LOCAL HAZARD MITIGATION PLAN

TOWN OF KIRBY, VERMONT

JULY 2017

Local Hazard Mitigation Plan Update

Town of Kirby, Vermont

Town of Kirby

346 Town Hall Road
Lyndonville, VT 05851
Phone: 802-626-9386
Email: kirbytc@kingcon.com

Prepared by:

JAMIE CAPLAN CONSULTING LLC
Emergency Management Services

351 Pleasant Street, Suite B #208, Northampton, MA 01060
Phone: 413-586-0867 Fax: 413-727-8282 Web: www.jamiecaplan.com

ACKNOWLEDGEMENTS

PLANNING TEAM

Jamie Caplan, Principal, Jamie Caplan Consulting
Wanda Grant, Town Clerk, Treasurer
Rebecca Hill-Larsen, Selectboard Clerk

HAZARD MITIGATION COMMITTEE

Selectboard	• Rebecca Hill-Larsen, Selectboard Clerk • Steven Baker • David Chase
Town Clerk/Treasurer	• Wanda Grant
Road Foreman	• John Ohina
Listers	• James Sawhill • Robert Van Vliet • Michael Wood
Planning Commission Members	• Edward DeMaio • Mary Etter • Brad Libby • Ben Mirkin • Karen Moore • Matt Reeve • Robert Van Vliet
Kirby Quilters	• Tracy Sherbrook • Sue Willey
Additional Stakeholders	• Richard Fisher, Concord Fire Department • Alison Low, Northeastern Vermont Development Association • Lieutenant Matthew Amadon, Vermont State Police • John & Anne McClaughry • Bruce Melendy, Northeastern Vermont Development Association • Ryan Noyes • Marc Podgwaite, Lyndon Rescue • Michael Wright, CALEX Ambulance

RECORD OF CHANGES

This Local Hazard Mitigation Plan, including Appendices, will be reviewed and approved on a bi-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 KIRBY, VERMONT SELECT BOARD
A RESOLUTION ADOPTING THE TOWN OF KIRBY, VERMONT 2017 LOCAL HAZARD MITIGATION PLAN

WHEREAS, the Town of Kirby has historically experienced severe damage from natural hazards and it continues to be vulnerable to the effects of the hazards profiled in the **2017 LOCAL HAZARD MITIGATION PLAN,** which result in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Town of Kirby has developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for its **2017 LOCAL HAZARD MITIGATION PLAN (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 Kirby; and

WHEREAS, the **Plan** recommends several hazard mitigation actions (projects) that will provide mitigation for specific natural hazards that impact the Town of Kirby 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 Kirby eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by Town of Kirby Select Board:

1. The **2017 LOCAL HAZARD MITIGATION PLAN** is hereby adopted as an official plan of the Town of Kirby;

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 Kirby on this 7 day of Aug 2017.

Date

August 7, 2017

Select Board Clerk

Select Board Member

Select Board Member

TABLE OF CONTENTS

CHAPTER 1

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 Kirby, 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 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.

FUNDING SUPPORT

This Local Hazard Mitigation Plan was funded by a FEMA Hazard Mitigation Planning Grant, administered by the Vermont Department of Emergency Management and Homeland Security (DEMHS). Support was provided by 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.

[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

2017 HAZARD MITIGATION GOALS

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

This is Kirby's first Hazard Mitigation Plan. The purpose of the Local Hazard Mitigation Plan is to provide the Town of Kirby (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 Town of Kirby 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 twenty hazards to profile, shown in Table 1.1 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 1.1 Hazards Included in the Plan

Ranking	Hazard Ranking
HIGH HAZARDS	• Flooding from Heavy Rainstorms and Snow Melt • Ice Storms • Blizzard • Nor'easter • Snow Events
MODERATE HAZARDS	• Flooding/Fluvial Erosion • Water Supply Contamination • Hurricanes • Extreme Cold • Microburst
LOW HAZARDS	• Earthquake • Drought • Wildfire • Tornadoes • Hail • Beaver Dams • Landslide
VERY LOW HAZARDS	• Ice Jams • Extreme Heat and Heat Wave • Lightning

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 five goals listed below. 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 Kirby.

1. Save Lives
    a. Reduce the loss of life and injury resulting from all hazards.
2. Protect Property and Infrastructure
    a. Mitigate financial losses incurred by the Town, residents and commercial establishments due to natural disasters.
    b. Reduce the damage to roads resulting from all hazards.
3. Incorporate All-hazard Planning
    a. Incorporate all-hazard mitigation planning concepts as a part of the municipal planning process.
4. Regional Collaboration
    a. Build capacity for hazard mitigation through regional collaboration.
5. Public Awareness
    a. Increase public awareness of hazards by implementing outreach and education programs.

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

2017 HAZARD MITIGATION ACTIONS

Mitigation actions have been determined to meet the above goals. The actions are ranked by several 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 Selectboard Clerk 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.

Table 1.2 Hazard Mitigation Actions

Priority	Mitigation Action	Description	Hazards Mitigated	Mitigation Category	Responsible Department	Costs	Funding Source	Timeline
Very High	Culvert on Lynhill – Mud Hollow Road	Culvert has rotted. Replace with 18" culvert to prevent clogging and flooding.	Flooding	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2017 – December 2017
Very High	Ridge Road Culvert Replacement	Replace culvert with 18" culvert to prevent clogging and flooding.	Flooding	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	June 2018 – June 2019
Very High	Kirby Corners – Blind corner from North Kirby Road	Need to dig down road. It is higher than surrounding land and snow blows onto it and sits there.	Snow Events	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2017 – June 2018
Very High	Ridge Road Paving	Needs to be re-paved and needs ditching along the corner near the sand pile. This road is so broken up and a quick change in temperatures degrades the road further. The holes fill with water and ice causing flooding and a dangerous situation.	Flooding	Structure and Infrastructure Projects	Road Foreman Road Commission	High	Town VTrans	June 2018 – June 2019
Very High	Apply Stamatt	Stamatt is applied to dirt roads to harden them and prevent the road from degrading. When dirt roads break down they are vulnerable to flooding and erosion. It is also more difficult to plow and salt/sand a road already in poor condition. Apply Stamatt as needed.	Flooding/fluvial erosion Snow events	Structure and Infrastructure Projects	Road Foreman Road Commission	Medium	Town VTrans	April 2019 – October 2019
Very High	Mitigate landslides and erosion by digging trenches along Kirby Road and on the South Side near Taylor Farm to allow for water flow.	By giving snow run-off and heavy rains a place to drain, landslides may be prevented.	Flooding/fluvial erosion Landslides	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	March 2018 – June 2020

Priority	Mitigation Action	Description	Hazards Mitigated	Mitigation Category	Responsible Department	Costs	Funding Source	Timeline
Very High	Collaborate with Lyndonville Electric and Green Mountain Power for tree clearing	Road obstruction and downed power lines are two of the biggest concerns in Kirby. Collaborate with the Lyndonville Electric and Green Mountain Power to keep trees trimmed and roads clear is essential to keep the roads free of debris and the power on.	Flooding Blizzard Nor'easter Snow Events Hurricanes Microburst Tornadoes Hail	Local Plans and Regulations	Road Foreman Road Commission	Low	Town Electric Companies	July 2017 – June 2022
High	Install a culvert at Burroughs Road and Cross Road.	This section is always wet and ruts in the road become deeper than two feet. An 18" culvert here would alleviate flooding. Needs property owner's permission.	Flooding	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2017 – September 2018
High	Brookside	Culverts here are undersized and the road needs ditching on both sides to prevent flooding.	Flooding	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2017 – September 2018
High	Dig bedrock along Mud Hollow Road to allow for water flow.	Mud Hollow Road sits on bedrock and needs an excavator to dig out the rock and create a channel for water to flow along the sides of the road. As it is now, water pools on the road. The box culvert previously added is not enough to remedy the problems.	Flooding	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2017 – November 2017
High	Apply Stamatt to Hayes Road	Hayes Road is very steep and water runs on the road and creates big ruts. As the road deteriorates it becomes harder to travel along.	Flooding	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2017 – November 2017
High	Willey Farm Road needs ditching on either side to prevent flooding.	This road needs excavation along each side to prevent flooding.	Flooding	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2017 – September 2018
High	Apple Tree Lane widening and ditching.	Needs widening and ditching to prevent flooding.	Flooding	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	April 2018 – June 2019
High	Plan for and maintain adequate road and debris clearing capabilities.	Keeping the roads clear of debris is necessary for safety. Some residents will stop and remove tree debris if possible from the road. A plan for maintaining clear roadways is necessary.	Blizzard Nor'easter Snow Events Hurricanes Microburst Tornadoes Hail	Local Plans and Regulations Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2017 – December 2017
High	Widen roads to allow for snow build-up and drainage.	In conjunction with other road projects, the roads should be widened to allow for snow build-up and drainage. Preventing roads from getting too narrow for cars to pass is a method for keeping them safe and mitigating the risk of accidents from snow build-up and flooding.	Flooding from heavy rain storms and snow melt Snow Events	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2018 – December 2020

Priority	Mitigation Action	Description	Hazards Mitigated	Mitigation Category	Responsible Department	Costs	Funding Source	Timeline
High	Increase the capacity of stormwater drainage.	Culvert cleaning increasing the capacity for stormwater drainage and prevents flooding. All of the culverts in Town need cleaning.	Flooding from heavy rain storms and snow melt Flooding/fluvial erosion	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town HMGP VTrans	July 2017 – December 2017
High	Develop a Road Erosion Inventory	Act 64 requires this inventory by 2019.	Flooding from heavy rain storms and snow melt Flooding/fluvial erosion	Local Plans and Regulations	Road Foreman Road Commission	Low	Town VTrans	July 2017 – December 2017
High	Maintain Culverts and Roadways to VTrans Standards.	Develop a culvert survey. Replace poor roadways, cut vegetation along roadways and improve ditching along roads ways to keep the roads up to VTrans standards.	Flooding from heavy rain storms and snow melt Flooding/fluvial erosion	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2017 – June 2022
High	Educate homeowners at Town Meeting about floods, how to shelter-in-place, how to access emergency information and other natural hazards.	The Hazard Mitigation Committee has prioritized education as one of the best methods to mitigate risks in Kirby. 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 Foreman to clear the roads and first responders to move about.	Flooding Winter Storms Power Outages	Education and Awareness Programs	Selectboard	Low	Town	July 2017 – June 2020
High	Send pamphlets with annual tax bills to educate all homeowners regarding the necessity of carbon monoxide detectors and the necessity to vent all fuel-burning equipment to the outside.	The Hazard Mitigation Committee has prioritized education as one of the best methods to mitigate risks in Kirby.	Hazards that create Power Outages such as winter storms Extreme Cold Extreme Heat	Education and Awareness Programs	Planning Commission	Low	Town	August 2017 – annually with tax bills
High	Purchase a permanent generator for the Town Hall.	The generator will allow the Town Hall to function as a shelter instantly and for the portable generator to be used at the Town Garage or Old Schoolhouse.	Hazards that create Power Outages such as winter storms Extreme Cold Extreme Heat	Structure and Infrastructure Projects	Selectboard	Low	HMGP	January 2019 – December 2019
High	Incorporate mitigation principles into future Town Plans and updated Zoning Regulations.	Incorporating mitigation principles will ensure that future growth in the town is consistent with this plan's findings.	All Hazards	Local Plans and Regulations	Planning Commission	Low	Town	August 2017 – December 2018
High	Establish Town Hall as a hazard information center.	Host educational meetings regarding mitigation here as well as maintain information.	All Hazards	Local Plans and Regulations	Selectboard	Low	Town	July 2017 – December 2018

Priority	Mitigation Action	Description	Hazards Mitigated	Mitigation Category	Responsible Department	Costs	Funding Source	Timeline
High	Update FEMA Flood Maps	Encourage FEMA to update and digitize floodplain maps for the Town. This will provide a great resource for land use planning as preventing flooding.	Flooding/fluvial erosion	Local Plans and Regulations	FEMA Planning Commission	Low	FEMA	September 2017 – June 2022
High	NVDA Hazard Mapping Support	Kirby would like a clear zoning map so the Zoning Regulations may be updated. They also would like to overlay an updated floodplain map with the zoning map.	All Hazards	Local Plans and Regulations	Planning Commission	Low	Town NVDA	September 2017 – June 2022
Medium	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. Need to find and purchase property to house a sand and salt shed.	Ice Storms Blizzard Nor'easter Snow Events Hail	Structure and Infrastructure Projects	Selectboard	High	HMGP	January 2020 – December 2020
Medium	Collaborate with VTrans	Roadway projects should be conducted to VTrans standards.	Flooding from heavy rain storms and snow melt Ice Storms Blizzard Nor'easter Snow Events Flooding/fluvial erosion Hurricanes Microburst Tornadoes Landslide	Local Plans and Regulations	Road Foreman Road Commission	Low	Town VTrans	July 2017 – December 2017
Medium	Update local first responders annually with information regarding residents with special needs.	This information is shared by way of the Local Emergency Operations Plan.	All Hazards	Local Plans and Regulations	Selectboard	Low	Town	Annually in May, beginning May 2017
Medium	Develop neighbors helping neighbors program for outreach to vulnerable residents during power outages and other disasters.	Residents with special needs may need someone to take them to a heating center or check on them during a disaster.	All Hazards	Education and Awareness Programs	Kirby Quilters	Low	Town	July 2017 – December 2018
Medium	Educate home owners about safe building practices for snow load, flooding, high winds, and bank erosion.	When residents drop off building permit applications, the Town will give them pamphlets and other information regarding safe building practices. The Town does not utilize building inspectors, as is typical in Vermont, so this is a way to ensure safe buildings.	Flooding/fluvial erosion Nor'easters Hurricanes Snow Events Earthquake Tornadoes	Education and Awareness Programs	Town Clerk Volunteer	Low	Town	July 2017 – December 2017

Priority	Mitigation Action	Description	Hazards Mitigated	Mitigation Category	Responsible Department	Costs	Funding Source	Timeline
Medium	Install a quick connect generator hook-up at the Old Schoolhouse.	This would enable this publicly owned building to be used during disasters and function as a back-up should the Town Hall become disabled.	Ice Storms Blizzard Nor'easter Snow Events Hurricanes Extreme Cold Microburst Wildfire Tornadoes Hail Extreme Heat	Structure and Infrastructure Projects	Selectboard	Low	HMGP	July 2018 – December 2019
Medium	River Corridor – adopt river corridor model recommendations for development in areas along river corridors and erosion areas to meet ERAF Standards.	Adopt a river corridor protection bylaw that meets or exceeds state model regulations and guidelines. This will prevent flooding and erosion along streams and rivers.	Flooding/fluvial erosion	Local Plans and Regulations	Planning Commission	Low	Town	June 2020 – December 2021
Medium	Amend the Road Project Budget to be for road projects and hazard mitigation.	Rename to Highway and Road Mitigation. This is part of adding to the culture of mitigation.	Flooding from heavy rainstorms and snow melt Snow Events Hurricanes	Local Plans and Regulations	Selectboard	Low	Town	January 2018 – December 2018
Medium	Restrict development in higher elevations by enforcing the Highlands District Zoning Regulations.	Per the Town Plan, new developments should not be undertaken in the higher elevation categories as to prevent any harmful introduction of pollutants close to wellheads into surface and sub surface waters which may result in groundwater and drinking water pollution.	Water Supply Contamination	Local Plans and Regulations	Planning Commission	Low	Town	July 2017 – December 2018
Medium	Develop a stream buffer ordinance to avoid building in floodplain areas.	The Planning Commission will review VT River Corridor studies for guidelines.	Flooding/fluvial erosion	Local Plans and Regulations	Planning Commission	Low	Town	January 2018 – December 2018
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. This data is necessary when conducting future benefit-cost analysis for mitigation grant funding.	All Hazards	Local Plans and Regulations	Road Foreman Town Clerk	Low	Town	July 2017 – June 2022
Medium	Remediate Beaver Dam Issues as They Arise	Prevent flooding caused by beaver dams.	Flooding/fluvial erosion	Structure and Infrastructure Projects	Road Foreman Game Warden	Low	Town	July 2017 – June 2022
Low	Improve NFIP Status from Emergency Phase to Regular Program	When the Town is a full member of the NFIP it will be easier for residents to get flood insurance if they so desire. Town government is interested in being a regular program member.	Flooding/fluvial erosion	Local Plans and Regulations	Town Clerk Selectboard	Low	FEMA Town	July 2017 – December 2017

Priority	Mitigation Action	Description	Hazards Mitigated	Mitigation Category	Responsible Department	Costs	Funding Source	Timeline
Low	Get a generator for Town Garage	To maintain power in the building especially during evening disasters.	Ice Storms Blizzard Nor'easter Snow Events Hurricanes Extreme Cold Microburst Tornadoes Hail	Structure and Infrastructure Projects	Selectboard	Low	HMGP	January 2019 – December 2019
Low	Send Hazard Mitigation Pamphlets	Send annually with tax bills in first week of August as a way to educate home owners about hazard mitigation.	All Hazards	Education and Awareness Programs	Town Treasurer	Low	Town	August 2017 – every August until 2022

AUTHORITY AND ASSURANCES

The Town of Kirby 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)
- Local Mitigation Plan Review Guide (October 2011)
- Demonstrating Good Practices Within Local Hazard Mitigation Plans (January 2017, FEMA Region 1)

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

CHAPTER 2

TOWN OF KIRBY PROFILE

CHAPTER 2. TOWN OF KIRBY PROFILE

The Town of Kirby is in Caledonia County, within the Northeast Kingdom region in northeastern Vermont. It is bordered by the town of St. Johnsbury to the southwest, Lyndon to the west, Burke to the north, Victory to the northeast, Concord to the southeast, and Waterford to the south. Kirby was originally settled in 1790 as Hopkinsville, Vermont, it was organized as Kirby in 1807.

