agreements with neighboring communities to address administering the NFIP following a major storm event.
- ☐ Address NFIP monitoring and compliance activities.
- ☐ Revise/adopt subdivision regulations, erosion control regulations, board of health regulations, etc. to improve floodplain management in the community.
- ☐ Participate in Community Rating System (CRS) or undertake activities to increase the grade level of the community's CRS current participation.
- ☐ Prepare, distribute or make available NFIP, insurance and building codes explanatory pamphlets or booklets.
- ☐ Identify and become knowledgeable of non-compliant structures in the community.
- ☐ Identify and become knowledgeable of submit to rate structures.
- ☐ Identify cause of submit to rate structure and analyze how to prevent non-compliant structures in the future.
- ☐ Inspect foundations at time of completion before framing to determine if lowest floor is at or above Base Flood Elevation (BFE).
- ☐ Require use of elevation certificates.
- ☐ Report any changes in the Special Flood Hazard Area (SFHA) to FEMA within 180 days of change.
- ☐ Identify and keep track of LOMA/LOMR in community.
- ☐ Gain familiarity with community's Flood Insurance Rate Maps (FIRMs).

APPENDIX E: KINGDOM COMMUNITY WIND QUESTIONS AND ANSWERS

ANSWERS TO COMMONLY ASKED QUESTIONS
ABOUT KINGDOM COMMUNITY WIND

What is Kingdom Community Wind?
Green Mountain Power partnered with Vermont Electric Cooperative to build 21 wind turbines on Lowell Mountain as a new source of renewable energy in Vermont. The project began generating electricity at the end of 2012.

How much electricity will Kingdom Community Wind produce?
The wind turbines at Kingdom Community Wind are 3 MW VESTAS V112, some of the newest technology on the market. Once fully operational, the plant is expected to produce approximately 186,000 MWH annually or the equivalent of enough electricity to power more than 24,000 homes each year.

Will the power stay in Vermont?
YES! Every single kilowatt hour of electricity will be used by Green Mountain Power and Vermont Electric Cooperative customers. Refer to page 4 to learn about the Renewable Energy Credits (REC).

How will this benefit Vermonters?
Vermonters will benefit from the lowest cost new renewable energy generated in the state by Kingdom Community Wind. As a utility-owned project, we can provide electricity to GMP and VEC more cost effectively than if the project were owned by an outside developer. It is like the difference between renting and owning – GMP's and VEC's customers will reap the long-term value.

How does wind keep pollutants out of the air?
Based on initial estimates for power production, clean energy from KCW will prevent over 74,000 tons of CO2 per year from entering the earth's atmosphere from fossil fuel generating plants. Every megawatt hour that a wind plant generates is a megawatt hour a plant – for the most part fossil fuel fired -- somewhere else in New England does not need to operate.

Why are the turbines sometimes not running?
Wind is variable along the length of the ridge and may cause some turbines at different points along the ridge to spin at different speeds. Sometimes, there just isn't enough wind to turn the blades. In addition, new generation plants, like Kingdom, need adjustments made during the startup phase. While this work is being done, turbines must be shut down. Other reasons why the turbines may not be spinning include: winter operating and noise monitoring and testing protocol; routine 3-month maintenance; and finally, requests from ISO New England for specific output levels. The regional electric system operator balances generation with load across New England. We have experienced periodic curtailment of generation and are working on several different paths to reduce curtailment, including installing a synchronous condenser.

How will GMP decommission the turbines and above-ground infrastructure?
Green Mountain Power has $6.1 million in a protected decommissioning fund. Decommissioning includes, among other things, the requirement that GMP remove all above-ground components and structures associated with the KCW Project and those below ground to a depth of at least 2 feet and transport them off-site for recycling or disposal; and re-grade all areas excavated during decommissioning to provide for permanent soil stabilization and to promote establishment of appropriate vegetation.