The Town is managed by a Select Board of three members, each of whom serves a three-year term and is elected at Town Meeting (held annually, on the first Tuesday in March). They are supported by a Clerk, Treasurer, and Tax Collector who are elected at Town Meeting. As of March 2017, the Clerk, Treasurer, and Tax Collector positions are held by the same person. The Clerk hires assistants and now has two part-time assistants. The Town also has a Planning Commission that develops the zoning regulations and functions as the Board of Adjustments. Although, Kirby does not currently operate a school, they do maintain a school board. In March 2017, the Town voted to join the NEK Choice School District. The Kirby Town School District will cease to exist after July 1, 2018. This is part of the State of Vermont's Act 46. This new school district includes the Towns of Bloomfield, Brunswick, East Haven, Granby, Guildhall, Kirby, Maidstone, Norton, and Victory.

Per the United States Census Bureau, Kirby has a total area of 24.4 square miles (63.3 square kilometers), of which 24.4 square miles (63.1 km^2) is land and 0.04 square miles (0.1 km^2), or 0.20%, is water. According to 2010 Census, the population in the Town of Kirby was 493.[7]

Per Kirby's Town Plan, "approximately 50% of the planning area's 15,305 acres are used for agricultural purposes and forest. Kirby's citizens live in house sites which are at least two acres in size. The 2006 bylaw increased the minimum lot size to 5 acres to ameliorate some of the density issues."[8] Growth in Kirby has been slow and steady. The graphic below indicates new home construction permits from 1997-2014.

- 1997: 6 buildings, average cost: $91,700
- 1998: 6 buildings, average cost: $98,300
- 1999: 7 buildings, average cost: $109,200
- 2000: 6 buildings, average cost: $118,000
- 2001: 4 buildings, average cost: $130,000
- 2002: 4 buildings, average cost: $130,700
- 2003: 6 buildings, average cost: $100,000
- 2004: 8 buildings, average cost: $126,800
- 2005: 2 buildings, average cost: $187,500
- 2006: 6 buildings, average cost: $127,500
- 2007: 1 building, cost: $181,200
- 2008: 5 buildings, average cost: $326,500
- 2009: 3 buildings, average cost: $86,900
- 2010: 1 building, cost: $165,900
- 2011: 3 buildings, average cost: $165,100
- 2012: 3 buildings, average cost: $225,000
- 2013: 4 buildings, average cost: $262,900
- 2014: 2 buildings, average cost: $135,000

Figure 2.1 Single Family New House Construction Building Permits (1997-2014)[9]

Kirby's Town Plan continued growth in the housing area is expected, particularly in the northern region with its gentle slopes and scenic beauty. In the past, Ridge Road, North Kirby Road, Burroughs Road, and Kirby Mountain Road have seen historical growth patterns.[10] According to the Town Plan, growth is expected as adjacent communities continue to grow.

---

[7] Community Facts. (2010). United States Census Bureau. Retrieved on March 1, 2017 from http://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml

[8] Kirby Town Plan. (2012). Town of Kirby. Pg.6. [The 2012 Town Plan recommends a change in the zoning regulations to allow smaller lot sizes and additional density for clustered development.]

[9] Kirby, Vermont. (2017). City-Data. Retrieved from http://www.city-data.com/city/Kirby-Vermont.html#ixzz4LZyheqh4 February 20, 2017.

[10] Kirby Town Plan. (2012.). Town of Kirby. Pg. 5

The town's goal is to protect their quality agricultural land, scenic resources and other unique and fragile areas. Development in areas above 1,600 feet in elevation is "strongly discouraged" since "erosion control and subsurface water confinement are severely hampered at these elevations."[11] "If construction is to take place at these levels, consideration will be given to requiring a soils study and an impact study on scenic vistas and ecosystems" prior to construction approval.[12]

INFRASTRUCTURE

Infrastructure in the Town of Kirby is simple. There are no municipal services such as public water or sewer in town. All water and septic are on–site systems. Energy needs in Kirby are limited to residential and home-based business use. These services are supplied by Lyndonville Electric Company and Central Vermont Public Service Corporation (CVPS). Lyndonville Electric supplies power to North Kirby and CVPS provides power to South Kirby and Mud Hollow.[13] The Town of Kirby is part of the Northeast Kingdom Waste Management District Solid Waste Implementation Plan. Household waste is deposited into transfer stations and hauled away by a private contractor. Residents take their own recyclables to the Waste District[14] or they can to the Town Transfer Station.

Transportation in the Town of Kirby is supplied by personal vehicles. The Town's road system includes 32 miles of roads with the following road class breakdown from the Town Plan[15]:

Table 2.1 Kirby Road Class

Road	Mileage
Class 2 Town Highways	4.01
Class 3 Town Highways	20.08
Class 4 Town Highways	7.13
State Highways: US Route 2	0.967
Total Miles Highway	32.387

Except for US Route 2 and a small piece of Ridge Road, the roads in Kirby are unpaved dirt roads. Kirby Mountain Road is the link between the road systems in the Town. Kirby Mountain Road provides a direct link to the adjacent towns of Lyndon and Concord. Ridge Road is a direct link between Lyndon and Burke. The dirt roads are susceptible to erosion from hazardous weather conditions.

Growth in the Town of Kirby has been along its current roadways, creating an increase in traffic and stress on the current roads. The roads are maintained by one person, the Road Foreman. He is solely responsible for plowing in the winter and maintaining access throughout the year. In an interview with him, he mentioned being aware of the needs of the dairy farmers to move milk on a regular basis. The largest industry in Kirby is dairy. There are multiple dairy farms in Town. The largest farms have been included in maps in this plan.

The Town does not have a current road maintenance plan; however, they were awarded a Better Roads grant that begins in the summer of 2017. They will inventory the roads. Town residents support the Road Foreman by

[11] Kirby Town Plan. (2012). Town of Kirby. Pg. 10.
[12] Kirby Town Plan. (2012). Town of Kirby. Pg. 11.
[13] Kirby Town Plan (2012). Town of Kirby. Pg. 20.
[14] Kirby Town Plan (2012). Town of Kirby. Pg. 15.
[15] Kirby Town Plan (2012). Town of Kirby. Pg.12.

participating in an annual "Green Up Day" in the Spring to clear the edges of Town roads from trash debris.[16] The roads have sustained significant damage in the past, as indicated from the following passage referenced from the Town Plan on page13.

> In 2011, Kirby Mountain Road suffered serious damage during mud season, requiring significant reconstruction. Then a large tropical storm on May 27th caused extensive damage to roads across the Town. Hurricane Irene came in August, and caused only minor damage. The Town has applied for FEMA monies to help pay for the cost of these unprecedented emergency repairs. The emergency repairs in 2011 cost in excess of $477,633. To qualify for future FEMA relief the Town must be part of the national flood insurance program. To participate in that, the town must adopt Inundation Hazard Area regulations as part of the zoning regulations. When re-writing the zoning bylaws, the Town should consider whether to have setbacks from streams to protect against property damage during flash flood events. The State of Vermont Flood Hazard Mapping Coordinator's office has recommended the Town consider a 100 foot setback from the banks of Kirby Brook or study of that brook for river corridor identification, and some other setback from the banks of other streams in town to protect against damage from stream erosion during flash flooding.

CRITICAL FACILITIES

Critical facilities are considered structures or institutions necessary for the Town of Kirby 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. Critical facilities typically include airports, emergency operation centers (EOCs), fire stations, hospitals, police stations, schools, government buildings, and railroad stations. Kirby is a very small town which shares several local services with the neighboring towns of Lyndon, St. Johnsbury, Concord and Danville. Kirby itself does not have a fire station, police station, hospital, or schools. The Town of Kirby relies on first responders from adjacent communities. The closest hospital to Kirby is the Northeastern Vermont Regional Hospital, which is located seven miles away in St. Johnsbury, Vermont. Children are transported to a school of their choice in the neighboring communities. The Town of Kirby does not have any buildings listed in the National Register of Historic Places.[17]

The Planning Team with the help of the Hazard Mitigation Committee identified the following three critical facilities, Town Garage, Town Hall/Clerks Office, and the Old South Kirby Schoolhouse. According to the Town Plan, The Town Garage "was built entirely by volunteers from the community in 1985. It houses all the Town equipment and stands next to the Town Hall."[18]

The Town of Kirby owns and maintains two local cemeteries which were not considered critical facilities for the purposes of this plan. For the purposes of this plan, the Dairy Farms were mapped and considered in the risk assessment because they represent the largest business in Kirby. Since roads are the greatest resource as well as liability to the Town, they were added to the list of critical facilities and considered in the risk assessment, capability

[16] Kirby Town Plan (2012). Town of Kirby. Pg. 4.
[17] 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
[18] Kirby Town Plan (2012). Town of Kirby. Pg. 4.

assessment, and mitigation strategy. The Natural Hazard Preparedness Survey asked respondents to rank the importance of critical facilities. Most respondents list the Town Hall, Town Garage, and Roads as critical facilities.

Figure 2.2 Town Hall and Town Garage

Table 2.2 lists the planning area's critical facilities, except for the roads, their building year, and assessed value. Figure 2.2 shows the location of the critical facilities and dairy farms. No data on previous losses were available. There are no known losses to critical facilities (though future losses are possible). These facilities have a combined building exposure value of about $773,000. Below this table is a map depicting the location of each critical facility as well as the dairy farms.

Table 2.2 Critical Facilities

Critical Facility	Address	Building Value	Value contents	Area (SF)	Built Year	Construction Type
Town Garage	346 Town hall Rd, Lyndonville	302,189	78,645	2520	1985	Frame
Town Hall / Clerks Office	346 Town hall Rd, Lyndonville	192,649	50,077	1605	1828	Frame
Old South Kirby Schoolhouse	7 Ranney Hill Rd, Lyndonville	118,603	30,841	988	1825	Frame
Total Value		$613,441.00	$159,563.00			
Total Building Exposure		**$773,000.00**				

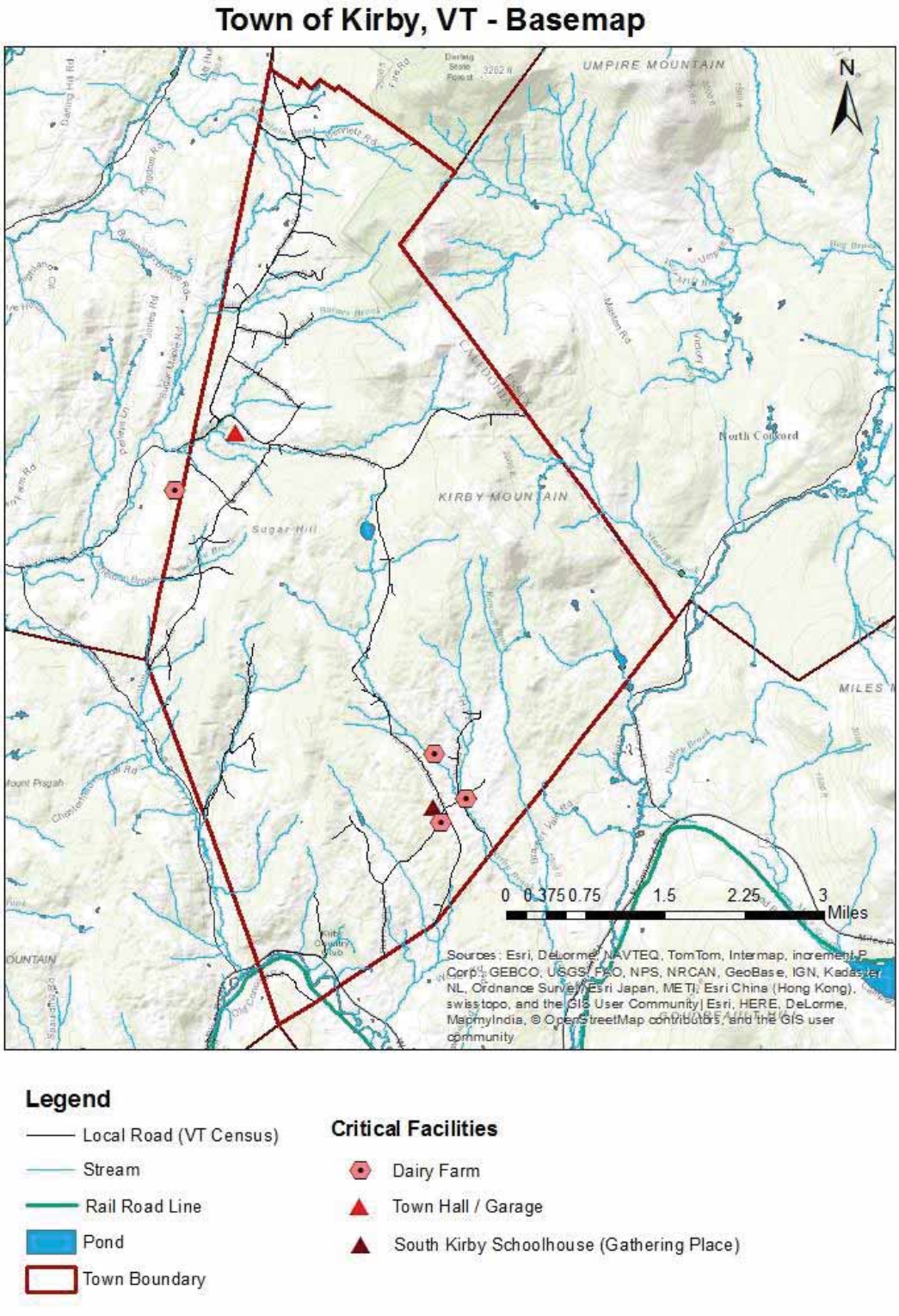


Figure 2.3 Location of the Critical Facilities and Dairy Farms

CHAPTER 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 with the suggestions found in the Demonstrating Good Practices Within Local Hazard Mitigation Plans, FEMA, Region 1 January 2017.

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 Town of Kirby 2017 Local Hazard Mitigation Plan that meets all the requirements under both Vermont Division of Emergency Management and Homeland Security (DEMHS) and FEMA.

PLANNING TEAM

The Town of Kirby received a grant from DEMHS and contracted with Jamie Caplan Consulting LLC to develop their Local Hazard Mitigation Plan. Jamie Caplan subcontracted with Clarendon Hill Consulting for assistance with the risk assessment portion of the plan.

A Planning Team was formed that included Jamie Caplan, Jamie Caplan Consulting; and Rebecca Hill-Larsen, Selectboard Clerk, and Wanda Grant, Town Clerk. This core group held regular meetings to ensure the project progressed efficiently. On November 29, 2016, Ms. Caplan toured the Town of Kirby for several hours with Rebecca Hill-Larsen and John Ohina, Road Foreman. During this tour, Mr. Ohina and Ms. Hill-Larsen pointed out high hazard areas along the roadways in Town. The purpose of the tour was to give Ms. Caplan a better sense of the Town as well as to gather information toward developing mitigation actions.

After touring the Town, Ms. Caplan interviewed Wanda Grant and Rebecca Hill-Larsen regarding the capabilities of the Town. Ms. Caplan used FEMA's Capability Assessment Worksheet 4.1 and the National Flood Insurance Program (NFIP) Worksheet 4.3 to guide the interview. Details regarding the Town's capabilities are in Chapter 5 Capability Assessment.

The project was divided into nine steps as illustrated by the Work Plan (shown in Appendix A) and the Work Plan Timeline shown in Table 3.1. Jamie Caplan Consulting developed the Work Plan with assistance from the Planning Team.

Table 3.1 Work Plan Timeline

Steps	Description	Oct 2016	Nov	Dec	Jan 2017	Feb	Mar	Apr	May
1	Assemble Planning Team and Kick-off Meeting	X	X						
2	Develop Work Plan	X	X						
3	Hazard Data Review		X	X					
4	Review Hazard Data/Public Meeting #1		X	X					
5	Complete Vulnerability Assessment		X	X					
6	Identify Mitigation Strategies			X	X	X			
7	Review Mitigation Strategies/Public Meeting #2				X	X	X		
8	Submit Plan to DEMHS and Revise Accordingly							X	
9	Submit Plan to FEMA, Revise if necessary and Adopt Plan								X
Meetings									
Kick-off Meeting, Assemble Planning Team		X							
Planning Team Calls – twice a month as necessary		X	X	X	X	X	X	X	X
Planning Team In-Person Meetings				X			X		
Stakeholder Meetings, Tour Kirby		X		X			X		
Public Meetings				X			X		

HAZARD MITIGATION COMMITTEE

The Planning Team identified twenty-five individuals to participate in the Hazard Mitigation Committee, shown in the list below. The Committee is large because the Town is extremely small and they rely on the support of folks living in the neighboring communities. Each member of this committee was invited to participate, but not all members attended every meeting. Meeting sign-in sheets are in Appendix A. Some of them participated in separate meetings or conversations with the Planning Team. Rebecca Hill-Larsen contacted each of the Committee members by phone and email inviting them to participate in the planning process.

Hazard Mitigation Committee Members

Selectboard	• Rebecca Hill-Larsen, Selectboard Clerk • Steven Baker • David Chase
Town Clerk/Treasurer	• Wanda Grant
Road Foreman	• John Ohina
Listers	• James Sawhill • Robert Van Vliet • Michael Wood
Planning Commission Members	• Edward DeMaio • Mary Etter • Brad Libby • Ben Mirkin • Karen Moore • Matt Reeve • Robert Van Vliet
Kirby Quilters	• Tracy Sherbrook • Sue Willey
Additional Stakeholders	• Richard Fisher, Concord Fire Department • Alison Low, Northeastern Vermont Development Association • Lieutenant Matthew Amadon, Vermont State Police • John & Anne McClaughry • Bruce Melendy, Northeastern Vermont Development Association • Ryan Noyes • Marc Podgwaite, Lyndon Rescue • Michael Wright, CALEX Ambulance

The two fire chiefs listed below were invited to participate by way of Bruce Melendy, NVDA. Each declined.

- Troy Ruggles, St. Johnsbury Fire Department
- Greg Hopkins, Lyndonville Fire Department

Hazard Mitigation Committee invitation email:

> The Town of Kirby has received a grant from the VT Emergency Management Agency (DEMHS) to develop a Local Hazard Mitigation Plan. The Town has hired a consulting team led by Jamie Caplan Consulting LLC to work with us on the plan.
>
> To prepare the best possible mitigation plan we need your support as a member of the Hazard Mitigation Committee. This Committee will meet two to three times over the next nine months. Your contributions during these meetings will help us to identify areas of risk in the Town as well as possible mitigation actions.
>
> Hazard mitigation is defined by the Federal Emergency Management Agency (FEMA) as "the effort to reduce loss of life and property by lessening the impact of disasters." Having a FEMA approved Hazard Mitigation Plan allows the Town to seek mitigation funding for projects such as structure and infrastructure projects, natural systems protection, education and awareness programs, and local planning and regulations.
>
> **Our first meeting is November 29, 2016 from 5:30 pm – 6:30 pm in the Town Hall at 346 Town Hall Road, Lyndonville, VT. Dinner will be served! Please RSVP to Rebecca Hill-Larsen at your earliest convenience.**
>
> **That evening we are also hosting a Public Meeting regarding the Hazard Mitigation Plan. We encourage you to attend this meeting as well and bring co-workers and family members. It will be held from 6:30 pm – 7:30 pm in the Town Hall.**
>
> We will need your participation in each meeting as well as help getting the word out about the public meeting. Attached for your convenience is a flyer advertising the Public Meeting. Please take a moment to distribute it.
>
> If you have any questions regarding your role in the Hazard Mitigation Committee or the mitigation planning project, please contact Rebecca Hill-Larsen at 402-218-9819 or by email at: beccanterry@gmail.com.

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.

NOVEMBER 29, 2016

Eight members of the Hazard Mitigation Committee attended the first in-person meeting on November 29, 2016 at the Kirby Town Hall. Rebecca Hill-Larsen, Selectboard Clerk gave a brief opening presentation and then turned the meeting over to Jamie Caplan. Ms. Caplan gave a presentation and led a discussion to introduce Hazard Mitigation Committee members to details regarding the planning process and answer any of their questions. Ms. Caplan spent extra time discussing the list of possible hazards, critical facilities and high hazard areas in Kirby. At the end of the meeting, participants had the opportunity to review maps laid out at the front of the room and mark them with key information.

Figure 3.1 Wanda Grant, John McClaughry and John Ohina Identifying High Hazard Areas on the Base Maps

During the initial review of the Hazard Mitigation Committee members it was recommended that the following people be invited to join the Hazard Mitigation Committee, the former Road Foreman, Fire Chief's for the Towns of Concord, St. Johnsbury and Lyndon, a State Police representative a CALEX Ambulance representatives and both constables. Bruce Melendy from the NVDA offered to make introductions to the first

responders. He participates in the LEPC 9 meetings and committed to introducing the Kirby Local Hazard Mitigation Plan at their meeting in December.

In terms of critical facilities, the Hazard Mitigation Committee felt that their roads are their greatest resource. They expressed an interest in adding other infrastructure to the critical facility list besides roads, such as electrical lines, gas lines and cell towers. Someone mentioned that the cell transmission tower in Concord routes calls in Kirby.

MARCH 27, 2017

The second Hazard Mitigation Committee meeting was held on March 27, 2017 at the Town Hall. This meeting was originally scheduled for February 2017 but it was rescheduled due to a snow storm. The focus of this meeting was to review the risk assessment and hazard ranking, to review the survey responses and to discuss mitigation actions. Ms. Caplan presented that flooding, blizzards, nor'easters, snow events, high winds and tree-related hazards seem to pose the highest risk to Kirby. Based on the high hazard areas identified in the previous meeting and during the risk assessment, as well as the identified critical facilities goal statements were reviewed. Ms. Caplan had previously presented possible goal statements to the Hazard Mitigation Committee, at this meeting, they were agreed upon. Meeting participants sat in a circle and reviewed the information by way of discussion and a handout. Instead of a PowerPoint presentation this style encouraged a relaxed meeting with group participation. Ms. Caplan reviewed the four types of mitigation techniques and presented a list of possible mitigation actions for Kirby. This list was divided into the following categories:

- Mitigating Risks to Roads
    - Specific Culverts and Bridges
    - Specific Roadway Intersections
    - Specific Road Sections
    - General Roadway Mitigation
- Power Outage
- Education Activities
- Protect Critical Facilities and Vulnerable Populations
- Integrate Mitigation into Local Planning Efforts
- Additional Hazard Mitigation Actions
    - Flood Mitigation

A key part of the meeting's discussion included the Zoning Bylaws that were about to be passed. The revised bylaws were developed over a long period of time; however, they do not specifically include hazard mitigation. Ms. Caplan educated the group about the potential benefit of using the Zoning Bylaws to mitigate risk. It was learned following this meeting, that the Bylaws were updated but do not include hazard mitigation.

It should be noted that only two people came to the Public Meeting, which was scheduled to begin immediately following the Hazard Mitigation Committee meeting. The Committee meeting did not adjourn and instead continued with the participation of the two members of the public.

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))

The Work Plan includes a Public Outreach Strategy that details the opportunities available for the public to participate in the mitigation planning process. The purpose of public outreach and stakeholder involvement was to:

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

The Public Outreach Strategy is included in the Appendix A, it is part of the Work Plan. Several opportunities were offered throughout the planning process for the public to participate in the mitigation plan. These included:

- Participate in the Public Preparedness Survey
- Attend Public Meetings at the Town Hall
- Attend Meetings with Planning Team Members
- Review and comment 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. The Public Preparedness Survey informed several aspects of the hazard mitigation plan development and is mentioned throughout the Plan.

Thirty-six surveys were completed. A copy of the survey and the results are attached in the Appendices. Surveys were distributed in hard copy at the polls on Election Day 2016 and at all meetings taking place at the Town Hall. In addition, hard copies were available in the Town Hall throughout the planning process and a link to an online version of the survey was provided on the Kirby Town website, http://kirbyvermont.org/notices/hazard-mitigation-planning-survey/.

Most the surveys were collected on Election Day, November 2016. Because it was a presidential election, turn-out was high. It also gave the Planning Team an opportunity to introduce Town residents to the planning process via casual conversations throughout the day. The following list is a summary of the most compelling results from the survey:

- Sixty-eight percent of respondents listed hurricanes as the biggest risk to their homes.
- The most effective way for respondents to receive information is mail and web based information.
- The roads were listed as the most important community asset, followed by the Town Hall and Town Garage.
- In terms of priorities regarding planning for natural hazards, the highest priorities were protecting and reducing damage to utilities and enhancing the natural environment.

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 A). The press releases appeared in the Caledonian Record, follow-up articles regarding the project also appeared in this paper. Below is copy of the article prior to the November 29, 2016 meeting. Jamie Caplan corresponded with Amy Nixon, a reporter for the Caledonian-Record following the first public meeting. Ms. Caplan provided additional information to Ms. Nixon and a second article ran the following week, it is also included in Appendix A.

THE RECORD • TUESDAY, NOVEMBER 22, 2016

Caledonian-Record

FOR THE RECORD

Dining Do's And Don'ts — Respecting Your Dog's Eating Space

BY PAT JAUCH

One of the more common causes of dog bites occurs when Fido feels that his food supply is threatened. If you adopt a dog as a puppy you can condition his behavior and teach him that his food will not be taken away and he does not need to protect it. However, if you adopt an older dog you need to determine his level of comfort with any perceived efforts to remove his food before he has finished it. Each dog has an individual personality and you must be mindful that no two dogs will respond identically. Some dogs are perfectly comfortable with the owner who takes major responsibility for keeping the food dish filled. Others distrust not only the food distributor but also any other human who approaches during mealtime. It is important to keep young children at a distance when you feed your pet. Children's shorter stature makes

ones we can be grateful for companionship, good health, and a safe environment. When necessary, there are care givers to look after us and tend to our needs. Good food is available to us, medical care is nearby, and shelter keeps a roof over our heads and protects us from cold wintry weather and summer's heat. These are basic things that sustain us and make our lives livable.

Now consider Thanksgiving from a companion animal's standpoint. Having an owner/forever home provides the love and nurturing needed to maintain good emotional health. A responsible owner sees to it that veterinary care is provided to the animal or animals in his or her care and assures that exercise is a part of everyday living. Spaying or neutering pets will prevent unwanted litters and aid the animal in living a long healthy life. Appropriate accommodations to insulate against winter's cold and summer's heat

NEWS BRIEFS

Town Of Kirby Disaster Planning Meeting

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

Join the Hazard Mitigation Committee on Nov. 29, from 6:30 to 7:30 p.m. to share your ideas for reducing risk and becoming less vulnerable to natural hazards such as floods, hurricanes and winter storms. At the meeting you will learn about the process of developing the Kirby Mitigation Plan and have the opportunity to contribute your ideas for making Kirby more resilient to natural hazards. The meeting will be held at the Town Hall, 346 Town Hall Road, Lyndonville, Vermont.

The purpose of the Hazard Mitigation Plan 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 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 Kirby eligible for federal and state mitigation grant funding pre-disaster.

Kirby was awarded a grant from DEMHS to develop the Hazard Mitigation Plan. The town hired Jamie Caplan Consulting LLC to work with them to develop the Hazard Mitigation Plan. Jamie Caplan Consulting is based in Northampton, Mass. They provide comprehensive emergency management services for all phases of disaster management with an emphasis on mitigation planning.

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 Rebecca Hill-Larsen, Selectboard Clerk, Town of Kirby at 802-626-9386 or beccanterry@gmail.com.

Figure 3.2 Caledonian-Record Announcement of First Public Meeting

NOVEMBER 29, 2016 PUBLIC MEETING

The Hazard Mitigation Committee hosted a public meeting at the Town Hall on November 29, 2016. Rebecca Hill-Larsen, Selectboard Clerk gave a brief opening and then turned the meeting over to Jamie Caplan. The purpose of the first Public Meeting was to introduce the public to the project and answer any of their questions. In addition, the meeting focused on identifying natural hazards, critical facilities and high hazard areas in the Town. Meeting participants had the opportunity to review maps laid out at the front of the room and mark them with key information. Comments during the meeting included a desire to organize small communities within each end of Town for mitigation and preparedness as well as response and recovery. The public also expressed an interest in a

Reverse 911 system. Since a new system may be cost prohibitive and the Town relies on their neighbors for fire and police it was recommended that joining another community's system would be cost effective.

MARCH 27, 2017

The second public meeting was poorly attended. However, the two people who participated joined the Hazard Mitigation Committee Meeting and a productive discussion took place regarding land use practices and potential mitigation actions for Kirby. The Planning Commission was represented at the meeting and discussion regarding the revised Zoning Bylaws took place. The Bylaws were not amended to include mitigation actions; however, they will be in the future.

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 towns that border Kirby; St. Johnsbury to the southwest, Lyndon to the west, Burke to the north, Victory to the northeast, Concord to the southeast, and Waterford to the south. Public meeting announcements were posted in the Caledonian-Record which publishes daily and serves six counties in Northeastern Vermont and Northern New Hamsphire.

Bruce Melendy, NVDA, reached out multiple agencies on behalf of the Kirby Mitigation Plan. Mr. Melendy participates in the LEPC #9 meetings and brought the Kirby Local Hazard Mitigation Plan to the attention of the group in their December 2016 meeting. NVDA supports the Local Emergency Planning Commission #9 (LEPC#9) by hosting volunteer meetings monthly. These meetings support the functions of the LEPC to conduct outreach, hazards identification, planning, training, and exercise plan. LEPC#9 includes the towns of Barnet, Burke, Danville, Groton, Hardwick, Kirby, Lyndonville, Newark, Peacham, Sheffield, Stannard, Sutton, Walden, Waterford, Wheelock, Concord, Granby, Guildhall, and Victory.

The Town of Kirby relies on first responders from Concord, St. Johnsbury and Lyndon as well as the State Police and CALEX Ambulance service. For this reason, representatives from each of the agencies were invited to participate in Kirby's Hazard Mitigation Committee. The Station Commander for the Barracks attends LEPC meetings so Mr. Melendy discussed Kirby's plan with him at the January 25, 2017 meeting. Mr. Melendy, also contacted the Ambulance Service. The Fire Department for that area is either Lyndon or Concord, depending on what area of Kirby the need for the fire department is. The Concord Fire Chief is Richard Fisher and he is the Chairperson of LEPC 9. Both Troy Ruggles, St. Johnsbury Fire Department and Greg Hopkins, Lyndonville Fire Department declined participation in the Kirby Hazard Mitigation Committee.

REVIEWING AND COMMENTING ON THE DRAFT MITIGATION PLAN

The Hazard Mitigation Committee had the opportunity to review digital and hard copies of the plan prior to its release to the public for their review. The Planning Team sent a copy of the draft plan to each Hazard Mitigation Committee member for his or her review. They were instructed to provide comments via email or phone to Rebecca Hill-Larsen, Selectboard Chair. After Hazard Mitigation Committee comments were gathered the plan was made available for review by the public. Announcement of the draft plan was made via flyer, press release and

email. The flyers were posted at all bulletin boards leading into Kirby as well as at the Town Hall. The plan was posted to the Town's website, http://kirbyvermont.org and hard copies were available for review at the transfer station and the Town Hall. The plan was available for public review for over two-weeks. The public was asked to provide comments via email or phone to the Town Clerk. The plan was also sent to Alison Lowe and Bruce Melendy at NVDA for their review.

CHAPTER 4

RISK ASSESSMENT

CHAPTER 4. RISK ASSESSMENT

This risk assessment aims at showing what natural disaster risks people are facing in the Town of Kirby. Based on this a comprehensive natural hazard risk and vulnerability assessment has been developed and is presented in the following. This risk assessment examines the vulnerability of current and future populations, and structures (critical facilities) to various natural hazards. The risk assessment provides a compilation of available information and data sets to the planning area for comprehensive planning purposes. The risk assessment addresses hazard history, probability, frequency, and impact.

HAZARD IDENTIFICATION

NATURAL HAZARDS

FEMA defines a hazard as an act or phenomenon that has the potential to produce harm or other undesirable consequences to a person or thing.[19] Without proper mitigation of hazards these could turn into disasters. Therefore hazards pose risks to property damage and human life, and have the ability to limit access to electrical power, tele-communication services, potable water, wastewater collection/treatment and transportation. Downed trees and tree limbs may also limit emergency access and hinder cleanup efforts. Table 4.1 below gives an overview of natural hazards and associated impacts.

Table 4.1 Natural Hazards and Associated Potential Impacts

Natural Hazards	Potential Impacts
Dam Failures / Breaches	Inland flooding
Droughts	Increased fire danger, limited water
Earthquakes	Damaging ground movement
Floods	Coastal flooding, inland flooding, erosion
Hurricanes	High winds, coastal flooding, inland flooding
Ice Storms	Ice buildup
Ice Jams	Inland flooding
Microburst	High winds
Nor'easters	High winds, coastal flooding, inland flooding
Thunderstorms	High winds, lightning, inland flooding
Tornadoes	High winds
Snowstorms and Blizzards	Heavy snowfall, coastal flooding, high winds
Wildfires	Fire

As shown in the following, natural hazards typically encountered in the planning area are high wind events, winter storms and heavy rain events and snow melts.

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

HAZARD IDENTIFICATION - METHODOLOGY

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)

This section identifies the types of hazards that can affect the planning area. The study focuses on natural hazards, a FEMA requirement.

Background on conducted research

This plan includes a description of the natural hazards that affect the planning area. We have reviewed the Vermont State Hazard Mitigation Plan, and existing town and state plans and information related to hazards in the planning area and included the information as applicable. Please refer to the resources section for detailed information. A list of major presidential disasters (declared disasters) within the jurisdiction has been reviewed as well (see Table 4.3). We have consulted with residents and stakeholders on their best knowledge of past hazard events. Past weather related events were downloaded from the National Climatic Data Center and researched and analyzed. Other web sources were researched as well.