1

Does wind power work?
Absolutely. Wind provides clean, renewable energy when the wind is blowing, and building sites are chosen based on having a good wind resource. The electric grid is designed to accommodate the different operating characteristics of all types of generation – such as nuclear power and large hydro, which run almost all the time, and gas turbines that can be turned on when customer demand is at its highest. Renewable resources, in general, are intermittent, meaning they run when the "fuel" is available, whether it is the sun, water or wind.

As customer demand increases and decreases throughout the day, intermittent resources are easily incorporated into the total operation of the grid. The benefit of wind generation, as well as hydro, solar, and other renewable energy plants, is that when they are producing power, generation from other plants in New England, most often fossil fuel plants, can be reduced.

What is "capacity factor"?
There is some confusion about a wind farm's "capacity factor" and the percent of the time the wind farm is generating electricity. The capacity factor is the ratio of the actual amount of electricity generated during a year divided by the theoretical maximum amount of generation that could be generated during that year. Turbines generate at their full capacity during relatively strong winds, but they still generate electricity during lighter winds, much as the generation of a river-run hydro plant varies with variations in water levels. For example, GMP's Searsburg wind plant generates power about 80 percent of the time while having a capacity factor between 20% and 25%. The capacity factor at KCW is expected to be around 33%.

THE IMPACT OF WIND TURBINES

Why do turbines need to be located along ridgelines?
Winds are stronger and more persistent at higher elevations, and the simple fact is that at lower elevations – even where mountains and other obstructions do not block the wind, the winds are not sufficient to generate economically viable power on a commercial scale.

Will Kingdom Community Wind affect property values?
We know this is an important question to some people who live in Lowell and neighboring communities. The largest and most comprehensive peer reviewed scientific study ever conducted was released in December 2009 and is available on-line at http://emp.lbl.gov/reports/re?page=1. The Lawrence Berkeley National Laboratory analyzed over 7,000 home sales surrounding more than 1,000 modern turbines. It reports "no statistical evidence that homes with a view of wind turbines have different values or appreciation rates than homes without such views." However, it's reasonable to be concerned that there could be isolated cases where some properties values are affected, and, in fact, the study indicates that "though one cannot rule out isolated cases where property values are negatively impacted, any such impacts within our sample are neither widespread nor statistically identifiable."

Do the turbines create sound?
Yes, turbines create sound, but Vermont has strict standards for wind projects that must be adhered to. The standard is 45 db--roughly the noise level of a quiet library. There are free apps available for mobile devices that measure sound – it's worth downloading one to get a sense of what 45 db is like.

Is the sound being monitored?
To assure KCW is staying within the allowed sound levels set forth by the Public Service Board, GMP has adopted a rigorous sound monitoring protocol. During the first two years of operations, four different locations near the wind farm will be monitored for sound four times a year for two-week periods or longer each time. The initial sound monitoring period will be observed by an independent third party sound professional to ensure that sufficient data is obtained and that the data collected accurately captures the sound level of the turbines at each of the monitoring locations.

The data obtained from the monitoring will help GMP confirm our preconstruction modeling of the sound levels around the project and further identify any specific conditions that result in noise above the modeled level, and allow adjustments of the operating practices to ensure compliance with CPG mandated noise limits. Individuals who live in the vicinity of the turbines can report any noise concerns to joanne.heidkamp@greenmountainpower.com or call 1-802-238-5414.

Will sound monitoring include infrasound?
Infrasound is audio frequencies below the level of human hearing. Infrasound commonly occurs in nature from numerous sources including surf, aurora borealis, solar flares, and thunderstorms. After extensive testimony from sound experts, the PSB concluded that the wind turbines are not likely to emit audible or perceivable infrasound. As a result, the Board did not require monitoring for infrasound.

Does the sound produced by wind turbines cause health effects?
More than 50,000 turbines are currently in operation in Europe and more than 30,000 in North America. Most people consider them good neighbors. It is true that some individuals have complained that living near turbines causes adverse health effects due to noise. We are unaware of any objective scientific study to support these claims.