Federal Disaster Declarations in Caledonia County, VT:

Between 1963 and 2013, Vermont experienced 34 federal disaster declarations according to the State Hazard Mitigation Plan. Among Vermont's counties that have received the most federal disaster declarations, Caledonia County ranks second after Lamoille County to the West of Caledonia County.[20] Between 1992 and 2016, nineteen presidential disasters have been declared for Caledonia County (compare Table 4.2).

All the disasters in recent years have been declared because of extreme weather conditions. Historically, flooding and flash flooding have caused the most disaster-related damage in Vermont. Most of the declared disasters were the result of suffering caused by flood damage.

Table 4.2 below shows presidential disasters reported in Caledonia County, VT and Table 4.3 shows identified hazards in the planning area.

[20] State of Vermont Hazard Mitigation Plan. (2013). Federal Emergency Management Agency: State of Vermont.

Table 4.2 Presidential Disasters Impacted Caledonia County, VT[21]

Disaster Name (Date of Event)	Date (Disaster Declaration)	Disaster Number (Type of Assistance)	Declared Areas
Severe storms and flooding	7/11/2014	DR-4178	Caledonia, Essex, Franklin, Lamoille, Orange, Orleans, and Washington counties
Severe winter storms	1/29/2014	DR-4163	Caledonia, Chittenden, Essex, Franklin, Grand Isle, Lamoille, and Orleans counties
Severe storms and flooding	8/2/2013	DR-4140	Caledonia, Chittenden, Orange, Orleans, Rutland, Washington, and Windsor counties
Severe storms and flooding	11/8/2011	DR-4043	Caledonia County added for PA and Washington County for IA
Tropical Storm Irene	9/1/2011	DR-4022	Addison, Bennington, Caledonia, Chittenden, Essex, Franklin, Lamoille, Orange, Orleans, Rutland, Washington, Windham, Windsor for PA Chittenden, Rutland, Washington, Windsor for IA
Severe storms and flooding	7/8/2011	DR-4001	Caledonia, Washington counties
Severe storms and flooding	7/8/2011	DR-4001	Essex, Orange, Caledonia, Washington for PA Washington for IA
Severe storms and flooding	9/15/2008	DR-1790	Addison, Caledonia, Essex, Lamoille, Orange, Washington, Windsor
Severe storms, tornado and flooding	8/15/2008	DR-1784	Caledonia, Grand Isle, Lamoille
Severe storms, flooding	8/3/2007	DR-1715	Orange, Washington, Windsor, Caledonia, Orleans
Severe storms, flooding	8/3/2007	DR-1715	Orange, Washington, Windsor, Caledonia, Orleans
Severe Storms, High Winds, Flooding	5/4/2007	DR-1698	Bennington, Caledonia, Essex, Orange, Rutland, Windham, Windsor, and Lamoille (added)
Severe storms and flooding	9/23/2004	DR-1559	Windham, Addison, Chittenden, Lamoille, Caledonia, Orleans, Franklin
Severe storm, flooding	7/12/2002	DR-1428	Caledonia, Franklin, Lamoille, Orleans, Essex
Tropical Storm Floyd	11/12/1999	DR-1307	Bennington, Caledonia, Essex, Lamoille, Orange, Orleans, Rutland, Washington, Windham, Windsor
Severe Storms	7/1/1998	DR-1228	Addison, Caledonia, Chittenden, Essex, Franklin, Lamoille, Orange, Orleans, Rutland, Washington, Windsor
Excessive Rainfall; High Winds; Flooding	4/25/1997	DR-1184	Caledonia, Franklin, Lamoille, Orleans, Washington
Heavy Rain; Flooding	8/16/1995	DR-1063	Caledonia, Chittenden, Essex, Lamoille, Orleans, Washington
Ice Jams; Flooding	3/18/1992	DR-938	Caledonia, Orange, Washington, Windsor

The Federal Emergency Management Agency (FEMA) conducts Flood Insurance Studies (FIS) and develops accompanying Flood Insurance Rate Maps (FIRMs) to determine the extents of the flood inundation area. Kirby has a FIRM and an Interim River Corridor Protection Program in place.[22] However, Kirby's FIRM area is not yet digitized.

[21] State of Vermont Hazard Mitigation Plan. (2013). Federal Emergency Management Agency: State of Vermont.
[22] Flood Ready Atlas: Kirby, VT. (2017). State of Vermont. Retrieved from http://floodready.vermont.gov/assessment/vt_floodready_atlas

According to the Town's printable flood map (flood map number 500188, dating 12/13/1974) the FIRM is completely located within the river corridor in south Kirby.

Table 4.3 Hazard Identification for the Town of Kirby

Natural Hazard listed in 2013 Vermont SHMP	Town of Kirby Relevance and Justification for Inclusion	Included in Town of Kirby HMP
FLOOD HAZARDS		
Flooding and Fluvial Erosion	FIRM for area of Moose River / Rt.2 (not yet digitized). Additionally flash flooding may be a concern. Partly expansive soils are present which yield a high rain water run-off. Furthermore, roads are subject to washouts from heavy rain events and snow melt.	Yes
WIND HAZARDS		
Severe Thunderstorm (incl. wind and lightning)	Lightning can result in death and injury. It is frequently associated with thunderstorms.	Yes
Hurricanes and Tropical Storms	Tropical Storm Irene impacted the planning area in 2011. Hurricanes or tropical storms can result in wind damage, tornadoes, and flooding.	Yes
Tornadoes	Tornadoes pose a significant risk because buildings may not be built to withstand severe winds in this part of the country. Microbursts are a concern as well.	Yes (Tornadoes and Microburst)
WINTER HAZARDS		
Severe winter storms	This hazard includes snow, ice and blizzard events. There are major disaster declarations associated with these events. Blizzards are an expected type of winter storm that pose a risk to the population and structures due to power failure, car accidents, and stranding. Ice storms are an expected type of winter weather that pose a risk to the population and structures due to power failure, car accidents, and stranding. They are also known to produce vegetative debris due to fallen limbs. Nor'easters are a concern and expected posing risks to population and structures associated with power failure. Snow events are also common occurrences in the winter months. It poses a risk to the population and structures due to power failure, car accidents, and stranding.	Yes (blizzard, ice storms, Nor'easter, snow events)
Ice Jams	Ice jams have been reported for the Moose River in Victory, VT.	Yes
Hail	Hail is typically associated with thunderstorms and can cause extensive property damage (especially to roofs) and vehicular damage.	Yes
Extreme Temperatures	Extreme temperatures may include extreme heat and cold. Cold and heat can become a hazard, particularly for vulnerable populations, if the power is disrupted or the event lasts several days. Cold may also result in hypothermia or frostbite due to exposure. Heat can result in a variety of health conditions including heat stroke.	Yes

Natural Hazard listed in 2013 Vermont SHMP	Town of Kirby Relevance and Justification for Inclusion	Included in Town of Kirby HMP
FIRE HAZARDS		
Drought	Drought typically occurs in the summer months and can result in wells to dry up and an increased fire hazard.	Yes
Wildfire	There is no history of natural fire events. However, this hazard was included due to the amount of open natural areas potentially at risk to wildfire.	Yes
GEOLOGICAL HAZARDS		
Earthquake	Earthquakes are possible in this area and may cause damage to structure and injury or death to the population.	Yes
Landslide	Landslides have not historically impacted the area but are considered possible. The area is made up from mostly expansive soils with several steep roads and creeks along roads that may flood or erode in high rain events.	Yes
OTHER POTENTIAL HAZARDS		
Invasive Species	Invasive species may destroy crops resulting in economic damage. They may also pose a direct threat to human health. No invasive species are shown in Kirby according to Vermont's Forest Plan.	No

The section on hazard profiles describes each identified hazard for the Planning area of Kirby in more detail. Hazards are presented in six overarching categories:

- Flood hazards
- Wind hazards
- Winter hazards
- Fire hazards
- Geologic hazards
- Other potential hazards

DESCRIPTION OF PRIORITIZATION AND CATEGORIZATION OF IDENTIFIED HAZARDS (PRIORITY RISK INDEX)

The prioritization and categorization of identified hazards for the planning area is based principally on the Priority Risk Index (PRI), a tool used to measure the degree of risk for identified hazards in a planning area. 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)]

The scoring criteria and weighting scheme of the priority risk index are shown in Table 4.4 below. According to the applied weighting scheme, the highest possible PRI value is 4.0. Table 4.4 lists 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 Kirby, 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 planning area, and the PRI is helpful in summarizing the potential risk.

Table 4.4 Priority Risk Index Scoring Criteria

PRI Category	DEGREE OF RISK			Assigned Weighing 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 affected.	3	
	Large	All areas affected.	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%
	6 to 12 hours	self-explanatory	2	
	12 to 24 hours	self-explanatory	3	
	More than 24 hours	self-explanatory	4	

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 in Table 4.3 is profiled separately to describe the hazard and its potential impacts on the planning area. 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 planning area (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, wave height, or property damage, for example;
- Probability of future events: The likelihood of future events impacting the planning area. 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.

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

FLOOD HAZARDS

Flood hazards include dams, beaver dams and flooding including fluvial erosion and flooding from heavy rainstorms and snowmelt.

Flood hazards from dam breaches are a minor concern in Kirby and are not assessed in this study. There is only one dam in the southeastern planning area bordering Essex County located along a small creek. It is rated with a low hazard potential (compare Appendix B Dams in Kirby).

Dams are classified through the U.S. Army Corps of Engineers based upon hazard potential. The hazard potential reviews the consequences if the dam were to fail. Its designation considers distance from nearest community

downstream, population density, acre-feet capacity of the dam, and age of the dam.23 Ratings are 1) high, 2) significant, or 3) low hazard. A low hazard dam failure would likely result in minimal property damage.

BEAVER DAMS

Description

Beavers build dams as a form of protection. Beaver dams are formed by tree branches, mud and rocks collected by the beavers. By flooding the area behind the dam, beavers build a safe basin which functions as their habitat and which allows them to easily obtain food (bark and aquatic vegetation). Beavers typically select spots where there is a large flat area to flood with plenty of trees nearby.[24] Beavers can impact the flow of water and cause flooding by cutting down trees and creating dams.

Location

Beaver dams are typically located in slow flowing currents where the water is relatively shallow, but deep enough to provide habitat under winter ice. Figure 4.1 depicts locations of beaver dams as noted in the public meeting on November 29th, 2016.

[23] National Inventory of Dams. (2017). U.S. Army Corps of Engineers. Retrieved from http://geo.usace.army.mil/pgis/f?p=397:1:10147282542258::NO

[24] Beaver Behavior and Biology. (2014). Beaver Solution. Retrieved on December 1, 2016 from http://www.beaversolutions.com/about_beaver_biology.asp

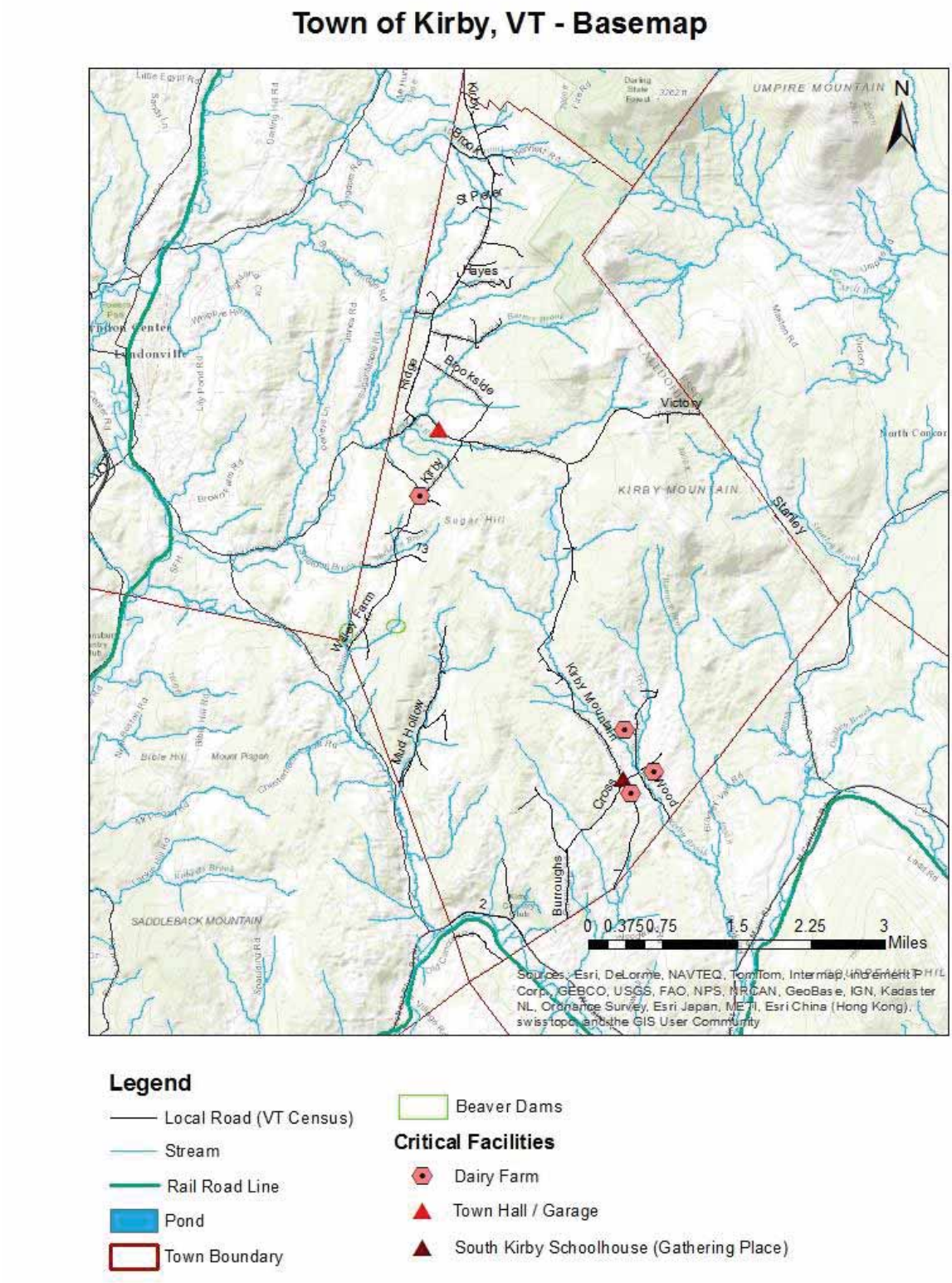


Figure 4.1 Location of beaver dams

Previous Occurrences and Extent

No actual damage from beaver dams has been reported. The size of the beaver population is unknown.

Extent can be defined as number of homes at risk to flooding. While exact figures are not provided, all structures in vicinity of the beaver dams are at risk and could be flooded due to the impacts of beaver dams. Figure 4.2 gives a close-up view on the beaver dam locations. As shown on Figure 4.2, one beaver dam is located approximately 115 m (377 ft) from a building east of Willey Farm Road, whereas two other structures on Shirley Lane are located about 70 m (230 ft) downstream from Woods Brook. The beaver dams themselves are located about 520 m (1700 ft) away from the structures on Shirley Lane.

Probability of Future Events and Extent

Since the size of the beaver population is unknown, it is difficult to estimate the likelihood of future events. Given the tenacity and industrious nature of beavers, it could be assumed that beaver dams are occurring annually though may not require annual attention. Regular monitoring of the beaver dams and - if needed - regular maintenance such as beaver dam reconstruction can prevent significant damage, such as flooding. A PRI probability of unlikely to possible was assigned.

Vulnerability Assessment and Estimated Losses

When a beaver dam is breached, it results in flooding. Any current or future structures or population near a beaver dam are potentially at risk. Losses can be assessed based on location and size of the existing beaver dam. However, since no further information about the beaver population size is given in Kirby, estimating losses is difficult. Proper management of beaver dams can mitigate any potential impacts that may arise.

There are no critical facilities at risk to beaver dams. Although previous occurrences are not known, it is assumed that the structures on Shirley Lane Road depicted in Figure

4.2 may be impacted in case the beaver dam brakes. The residents of Shirley Lane Road voiced their concern about the beaver dams in the past. The structure on Willey Farm Road would likely not be impacted since it is located upstream from the creek. It is assumed that, in case of a beaver dam brake, Willey Farm Road and Shirley Lane Road would be locally flooded respectively. Shirley Lane Road is a Class 4 Road. Other than Class 1, 2, and 3 highways, Class 4 Roads are not maintained and do not receive state aids.[25]

Annualizing potential losses over time would likely result in negligible losses.

[25] Horn, Karen. (2014).

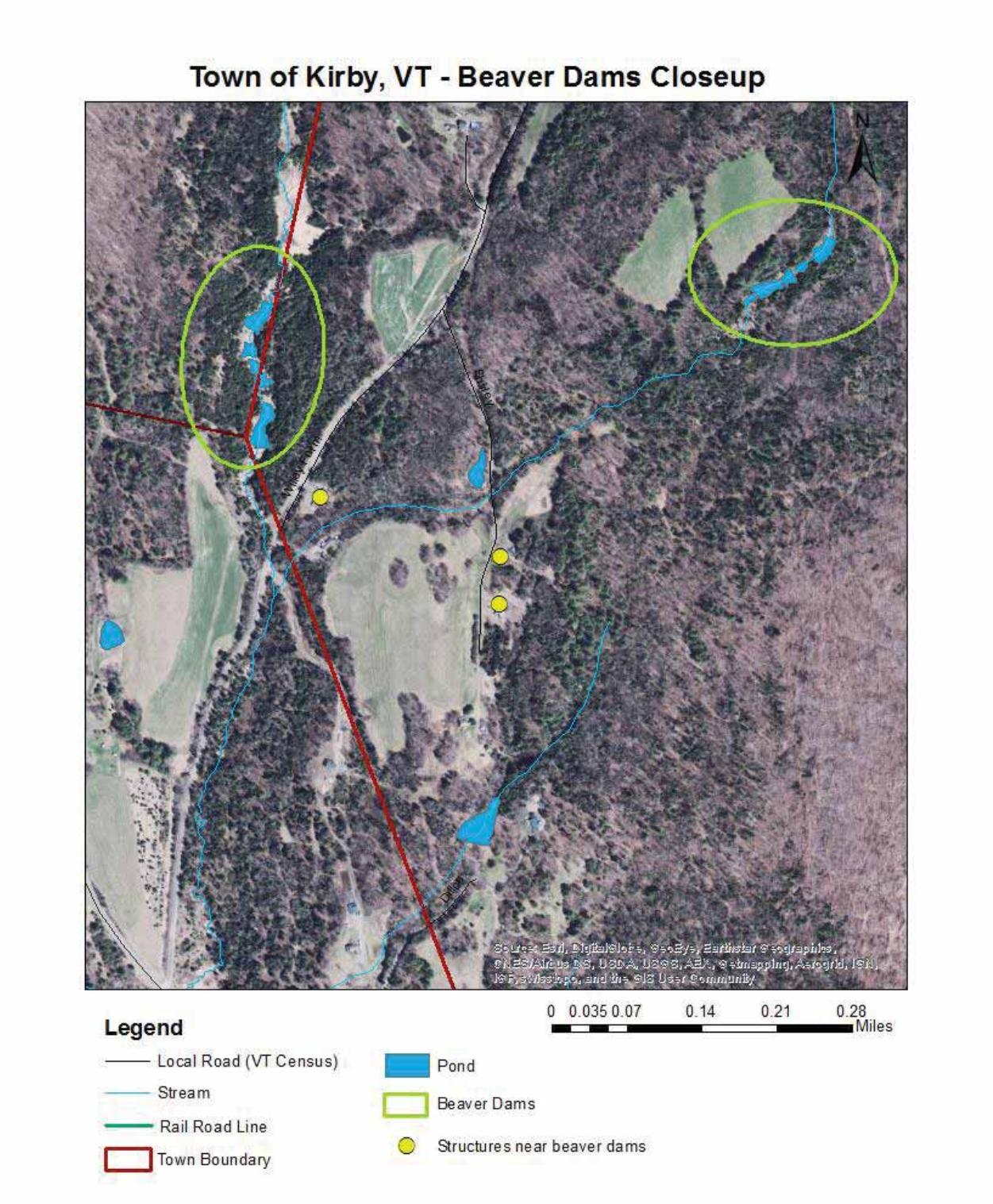


Figure 4.2 Beaver dam location close-up

FLOODING / FLOOD INCLUDING FLUVIAL EROSION AND FLOOD FROM HEAVY RAINSTORMS AND SNOW MELT

Flooding is a frequent, dangerous, and costly hazard. Flooding in the US accounts for a 10-year average of 84 deaths per year.[26] Nearly 90 percent of all presidential disaster declarations result from natural events that included flooding as a major component. In addition, high rain events and snow melt that lead to flooded roads are a concern on Kirby's dirt roads.

Description

The National Oceanic and Atmospheric Administration (NOAA) National Weather Service (NWS) defines a flood as the inundation of a normally dry area caused by rising water in an existing waterway, such as a river or stream, and notes that flooding is a longer-term event that may last days or weeks.[27]

Flooding events are typically dependent on a combination of several factors, including river basin topography, precipitation and weather patterns, recent soil moisture conditions, and degree of impervious surface.

There are four main types of flooding that occur in Vermont: 1) flash flooding, 2) sheet flooding, 3) urban flooding and 4) riverine flooding. The effects of all types of flooding events can be worsened by ice or debris jams or the failure of infrastructure including bridges, culverts, and dams as well as beaver dams.[28]

The types of flooding are presented below:

1. A flash flood is defined as a flood caused by heavy or excessive rainfall in a short period, generally less than six hours. Flash floods are usually characterized by raging torrents after heavy rains that rip through river beds, urban streets, or mountain valleys. They can occur within minutes or a few hours of excessive rainfall. They can also occur even if no rain has fallen, for instance after a levee or dam has failed, or after a sudden release of water by a debris or ice jam.[29]

2. 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.

3. Urban flooding is usually caused by heavy rain over a short period. 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. Urbanization increases runoff two to six times over what would occur on natural terrain. Consequently, 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

[26] Weather Fatalities. (2014). National Weather Service. Retrieved on January 12, 2017 from www.nws.noaa.gov/om/hazstats/resources/weather_fatalities.pdf
[27] National Weather Service Glossary. (2016). National Oceanic and Atmospheric Administration.
[28] Division of Emergency Management and Homeland Security. (2013). State of Vermont.
[29] National Weather Service Glossary. (2016). National Oceanic and Atmospheric Administration.

development within stream floodplains. Streets or rail tracks within or adjacent to floodplains are prone to flooding.

4. 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 magnitude and an equal or larger flood. Flood magnitude increases with increasing recurrence interval.

Flooding can occur within a designated floodplain area and adjacent to it. Floodplains are designated by the frequency (and severity) of the flood that occurs on 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 each 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. Furthermore, all development and infrastructure located in floodplains and other areas where water may accumulate within the Town are potentially vulnerable to the flood hazard.

Fluvial erosion is a significant component of flood disasters. Steeper sloped areas and smaller streams are most prone to fluvial erosion. Flood erosion hazards (FEH) are currently not depicted on FIRM data. Whatsoever, the Vermont Agency of Natural Resources (VANR) has been working with towns to identify and map river corridors and implement protection strategies designed to mitigate FEH. A river corridor map shows the area a river needs to accommodate equilibrium conditions, specifically the meanders (stream length) and slope requirements of a stable stream channel. It also shows the land most vulnerable to erosion from flooding. Preventing further encroachment into the river corridor will minimize fluvial erosion hazards and property loss from flooding, enhance public safety, maximize channel stability, and maintain or improve water quality and habitat function30.

In addition, flooding due to snow melt is common in the spring months due to fast warming temperatures. High rain events and snow melt that lead to flooded roads are a concern on Kirby's dirt roads. We have reviewed weather data for heavy rain events and snow melt to better address this hazard.

Flooding from Heavy Rainstorms, Thunderstorms and Snowmelt

Rainstorm and Thunderstorms

A rainstorm is defined as a storm characterized by the fall of liquid precipitation according to the meteorology glossary. A more severe rainstorm associated to a storm is considered a thunderstorm. 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.[31] These storms may also bring flash

[30] Vermont Agency of Natural Resources. (2016). State of Vermont.
[31] Thunderstorm. (2012). Meteorology Glossary: American Meteorological Society. Retrieved on December 14, 2016 from http://glossary.ametsoc.org/wiki/Thunderstorm

flooding and frequently result in flood watches and warnings. This hazard profile will consider the rain produced by thunderstorms.

Snowmelt

Snowmelt is the water resulting from the melting snow. According to the U.S. Geological Survey (USGS), most run and stream flow in rivers is attributed to snowmelt. The effect of snowmelt on flooding occurs mainly in the spring when temperatures begin to rise. Snowmelt may also occur when rain falls on snow (a rain-on-snow-event). This results in increased run off from the rain event.[32]

Climate Change does have an accelerating effect on flooding due to the increase in frequent high rain events.

Location

Kirby is located in the Passumpsic and Upper Connecticut River Tactical Basin within the subwatersheds of the Moose River watershed and the Passumpsic River (to the north). The Moose River watershed covers most of the planning area with the exception of a small portion to the north.

Kirby sits on hilly terrain with elevation levels ranging from 815 feet (ft) to above 2,500 ft above sea level. The lower portion (about ten percent (%) of the land) contains the Town's Flood Plain area along the Moose River. Forty percent of the land sits on land ranging from 1,100 to 1,400 feet (ft) and contains primarily land for homes and farmlands. Areas above 1,400 ft are mostly forested (some lower parts are used as pasture) and commonly have steep slopes hindering land utilization. Kirby's major population areas are located in northern, middle (Mud Hollow Rd) and southern Kirby. Homesteads are mostly located alongside the streets. An area zoned as commercial/light industrial area including a few residences is located along the Moose River corridor with access to Route 2 in the southern tip of the planning area.[33]

Kirby has a FIRM and an Interim River Corridor Protection Program in place.[34] However, Kirby's FIRM area is not yet digitized. According to the Town's printable flood map (flood map number 500188, dating 12/13/1974) the FIRM is completely located within the river corridor in south Kirby shown on Figure 4.3. The main source of riverine flooding in Kirby is the Moose River. It has a total drainage area of 75 m^2. The Southern Kirby portion located along Route 2 runs adjacent to the floodplain area and is susceptible to flooding.

Kirby has enacted a Floodplain District. This zone encompasses all land "within the 100 year floodplain in town, all of which is located along the Moose River at the south end of town." [35] Zoning maps showing the exact location of the zoning districts were not available.

According to the Town of Kirby, flooding from the river does not occur often and is not a serious threat.

[32] Snowmelt – The Water Cycle. (2016). U.S. Geological Survey. Retrieved from http://water.usgs.gov/edu/watercyclesnowmelt.html
[33] Kirby Town Plan. (2012). Town of Kirby. Pg. 8.
[34] Flood Ready Atlas: Kirby, VT. (2017). Flood Ready Vermont. Retrieved from http://floodready.vermont.gov/assessment/vt_floodready_atlas
[35] Kirby Town Plan. (2012). Town of Kirby. Pg.6.

Figure 4.3 Kirby's river corridors

Heavy rainstorms and *snow melt* will impact the entire planning area. Roads and properties on steep areas or low-laying areas may experience the hazardous aspects of snow melts. The Town of Kirby is concerned with the transportation conditions on their roads. Heavy rain events and snow melt have washed out roads in the past.

Kirby's transportation system consists of a few dirt roads which connect the residents to services outside of Kirby and one asphalt road which seems to be in bad shape (according to our site visit in November 2016). Several of the roads are very steep and hard to travel on. Hazardous weather conditions such as winter weather or quick thaw transform the roads into slippery and muddy arteries that are dangerous to navigate.

Figure 4.4 shows problem road areas in Kirby. The public meeting on November 29, 2016 addressed several issues and localized road problem areas which are depicted in Figure 4.4. Kirby's roads are mostly made up from dirt roads. As can be seen in Figure 4.4, several of the culverts are located in crossings to rivers and creeks and are prone to flooding and wash out in case of heavy rain events or snow melt. As an existing mitigation measure to road wash out, the Town has applied ditches to lead the water away from the roads. Another mitigation measure in place is a stamtt on Kirby Road. A stamatt is a mat that is put on top of the dirt road to harden the soil and improve driving conditions – the mat is re-applied every few years. Additionally, per conversations with the town, the lower part of Kirby Road is an asphalt road which is in bad shape.[36]

Snow and ice removal operations on roadways in Kirby appear to be somewhat cumbersome due to operational practices in place. The sand pile used to treat the roads in winter is hard to access. According to our conversations with the town, the sand pile is located on town-land along side of a hill. However, in order to access and make use of the sand, several steps need to be undertaken since the equipment for obtaining the sand is stored someplace else due to limited space on-site.

[36] Kirby participates in the "Better Roads" program and is currently conducting an inventory of their roads. The Town is planning to repave its asphalt road.

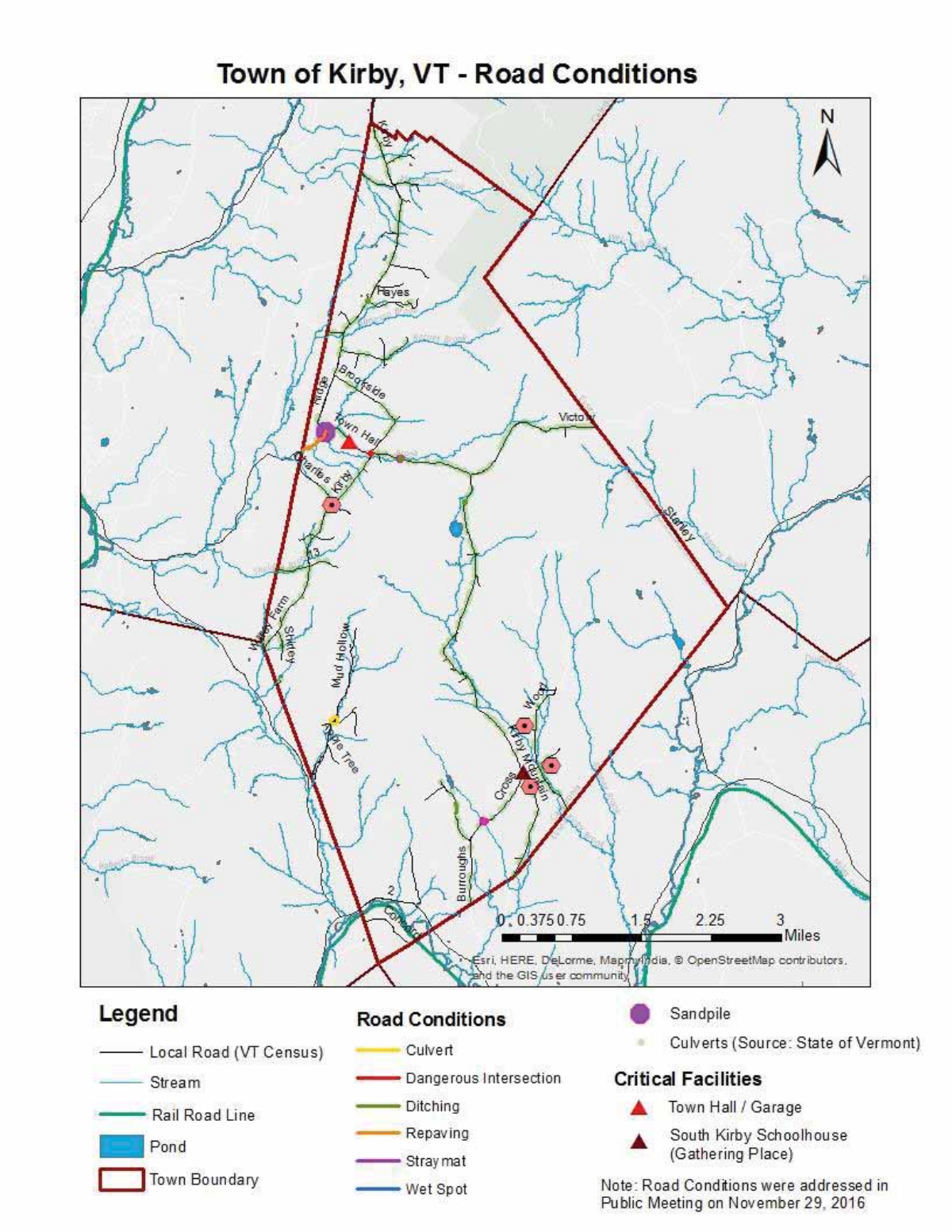


Figure 4.4 Kirby's road conditions

Furthermore, hydrologic soil groups in the planning area have been analyzed to further assess the risk of flooding.

Hydrologic Soil Groups[37]

Soils are classified by the Natural Resource Conservation Service into four Hydrologic Soil Groups based on the soil's runoff potential. The four Hydrologic Soils Groups are A, B, C and D. Soils grouped as A's generally have the smallest runoff potential and D's the greatest. Table 4.5 provides more background on the soils water infiltration capacity:

- Group A is sand, loamy sand or sandy loam types of soils. It has low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission.
- Group B is silt loam or loam. It has a moderate infiltration rate when thoroughly wetted and consists chiefly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.
- Group C soils are sandy clay loam. They have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure.
- Group D soils are clay loam, silty clay loam, sandy clay, silty clay or clay. They have the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with high swelling potential, soils with a permanent high water table, soils with a clay pan or clay layer at or near the surface and shallow soils over nearly impervious material.

Table 4.5 Hydrologic Soil Groups (HSG) water infiltration potential

HSG	Soil texture	Saturated hydraulic conductivity of the least transmissive layer
A	Sand, loamy sand, or sandy loam	>40.0 µm/s (>5.67 in/h)
B	Silt loam or loam	≤40.0 to >10.0 µm/s (≤5.67 to >1.42 in/h)
C	Sandy clay loam	≤10.0 to >1.0 µm/s (≤1.42 to >0.14 in/h)
D	Clay loam, silty clay loam, sandy clay, silty clay, or clay	≤1.0 µm/s (≤0.14 in/h)

As can be seen on Figure 4.5 (soil map), the soils making up the creek areas are mostly classified as sandy clay loam or clay soils (HSG group C or D). These soils are more prone to fluvial erosion. Per the Town Plan, the flood plain soils are comprised of Windsor-Gravelly Windsor Association and Limerick-Winooski Association soils which develop a "flooding or 'ponding' hazard"[38]. Based on these findings, the soils making up the creeks in the planning area are susceptible to fluvial erosion.