There is nothing unique about the type of noise produced by an operating wind turbine. According to the U.S. Department of Energy, at a distance of 1,140 feet, modern wind turbines can be expected to be about as noisy as a quiet bedroom – 35-40 decibels, which compares to about 40 decibels for a typical rural night-time background. The closest neighbor to KCW is over 3,400 feet away.

Do the turbines have lights?
The Federal Aviation Administration (FAA) requires lights on anything over 200 feet tall. KCW has 8 red LED lights that blink slowly and do not create glare, similar to the ones atop tall buildings and communications towers. We currently have a request in to the FAA to use Obstacle Collision Avoidance System (OCAS) radar. This system, currently used in Europe, would allow the lights to stay off unless aircraft are in the area.

How will the development affect water quality and the environment?
Green Mountain Power worked closely with the Vermont Agency of Natural Resources to ensure the smallest possible impact on water quality and the environment. Water quality in streams in the vicinity of the site will be fully protected during both the construction phase and operational phase of the project. This includes the hydrology, the water chemistry, and the aquatic biota, specifically fish and aquatic insects. The permits establish extremely protective standards and requirements and require extensive monitoring to ensure that this is the case.

How much land was disturbed to build the project?
The land leased for the project has been an active logging operation for decades. Of the thousands of acres that comprise Lowell Mountain a total of 135 acres was used for the wind plant. Direct impact to bear habitat totaled 20 acres, impact to wetlands totaled half an acre, and for high level wetlands the impact was one-tenth of an acre. To mitigate these impacts and the habitat fragmentation caused by the road, GMP procured conservation easements on over 2,800 acres. The conserved area includes over 1,100 acres on Lowell Mountain, and over 1,600 acres in Eden connecting important wildlife corridors between Green River Reservoir and the Lowell wildlife habitat area.

What are you doing to protect bats?
The operation of the turbines will be regulated based on the atmospheric conditions that affect the behavior of bats. These conditions include the time of day, wind speed, and temperature. When bats are active the turbines will pause.

TAX SUBSIDIES AND RENEWABLE ENERGY CREDITS (RECS)

Is wind generation subsidized?
Yes. Wind power receives federal tax incentives based on production and effectiveness. The full amount of these incentives will flow through to VEC and GMP customers by lowering the cost of the energy produced by the project. It is also important to bear in mind that many forms of electric generation enjoy federal and sometimes state tax or other financial incentives. Wind is not unique in this regard.

Who will benefit from federal production tax credits?
Any tax credits will be applied to reduce the cost of power from the project to GMP and VEC customers. Unlike a private developer who can increase earnings through the tax credits, a regulated utility is required to pass along to customers any benefits that reduce the cost of the project. It is estimated the PTC will generate over $40 million dollars. These funds go to lower the cost that GMP customer and VEC members pay.

How do Renewable Energy Credits (RECs) lower the cost of electricity for Vermonters?
The purpose of the REC market is to provide incentives to develop renewable generation, like wind power. In all New England states, except Vermont, utilities need RECs to meet state-mandated renewable energy requirements, and thus increase the amount of renewable energy they can claim. These out-of-state utilities are looking for RECs to purchase. Because of this, and because the Vermont law encourages our utilities to sell their RECs in order to lower the cost of electricity for their customers, it is likely that GMP and VEC will sell the RECs associated with KCW. When considering the REC issue it is important to recognize that GMP and VEC will control the RECs. They can choose to sell them to benefit their respective customers or members, or if the regulatory environment evolves so Vermont utilities are required to have RECs associated with a percentage of the electricity they sell, they can retain any RECs required (as opposed to having to buy them at market prices).