[37] Urban Hydrology for Small Watersheds Technical Release. (2016). United States Department of Agriculture: Engineering Division of the Natural Resource Conservation Service. Pg. 55.
[38] Kirby Town Plan. (2012). Town of Kirby. Pg.9

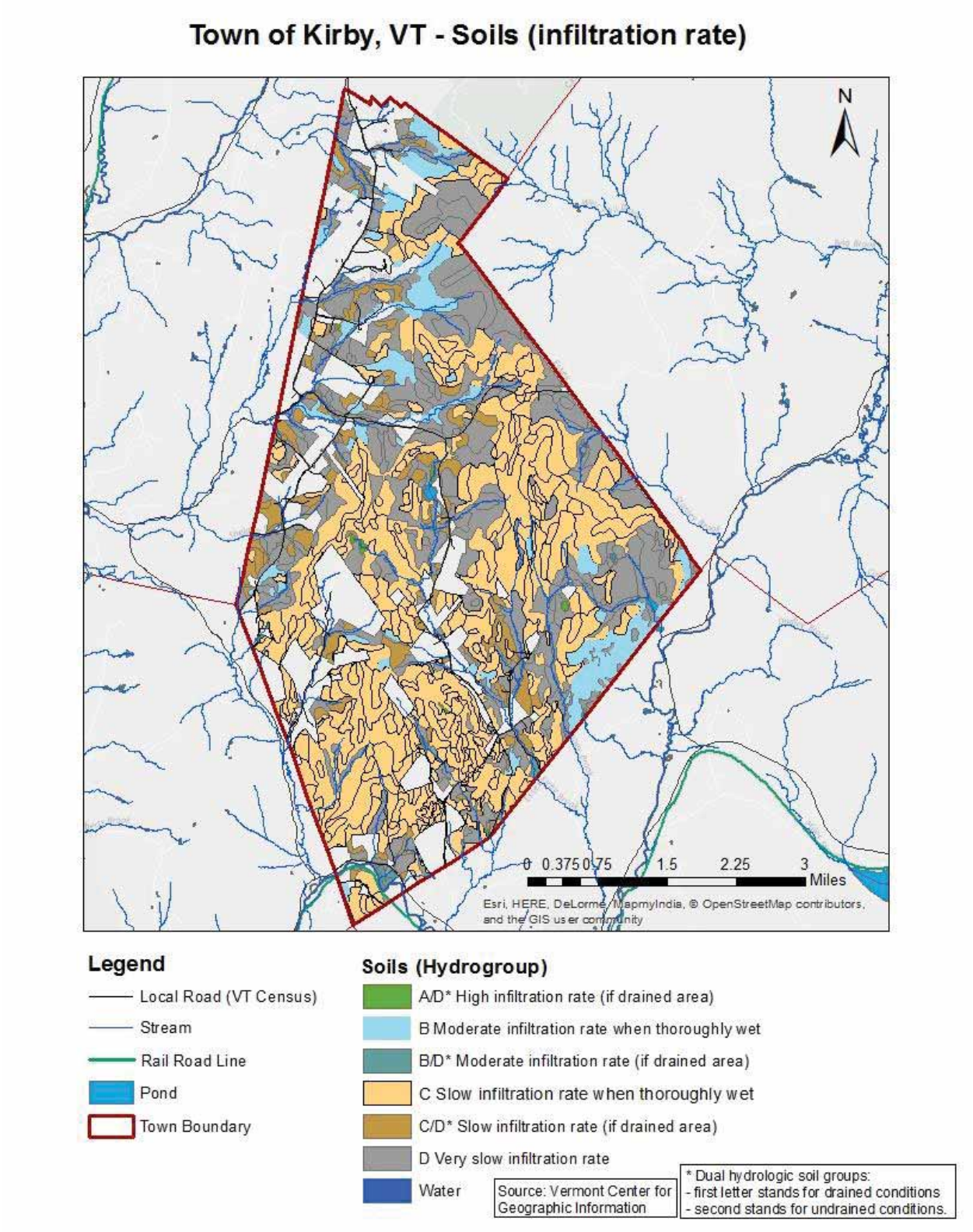


Figure 4.5 Kirby soils (water infiltration rate)

Previous Occurrences

Flooding including fluvial erosion. Various sources were consulted to collect data on previous occurrences of flooding, including:

- Kirby Town Plan (2012)
- Vermont Hazard Mitigation Plan – Significant Flood Events in Caledonia County 2002-2012 (DEMHS, 2013)
- FEMA Disaster Declarations for Caledonia County 2002-2016 (FEMA, 2016)
- NOAA National Climatic Data Center (NCDC) Storm Events Database 1950-2016
- NOAA NWS Historic Crests for Moose River at Victory, VT 1927-2016

Summary tables of previous flooding events compiled from these sources are provided below.

Table 4.6 Significant Floods Events in Caledonia County, VT (2002-2012)[39]

Begin Date	End Date	Remarks	Property
4/13/2002	4/14/2002	--	$25,060
12/6/2002	6/13/2002	--	$29,759
10/27/2003	10/28/2003	--	$6,190
3/4/2005	3/4/2005	Flood	$5,778
1/18/2006	1/19/2006	Flood	$28,261
5/16/2007	5/16/2007	Flood	$21,895
11/7/2007	11/7/2007	Flash Flood	$273,684
4/29/2008	4/30/2008	Flood	$26,263
6/8/2008	6/8/2008	Flash Flood	$52,525
7/24/2008	7/24/2008	Flood	$10,505
8/3/2008	9/3/2008	Flash Flood	$210,101
1/10/2010	1/10/2010	--	$104,000
3/23/2010	3/23/2010	--	$2,080

**Adjusted for inflation to 2013.*

Table 4.7 FEMA Disaster Declarations for Caledonia County, VT (2002 – 2016)[40]

ID	Begin Date	End Date	Disaster Type	Total Public Assistance (Statewide)
DR-4178	4/15/2015	4/18/2015	Severe Storms and Flooding	$1,781,052
DR-4140	6/25/2013	7/11/2013	Severe Storms and Flooding	$5,294,321
DR-4022	8/27/2011	9/2/2011	Tropical Storm Irene	$177,047,881
DR-4001	5/26/2011	5/27/2011	Severe Storms and Flooding	$10,073,955
DR-1790	7/21/2008	8/12/2008	Severe Storms and Flooding	$4,339,132
DR-1784	7/18/2008	7/18/2008	Severe Storms, Tornado, and Flooding	$264,534
DR-1715	7/9/2007	7/11/2007	Severe Storms and Flooding	$4,743,733
DR-1698	4/15/2007	4/21/2007	Severe Storms and Flooding	$2,791,537
DR-1559	8/12/2004	9/12/2004	Severe Storms and Flooding	$2,344,966
DR-1428	6/5/2002	6/13/2002	Severe Storms and Flooding	$1,744,455

**Older disaster declarations are listed for Vermont going back to 1964, but county-specific information is not available.*

[39] Division of Emergency Management and Homeland Security. (2013). State of Vermont.
[40] Disaster. (2016). Federal Emergency Management Agency. Retrieved from https://www.fema.gov/disaster/

Additionally, a table on storm events in Caledonia County can be found in the Appendix B. As shown in these tables, flooding is a serious concern which caused significant damage in the areas surrounding Kirby. However, no events are noted for the planning area in particular. According to our research and conversations with the Town, Kirby itself has not experienced any significant flood disasters.

Flooding from heavy rainstorms and snow melt

As shown in Appendix C flooding from heavy rainstorms occurred eight times in Caledonia County between 2002 and 2016. Table 4.8 below details those heavy rainstorm events.

Table 4.8 Flooding from heavy rainstorms[41]

Begin Location	End Location	Begin Date	Event Type	Property Damage	Flooding Cause
Danville	East Peacham	5/30/2011	Flash Flood	$75,000	Heavy Rain
Ricker Mills	East Ryegate	5/26/2011	Flash Flood	$2,500,000	Heavy Rain
Lyndon Center	Lyndon	10/1/2010	Flood	$100,000	Heavy Rain
Barnet Center	St Johnsbury	8/6/2008	Flash Flood	$50,000	Heavy Rain
Lyndon Center	Lyndon Center	7/24/2008	Flood	$10,000	Heavy Rain
Hardwick	Hardwick	7/11/2007	Flash Flood	$250,000	Heavy Rain
Stannard	Stannard	5/16/2007	Flood	$20,000	Heavy Rain
Caledonia		6/12/2002	Flood	$50,000	Heavy Rain

The following details are known about these eight events[42]:

- **05/16/2007:**
  Stannard, VT. Heavy rainfall exceeded 2 inches across a large portion of Caledonia, Essex and Orleans counties and resulted in flooding of streams, small rivers as well as induced a landslide. The Stannard Brook in Stannard (Caledonia County), Nichols Brook south of Hardwick (Caledonia County), and the headwaters of the Lamoille River flooded fields and portions of Streets. Nichols Brook overflowed portions of Route 14 and Lamoille River overflowed on Rt. 16 in Greensboro Bend (Orleans County). Heavy rains resulted in a landslide on the Hunt Hill road in Brownington (Orleans County) after 2.6 inches of rain and a mudslide which led to closure of portions of Route 102 in Bloomfield (Essex County). Stannard, VT is located about 20 miles west, Hardwick about 28 miles west and Greensboro Bend about 23 miles west of Kirby.
- **07/24/2008:**
  Lyndon Center. Heavy rainfall caused flood problems across central and north central Vermont on already saturated soils from previous heavy rain fall events of July 18 and July 21st and 22nd. Route 122 and Stevens Loop closed due to high water on roadways. Property damage of $10,000.
- **10/01/2010:**
  Lyndon Center. Heavy rains caused flooding along the Passumpsic River and its tributaries in Lyndonville. On the north side of Lyndonville, Water covered Routes 122, 114, and 5 between the confluence of the East and West Branches of the Passumpsic, and Miller Run. Miller Run also flooded Center Street near Route 122. Further downstream along just south of Lyndonville village, Route 5 was closed between Hill

[41] Storm Events Database. (2016). National Oceanic and Atmospheric Administration. Retrieved from https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=5304848
[42] Abid.

Street and Red Village Road by flood waters from the Passumpsic. A motorist was trapped by rising flood waters but escaped to safety, and two kayakers were reported missing but later found safe. Evacuations were recommended to residents along Route 122 between Lyndonville and Interstate 91 due to limited access.

- **05/30/2011:**
  Danville. Heavy rains from thunderstorms washed out multiple local roads in Danville. Property damage of $75,000.
  Danville is located about 19 miles southwest of Kirby.
- **06/29/1998:**
  Ricker Mills. Flash flooding from thunderstorms resulted in road washouts in and around Ricker Mills. Specifically, road washouts were reported in the Ricker Campgrounds (Caledonia County). Property damage of $5,000.
  Ricker Mills is located about 40 miles southwest of Kirby.
- **08/06/2008**:
  Barnet Center / St. Johnsbury. Flash flooding closed roads in Barnet and Danville. In St. Johnsbury, a business was evacuated on Emerson Falls Road. Property damage of $50,000.
  Barnet Center is located about 20 miles southwest of Kirby.
- **07/11/2007:**
  Hardwick. Multiple road closures/washouts due to washed out culverts and flooded streams in Hardwick, which included Brook road, where the Cooper Brook overflowed its banks and caused some flooded basements and structural damage to homes. Property damage of $250,000.
  Hardwick is located about 28 miles west of Kirby.
- **02/06/2002:**
  Caledonia County. Heavy rains averaging 2 to 4 inches caused countywide flooding. A few minor road washouts and a few minor mudslides were reported. Main stem rivers including the Passumpsic River flooded. Flooding of the Passumpsic River resulted in significant flooding especially in and around the Lyndonville area.

Additionally, Caledonia County experienced five heavy rain events between 1950 and 2016 as shown in Table 4.9 below.

Table 4.9 Heavy rain events in Caledonia County between 1950 and 2016

Location	Date	Event Type	Property Damage
Caledonia County	9/27/2002	Heavy Rain	$0
Caledonia County	10/26/2003	Heavy Rain	$0
Caledonia County	8/30/2005	Heavy Rain	$0
Caledonia County	10/7/2005	Heavy Rain	$0
Caledonia County	10/15/2005	Heavy Rain	$0

The National Climate Data Center (NCDC) reported 75 days of thunderstorm events in Caledonia County of which 58 resulted in property damage. However, specific amounts of rainfall or damage that caused flooding have not been reported. Damage from high winds includes downed trees.

Flooding from snow melts has been reported five times by the National Climate Data Center (NCDC) as shown in Table 4.10.

Table 4.10 Flooding from rain and snowmelt (1950 – 2016)[43]

Begin Location	End Location	Begin Date	Event Type	Property Damage	Flooding Cause
South Peacham	Wheelock	4/15/2014	Flood	$350,000	Heavy Rain / Snow Melt
Sheffield	Passumpsic	4/27/2011	Flood	$750,000	Heavy Rain / Snow Melt
Egypt	East Lyndon	4/11/2011	Flood	$5,000	Heavy Rain / Snow Melt
Lyndon Center	Lyndonville	3/23/2010	Flood	$2,000	Heavy Rain / Snow Melt
Lyndon Center	Lyndonville	4/29/2008	Flood	$25,000	Heavy Rain / Snow Melt

The following details are known about these five flood events[44]:

- **4/15/2014**
  South Peacham. Heavy rainfall and snowmelt caused widespread flooding across Caledonia County, mainly in the Passumpsic River Basin. Route 5 was inundated from Lyndonville to St. Johnsbury by the Passumpsic River, and other smaller creeks and streams washed out roads and culverts in Lyndon, St. Johnsbury, Barnet, and Kirby.
- **4/27/2011**
  Sheffield. Runoff from heavy rain and snowmelt caused flooding of the upper reaches of the Passumpsic River and its tributaries. In Lyndonville, Routes 5, 122, and 114 were closed by flood waters, and homes and businesses were flooded. Downstream in St. Johnsbury Center Route 5 was flooded, forcing the evacuation of three houses and the closure of several businesses.
- **4/11/2011**
  Egypt. Runoff from heavy rainfall and snowmelt caused minor flooding in the upper reaches of the Passumpsic River in Lyndonville. Center Street at the Millers' Run Bridge was closed due to high water, and the intersections of routes 5, 114, and 122 were flooded on the north side of Lyndonville. Property damage $5,000.
- **03/23/2010**
  Lyndon Center. Runoff from heavy rain and snow melt caused flooding along the Passumpsic River in Caledonia County near Lyndonville. Center Street was closed due to high water, and Route 114 was partially covered by water. Property damage $2,000.
- **04/29/2008**
  Lyndon Center. Heavy rainfall of up to 3 inches combined with melting snow caused several smaller streams and rivers in Caledonia County, including Millers Run and the East Branch of the Passumpsic to flood and led to portions of the Passumpsic River in Lyndonville to flood as well. Flooding was mainly confined to state and local roads with a few flooded house trailers in Lyndonville. Property damage $25,000.

The extent of snowmelt will depend on the amount of snow and the rise in temperature and current water level. For example, a late spring snow followed but fast warming temperatures could easily result in flooding on already saturated ground and swollen rivers. Snowmelt can result in a rise of several extra inches in the water level.

[43] Storm Events Database. (2016). National Oceanic and Atmospheric Administration. Retrieved from https://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=5304848
[44] Abid.

In summary, past damage from heavy rain events and snow melt shows thirteen incidents in the neighboring towns of Kirby since 1950 (compare Tables 4.8, 4.9, and 4.10). The NCDC also reports one snow melt induced flood event in Kirby (2014) which led to washed out roads and culverts.

Extent

Flooding including fluvial erosion

Kirby's houses are mostly located on hilly terrain. None are located in the floodplain. The geographic extent of riverine flooding within the Town of Kirby is limited to the area adjacent to the Moose River in South Kirby. A portion of Route 2 in Southern Kirby is susceptible to flooding.

The depth of flow in rivers and streams can provide information about the extent of flood hazards. The US Geological Survey (USGS) maintains river gages that measure streamflow and stage height (water depth), which are used in forecasting river conditions and flood hazards. The NWS defines the following flood categories for each gage location that describe the expected severity and extents of flood impacts in nearby streams[45]

- **Action Stage** – The stage at which some type of mitigation action should be taken in preparation for possible significant hydrologic activity.
- **Flood Stage** – The established gage height for a given location above which a rise in water surface level begins to create a hazard to lives, property, or commerce. The issuance of flood advisories or warnings is linked to flood stage.
- **Minor Flooding** – The stage at which minimal or no property damage, but possibly some public threat is expected. A Flood Advisory is issued to advise the public of flood events that are expected not to exceed the minor flood category.
- **Moderate Flooding** – The stage at which some inundation of structures and roads near the stream may occur and some evacuations of people and/or transfer of property to higher elevations may be necessary. A Flood Warning is issued if moderate flooding is expected during the event.
- **Major Flooding** – The stage at which extensive inundation of structures and roads will occur. Significant evacuations of people and/or transfer of property to higher elevations are necessary. A Flood Warning is issued if major flooding is expected during the event.