Can I visit the Kingdom Community Wind Farm?
Beginning in 2013, we will be offering limited public tours, to give the community a chance to learn more about Vermont's most abundant renewable resource and the amazing technology we use to harness the wind. To minimize impact to bear habitat, tours will only be available when bears are least active. To learn about tours, contact Gert or Andy Tetreault. 802-744-6664. gert@kingdomcommunitywind.com

Kingdom Community Wind Contacts:

Dorothy Schnure, GMP, 802-655-8418, Schnure@greenmountainpower.com
Robert Dostis, GMP, 802-655-8412 dostis@greenmountainpower.com
Dave Hallquist, VEC, 802-730-1138, dhallquist@vermontelectric.coop

February 2013

APPENDIX F: 2005 MITIGATION PLAN GOAL STATEMENTS

2005 Hazard Mitigation Plan Goal Statements

- Reduce the loss of life and injury resulting from all hazards.
- Mitigate financial losses incurred by municipal, residential, industrial, agricultural and commercial establishments due to disasters.
- Reduce the damage to public infrastructure resulting from all hazards.
- Recognize the connections between land use, storm-water road design and maintenance and the effects from disasters.
- Ensure that mitigation measures are compatible with the natural features of community rivers, streams and other surface waters; historic resources; character of neighborhoods; and the capacity of the community to implement them.
- Encourage all-hazard mitigation planning as a part of the municipal planning process.

APPENDIX G: IMPLEMENTATION PLAN SUPPORT MATERIALS

MITIGATION PROGRESS REPORT WORKSHEET

Progress Report Period	From Date:	To Date:
Action/Project Title		
Responsible Agency		
Contact Name		
	Phone	Email
Project Status	☐ Project Completed	
	☐ Project Canceled	
	☐ Project on Schedule	
	☐ Anticipated Completion Date	
	☐ Project Delayed – Including Explanation	

1. **What was accomplished for this project during this reporting period?**

2. What obstacles, problems, or delays dis the project encounter?
3. If uncompleted, is the project still relevant? Should the project be changed or revised?
4. Other comments

PLAN UPDATE EVALUATION WORKSHEET

Plan Section	Considerations	Explanation
Planning Process	Should new jurisdictions and/or districts be invited to participate in future plan updates?	
	Have any internal or external agencies been invaluable to the mitigation strategy?	
	Can any procedures (e.g. meeting announcements, plan updates) be done differently or more efficiently?	
	Has the Hazard Mitigation Committee undertaken any public outreach activities?	
	How can public participation be improved?	
	Have there been any changes in public support and/or decision-maker priorities related to hazard mitigation?	
Capability Assessment	Have jurisdictions adopted new policies, plans, regulations, or reports that could be incorporated into this plan?	
	Are there different or additional administrative, human, technical, and financial resources available for mitigation planning?	
	Are there different or new education and outreach programs and resources available for mitigation activities?	
	Has NFIP participation changed in North Reading?	
Risk Assessment	Has a natural and/or technical or human-caused disaster occurred?	
	Should the list of hazards addressed in the plan be modified?	
	Are there new data sources and/or additional maps and studies available? If so, what are they and what have they revealed? Should the information be incorporated into future plan updates?	
	Do any new critical facilities or infrastructure need to be added to the asset lists?	
	Have any changes in development trends occurred that could create additional risks?	

Plan Section	Considerations	Explanation
	Are there repetitive losses and/or severe repetitive losses to document?	
Mitigation Strategy	Is the mitigation strategy being implemented s anticipated? Were the cost and timeline estimates accurate?	
	Should new mitigation actions be added to the Action Plan? Should existing mitigation actions be revised or eliminated from the plan?	
	Are there new obstacles that were not anticipated in the plan that will need to be considered in the next plan update?	
	Are there new funding sources to consider?	
	Have elements of the plan been incorporated into other planning mechanisms?	
Plan Maintenance Procedures	Was the plan monitored and evaluated as anticipated?	
	What are needed improvements to the procedures?	