The closest water gage near Kirby is Gage No.1134500 on the Moose River in Victory, VT (VICV1), with a drainage area of 75.2 square miles, operated since 1947. This gage is located 1.5 miles east of Kirby's boundary. The gage is located upstream and provides the best available data for predicting flood hazards in Kirby.[46]

Table 4.11 provides the following statistical information on the flood discharges at the Moose River gage in the Town of Victory, VT. As can be seen in Table 4.11, the maximum recorded flood at Moose River gage in Victory, VT was 4,940 ft^3/s. This equals a 100-year event.

[45] National Weather Service Glossary. (2016). National Oceanic and Atmospheric Administration. Retrieved from http://w1.weather.gov/glossary/index.php

[46] Moose River at Victory, VT. (2017). U.S. Geological Survey: National Water Information System. Retrieved from http://waterdata.usgs.gov/nwis/inventory/?site_no=01134500&agency_cd=USGS

Table 4.11 Statistical flood discharge at Moose River Gage in Victory, VT at selected recurrence intervals (ft3/s)[47]

USGS Stream Gage Station	Flood discharges at selected recurrence intervals (ft3/s)							Maximum Recorded Flood	
	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Discharge (ft3/s)	Date
01134500	2,090	2,760	3,220	3,810	4,270	4,740	5,880	4,940	7-1-1973

Figure 4.6 depicts actual measured discharges for the Moose River gage from 2008 to 2016.[48] As shown in Figure 4.6, a maximum discharge of > 4,000 ft^3/s was measured once over the reporting period, in spring 2014. Table 4.12 below combines the findings relative to the statistical flood recurrence intervals noted in Table 4.11.

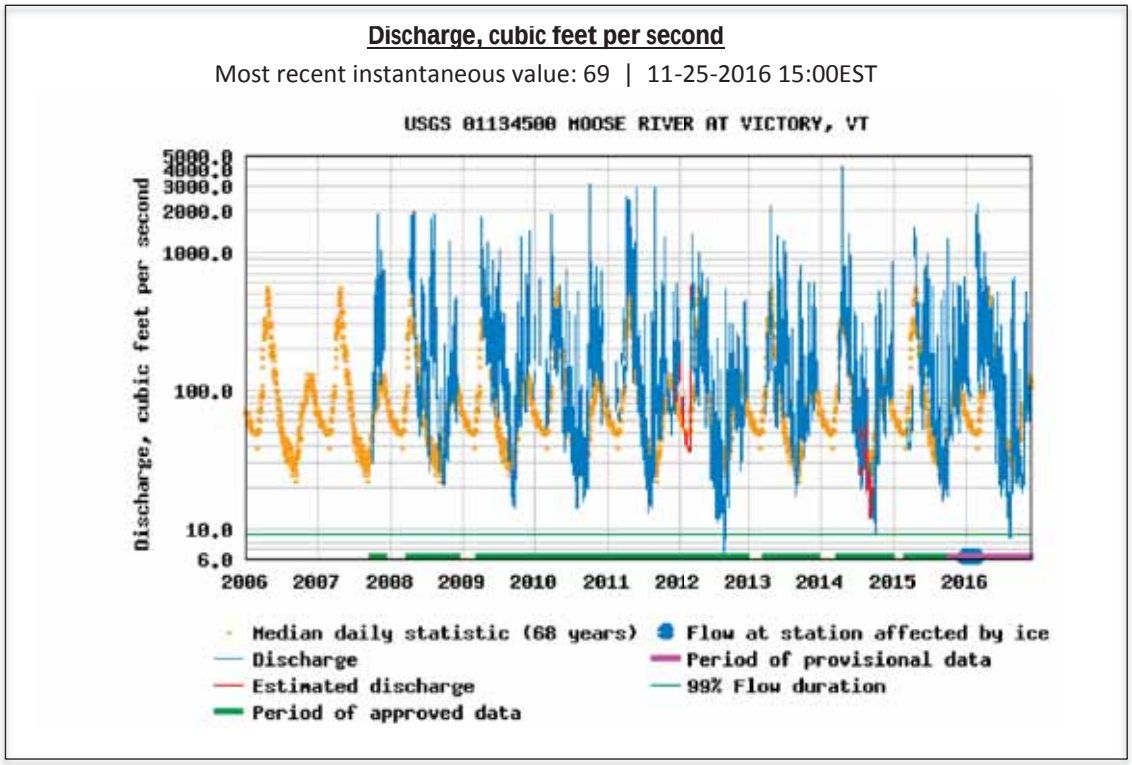


Figure 4.6 USGS gage data (CFS) for the Moose River at Victory, VT from 2006 - 2016[49]

Table 4.12 Selected statistical recurrence intervals of flood discharges at Moose River compared to actual measurements from 2006 to 2010

Flood discharges comparable to selected recurrence intervals	Number of Events
5-yr event (> 2,760 ft3/s)	2
10-yr event (>3,220 ft3/s)	1
25-yr event (>3,810 ft3/s)	1
50-yr event (>4,270 ft3/s)	1 (2014)

[47] Olsen. (2009). "Estimation of Flood Discharges at Selected Recurrence Intervals for Streams in New Hampshire." U.S. Geological Survey. Pg. 36.
[48] The available data for Moose River gage in Victory, VT go back to 2008; the reporting period starts in 2006.
[49] Discharge (CFS) at Moose River in Victory, VT. (2017). U.S. Geological Survey. Retrieved from www.nwis.waterdata.usgs.gov

Based on the comparison in Table 4.12, the flood event in spring 2014 with a flood discharge of > 4,000 ft^3/s was similar to a 50-year event (with a 2 percent chance of annual occurrence). Furthermore, as noted earlier, a 100-year flood event took place in 1974.

Extent of flooding from heavy rainstorms and snow melt

No critical facility is located in vicinity of the problem culvert areas. The town hall is located about 3000 meters (9800 feet) up-hill from the problem culvert area on Ridge Road / Town Hall Road.

Extensive flooding from heavy rainstorms and snow melt leading roads to be washed out is localized around selected creeks and streams intersecting with Kirby's roads. In the meeting on November 29, 2016 several problem culvert areas were noted. These are depicted on Figure 4.5 Kirby's Roads conditions. As can be seen on Figure 4.4, the following road intersections have been identified as at risk to flooding due to mal-functional culverts:

- Ridge Road / Town Hall Road crossing – intersection with Barnes Brook (It shall be noted that this intersection also marks the access to the town's sand pile.)
- Kirby Mountain Rd – intersection with Hawkins Brook (Note: Ditching was noted for this culvert area.)
- Cross Rd – intersection with Creek

Other culvert problem areas noted in the public meeting were:

- Ridge Rd crossing Mountain Rd
- Ridge Rd crossing Barnes Rd
- Mud Hollow Rd – intersection with un-named creek
- Cross Rd crossing to Burroughs Rd

All structures near those problem culvert areas are at risk from flooding in high rain events. Additionally, vehicles traveling on those roads with road problem areas are at risk to dangerous driving conditions due to streets possibly washing out from high rain events or snow melt.

Probability of future events

Flooding including fluvial erosion

In recent years, flood intensity and severity in Vermont appear to be increasing. It is highly likely that flooding will continue in both the short- and long-term (DEMHS, 2013).

According to NOAA, the action stage for the Moose River gage in Victory, VT is at 10 feet.
Information on historic crests was available for the time period of 2006 to 2016 and is summarized in Table 4.13 below[50]:

Table 4.13 Flood stage discharges at Moose River above 10 ft between 2006 and 2016[51]

Gage Height	Number of Events
>10 ft (flood stage)	5

[50] Water discharge (in ft) at Moose River in Victory, VT. (2016). U.S. Geological Survey. Retrieved from www.nwis.waterdata.usgs.gov
[51] Abid.

Based on five events over 10 years above the flood stage shown in Table 4.13 a likelihood of likely (50%) is given for the Moose River to flood at Victory, VT. It is assumed that flooding in Victory, VT would result in flooding at the Moose River in Kirby as well.

Flooding from heavy rain events and ice melt

Given a limited amount of reported events for Kirby itself, probability is a bit hard to assess. Merely one snowmelt event was noted for Kirby which led to flooding (2014, compare Table 4.10). Based on one event over 66 years in Kirby itself, the likelihood of re-occurrence in Kirby is 1.5%. Based on their occurrence in neighboring towns, the probability of future rainstorm and thunderstorm events to cause flooding would be likely (eight events in 66 years) and for flooding from snowmelts would be possible (five events in six years). Given the concern expressed by local citizens and the problem areas mapped at the November 2016 public meeting (depicted in Figure 4.4), it can be assumed that the NCDC events underrepresent the conditions in Kirby. Flooding from heavy rainstorms and snowmelt leading to the flooding of certain roads in Kirby was assessed with highly likely.

Climate change may exacerbate flood hazards over time. Research suggests that the frequency and intensity of related hazards such as rain, snow, and severe storms may increase with climate change, which may lead to an increased risk of flooding.

Additionally, UMASS Climate System Research Center data states that winter months are likely to be wetter (likely with rain). This could mean more snow events and favorable snowmelt conditions in the spring months, such as rain-on-snow events, increasing floods induced by heavy rain or snowmelt.

Does the Plan address NFIP insured structure 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)

According to FEMA flood insurance policy records as of December 13, 1974, there have been no flood losses reported in the Town of Kirby through the National Flood Insurance Program (NFIP).

Vulnerability assessment and Estimated Losses

Flooding including fluvial erosion

Flood is designated for the flood plain area which is limited to the river valley of the Moose River. A few buildings located in vicinity of the flood plain area along Route 2 are at risk to flooding. Additionally, flash floods could put current and future buildings and populations at risk. Impacts of flood include crop damage, business interruption, mold issues, and damaged contents and equipment, to name a few.

With the use of GIS, a spatial analysis was performed to identify vulnerable structures in or in vicinity of the flood plain area. Mapped river corridors located in the planning area are Moose River, Kirby Brook, and Hawkins Brook (compare Figure 4.5). Figure 4.7 shows the river corridor for the Moose River and Figure 4.8 the river corridor for Kirby Brook in closer detail.

The GIS spatial analysis determined structures located in or in vicinity to the river corridors. No structures including critical facilities are located within the river corridor area.

As shown in Table 4.14, fifteen building structures were identified in the vicinity of Route 2 and the Moose River corridor.[52] In addition to this, the rail road runs within 10 m (33 ft) of the Moose River corridor at its closest distance. Furthermore, a portion of Route 2 runs within 10 m (33 ft) to the river corridor for a length of 500 m (1,640 ft). In vicinity from the Kirby Brook river corridor, thirty-three building structures including two dairy farms were identified. One building structure is located within 200 m (656 ft) from the Hawkins Brook river corridor.

Table 4.14 Building structures near river corridors

Distance from river corridor (m)	River Corridor Name (Number of building structures near river corridor)		
	Moose River	Kirby Brook	Hawkins Brook
50	4	10	-
100	8	20	-
150	11	26	-
200	13	28	1
250	15	33	-

While no structure is located within any of the river corridors, structures within the vicinity of a river corridor are at risk to flooding and fluvial erosion. Information on localized past flooding events at each of the rivers and brooks would be required for a more detailed risk delineation. However, this information was not available. For the purpose of this study it was assumed that flooding and fluvial erosion would be localized and would not extend beyond an area of 100 m (328 ft) outside of the river corridor.

A total of twenty-eight structures are located within 100 m (328 ft) of the river corridors of Moose River, Kirby Brook and Hawkins Brook. The river corridor areas fall together with some of the major centers of population in the Town of Kirby. Based on a total of 242 structures (190 year round and 52 vacation homes noted in the Town Plan), 11.6% of all structures in Kirby are located within 100 m (328 ft) of any of the river corridors.

Based on the assumption that flooding and fluvial erosion may occasionally occur localized outside the river corridor but would not extend beyond an area of 100 m, eleven percent of the structures may potentially have a slightly increased chance of flooding or fluvial erosion due to their proximity to the river corridor. A portion of 500 m along Route 2 in the southern planning area and a portion of the rail road are vulnerable to potentially being flooded as they are located 10 m or less away from the river corridor.

No critical facility or dairy farm is located within 100 m (328 ft) from any of the mapped river corridors.

[52] Structures with up to 250 m (820 ft) distance from the river corridor were identified for comparison purposes. Most of the structures in vicinity to any of the river corridors can be grouped into having a distance of 250 m.

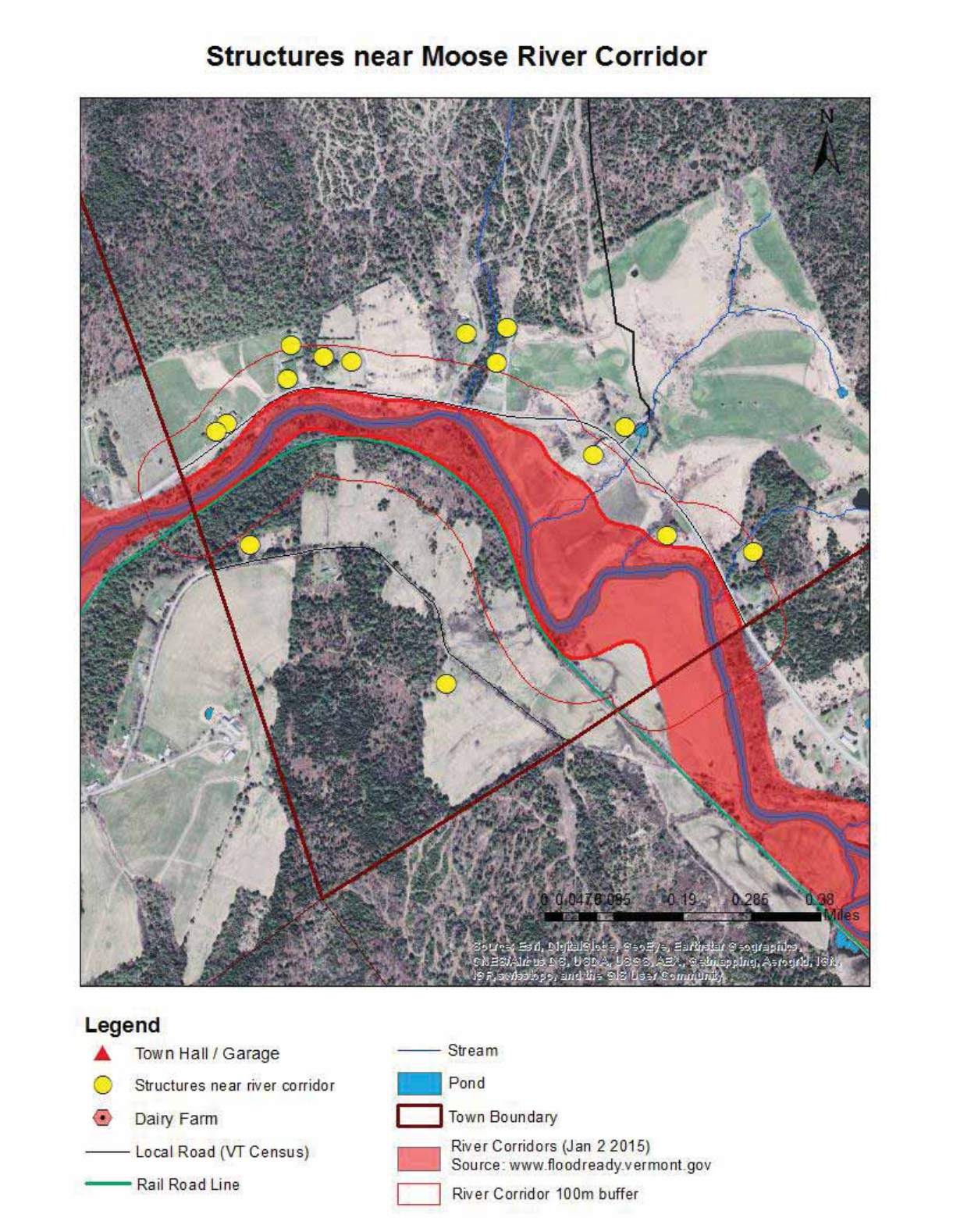


Figure 4.7 Moose River corridor

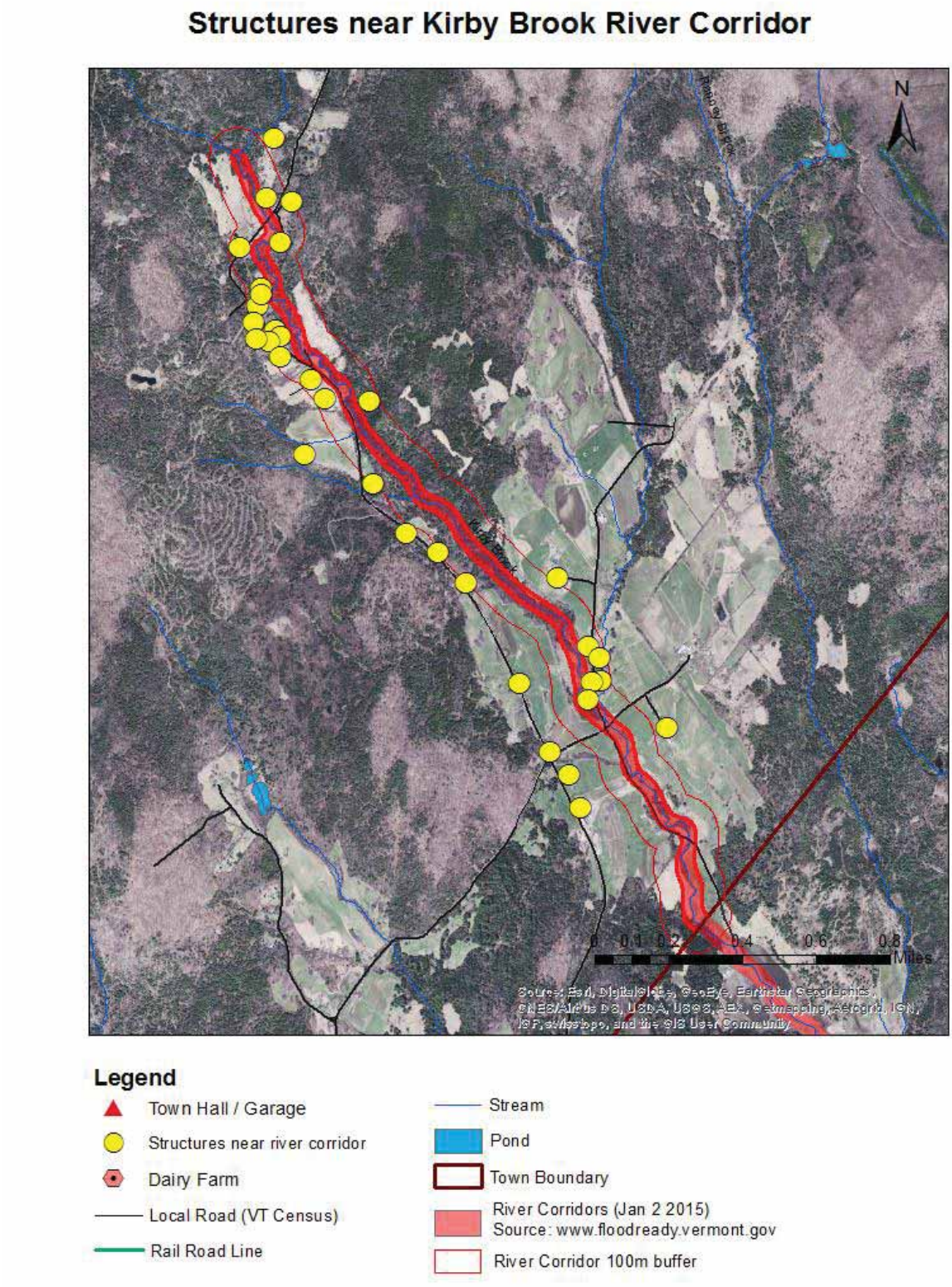


Figure 4.8 Kirby Brook river corridor

Flooding from heavy rain events and ice melt

Kirby is located in a remote location and shares their fire and police services with Lyndon. The Town of Kirby considers their roads one of their most critical assets; a potential wash out of those roads is a concern in Kirby. The roads connect Kirby with the surrounding Towns and furthermore to services not provided in Kirby. These services include schools, medical services, fire-fighting and police. As most of Kirby's roads are dirt roads they are prone to wash outs either from high rain events or from melting snow. Furthermore, as can be seen on Figure 4.8, Kirby's main roads travel partly along or intersect with various creeks and rivers including a 500 m (1640 ft) portion of Route 2 in the southern planning area.

Additionally we've overlaid elevation contours with the map of the planning area to illustrate the steepness of the terrain (Appendix B Figure Elevation Contours). Areas with close elevation lines have steep slopes. What can be seen is that while most of the roads and homes follow the terrain lines (i.e. Northern Kirby Road and Ridge Road), several roads cross the elevation lines. These roads are Town Hall Road, Kirby Mountain Road (middle part), and Mud Hollow Road. As shown on the Figure in Appendix B, Town Hall Road and Kirby Mountain Road climb the terrain of Sugar Hill Mountain and cross steep slopes in the middle part of the planning area. Furthermore, Kirby Mountain Road partly follows two creeks, first in east-western direction and then in southern direction. Mud Hollow Road also follows a creek trough steep terrain. It can therefore be expected that those roads are subject to flooding from those creeks in the case of high rain events.

While the town has applied ditches along parts of the roads to divert water away from the roads, several culverts have been reported to be mal-functioning. Due to this, Kirby's roads are very vulnerable to being washed out in heavy rain events or flooding which could cause hazardous driving conditions.

Given limited information on past damages and values or estimated values of the roads a reliable estimate on losses cannot be determined. Due to this, loss estimates were not conducted. However, it can be assumed that road closures from washed out of roads (due to heavy rain events or snowmelt) would result in lost travel time and businesses losses i.e. loss of cow milk. Furthermore, unpassable or closed roads make the population highly vulnerable in case of an emergency situation as travel time to the hospital or for fire fighters and police officers would be prolonged and could result in life-threatening situations.

WIND HAZARDS

Wind hazards include hurricane, microburst, and tornado events.

HURRICANE

Description

A hurricane is a type of tropical cyclone, which is a generic term for a low-pressure system that generally forms in the tropics. The cyclone is accompanied by thunderstorms and a counterclockwise circulation of winds near the earth's surface (in the Northern Hemisphere). Tropical cyclones are classified as follows: A *tropical depression* is an organized system of clouds and thunderstorms, with a defined surface circulation, and maximum sustained winds of 38 miles per hour or less. A *tropical storm* is an organized system of strong thunderstorms, with a defined surface circulation, and maximum sustained winds of 39 to 73 miles per hour. A *hurricane* is an intense tropical weather system of strong thunderstorms, with a well-defined surface circulation, and maximum sustained winds of 74 miles per hour or higher.

Atlantic hurricanes form off the coast of Africa or in the southern Atlantic Ocean, Caribbean Sea, or Gulf of Mexico. Hurricanes require warm tropical oceans, moisture, and light winds above them to form. A hurricane can produce violent winds, tornadoes (primarily on the leading and trailing edges of the hurricane), powerful waves and storm surge, and torrential rains and floods.

Atlantic hurricane season lasts from June to November, averaging 11 tropical storms each year, six of which turn into hurricanes. Vermont is at highest risk between August and October when water temperatures in the Northern Atlantic are most likely to reach a temperature warm enough to develop and sustain a hurricane. According to the National Hurricane Center, the Atlantic hurricane season is currently in a period of heightened activity that started around 1995 and could last at least another decade.[53]

Table 4.15 below shows the scale for describing hurricane intensity (Saffir-Simpson Scale) and Table 4.16 describes the damage that could be expected for each hurricane category.

Table 4.15 Saffir-Simpson Scale (hurricane intensity)[54]

Category	Maximum sustained wind speed (MPH)
1	74-95
2	96-110
3	111-129
4	130-156
5	157+

Table 4.16 Hurricane Damage Classification[55]

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).

[53] National Hurricane Center. (2012). National Oceanic and Atmospheric Administration. Retrieved from www.nhc.noaa.gov/
[54] Abid.
[55] Abid.

Storm Category (Saffir-Simpson Scale)	Damage level	Description of Damages
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

Hurricanes rarely reach as far inland as Vermont, more often reaching Vermont are tropical storms or depressions. Hurricanes and tropical storms potentially impact the entire planning area. Powerlines in Kirby are located above ground and therefore at risk to high wind events.

Previous Occurrences and Extent

From 1950 to 2016 no events with wind speeds above 74 MPH (Hurricane category 1) were reported in Caledonia County. However, one event with wind speeds above 69 MPH was reported on April 16, 2007 in Caledonia County.

As shown in Table 4.17, there were major disaster declarations as a result of tropical storm Irene (2011) and Floyd (1999) in Caledonia County. The most severe non-winter storm to hit Vermont was the disastrous hurricane of 1938. Figure 4.9 shows the rainfall amounts from Tropical Storm Irene 2011. Table 4.18 lists major disaster declarations due to Hurricane and Tropical Storms in Caledonia County.

Additionally, heavy rain events and flooding were reported in Kirby on September, 12 2008 which can be associated with Hurricane Ike (compare FEMA disaster declarations document in Appendix). Those heavy rain events caused local washouts on Kirby Mountain Road, Ridge Road, Barnes Brook Road, Brook Road, Brookside Road, and Mountain Road. The road repairs amounted to approximately $35,200 in total project cost. FEMA provided assistance in the amount of approximately $26,396, whereas the State covered $4,399 in assistance for those repair projects (compare FEMA disaster declarations document in Appendix).

Examples of tropical storms and hurricanes which impacted Vermont:

> The Hurricane of 1938: On September 21, 1938, a very fast-moving hurricane made landfall in Suffolk County, Long Island (known as the "Long Island Express") and hit Vermont in the early evening causing wind damage. There was also severe flooding as a result of more than four inches of rain that accompanied the storm. Buildings were lost, power lines downed, and many trees felled.[56]

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

Tropical Storm Floyd: Tropical Storm Floyd hit Vermont in September 1999 and caused flooding and wind damage in parts of Vermont. Floyd is responsible for one fatality and resulted in a federal disaster declaration.[57]

Tropical Storm Irene: In August 2011, Tropical Storm Irene moved up the Eastern Coast of the United States, gradually turning into a tropical storm as it made landfall in New York and Connecticut. The tropical storm moved into Vermont, dropping as much as 11 inches of rain on the state, causing nearly every river and stream to flood and experience catastrophic fluvial erosion. This resulted in extensive transportation damage with nearly every state highway being affected and many local roads been washed away. Statewide, three people died and many were injured from the floods.[58]

In general, severe hurricanes are not considered likely nor do they pose a recurring threat for Vermont.

Figure 4.9 depicts the amounts of rainfall from tropical storm Irene. Table 4.17 shows major disaster declarations in Caledonia County due to Hurricane and Tropical Storms.

[57] State of Vermont Hazard Mitigation Plan. (2013). Federal Emergency Management Agency: State of Vermont.
[58] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.

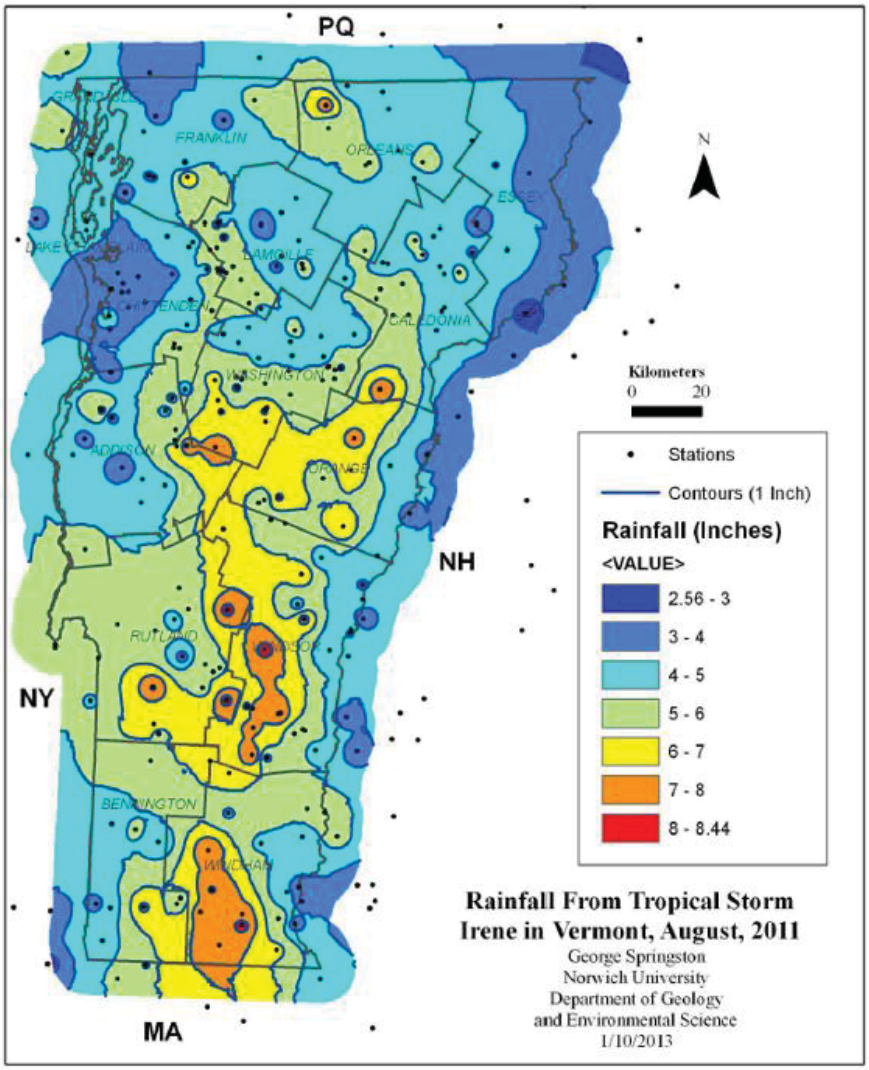


Figure 4.9 Rainfall amounts from Tropical Storm Irene[59]

Table 4.17 Major Disaster Declarations in Caledonia County due to Hurricane and Tropical Storms[60]

Disaster Name (Date of Event)	Disaster Number (Type of Assistance)	Declared Areas
Tropical Storm Irene, 2011	DR-4022	Addison, Bennington, Caledonia, Chittenden, Essex, Franklin, Lamoille, Orange, Orleans, Rutland, Washington, Windham, Windsor for PA Chittenden, Rutland, Washington, Windsor for IA
Tropical Storm Floyd, 1999	DR-1307	Bennington, Caledonia, Essex, Lamoille, Orange, Orleans, Rutland, Washington, Windham, Windsor

[59] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.
[60] Abid.

Probability of Future Events

The planning area is in a very low hurricane risk zone. Based on past hurricane and tropical storm events, the frequency of hurricanes in Vermont is an average of once every 18 years. In addition, GIS analysis was used to determine that 13 tropical storms and hurricanes have passed within 75 miles of the planning area between 1866 and 2011. This means that on average once every eleven years a hurricane had an indirect impact on the planning area. This results in an annual probability of 9%. Based on this, a probability of possible was assigned.

Vulnerability Assessment and Estimated Losses

Hurricane and tropical storms had varying impacts on the planning area. The 1938 storm caused great wind damage and some flooding, while tropical storm Floyd caused flooding and wind damage in parts of Vermont. Tropical Storm Irene had the most devastating impacts due to its immense amounts of flooding.

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 wind events have a large spatial extent and would affect many buildings. There is typically adequate warning with this hazard allowing for evacuation which reduces the impact on the population. The event itself would likely last less than 24 hours. Flooding is a major concern as shown before since low moving hurricanes (or ones that stall over an area) can dump tremendous amounts of rain. Additional impacts include water damage in buildings from building envelope failure, business interruption, loss of communications, and power failure. Utility disruption is a serious threat for areas with above ground electrical wiring.

Climate change impacts are difficult to predict but likely will affect hurricane behavior in the northeast. Rising sea temperature could lengthen the hurricane season and fuel stronger hurricane events. The National Climate Assessment Report 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. This would result in greater losses due to increased flooding, associated building damages and business interruption impacts.[61]

Per the disaster declaration document, flood events associated with Hurricane Ike led to local road washouts in several locations in Kirby in September 2008. Road repair amounted to approximately $35,200 in repair costs (compare Disaster Declaration document in Appendix).

HAZUS-MH

"HAZUS is a nationally applicable standardized methodology that contains models for estimating potential losses from earthquakes, floods and hurricanes. HAZUS uses Geographic Information Systems (GIS) technology to estimate physical, economic and social impacts of disasters. It graphically illustrates the limits of identified high-risk locations due to earthquake, hurricane and floods. Users can then visualize the spatial relationships between populations and other more permanently fixed geographic assets or resources for the specific hazard being modeled, a crucial function in the pre-disaster planning process."[62] The software HAZUS-MH 2.2 was used to assess

[61] Walsh and Wuebbles (2014). "Changes in Hurricanes. National Climate Assessment." U.S. Global Change Research Program.
[62] Hazus. (2017). Federal Emergency Management Agency. Retrieved from https://www.fema.gov/hazus

potential losses from hurricanes in the planning area. The most current HAZUS version is HAZUS-MH 3.2 which was released in October 2016.

Results from HAZUS-MH 2.2 Hurricane Wind Analysis

HAZUS-MH 2.2 was used to estimate losses. Two scenarios were run. The first was a historic scenario based on Hurricane Gloria, the second a probabilistic scenario based on Hurricane Gloria to determine annualized losses. It has to be noted that the HAZUS results are aggregated based on Caledonia county census data.

Background information on Hurricane Gloria

Hurricane Gloria formed on September 18, 1985. The hurricane topped out at 145 miles per hour (Category 4) near the Bahamas. Gloria made landfall three times including the Outer Banks, North Carolina (on September 26th, 1985), Long Island, New York, and Connecticut. The storm caused impacts from South Carolina to Maine including 14 fatalities (six related to fallen trees) and extensive power outages.[63]

Probabilistic Scenario: Annualized Losses

The probabilistic scenario runs a variety of scenarios, both catastrophic and minor, to determine potential losses on an annual basis. Scenarios are modeled for the 10-, 20-, 50-, 100-, 200-, 500- and 1,000-year scenarios to estimate annualized loss.

Findings from the HAZUS-MH probabilistic analysis

According to the HAZUS-MH results, if hurricane Gloria were to impact the planning area today, it would result in approximately $9 million in total damage at the most catastrophic scenario (a 1000 year return period). The annualized cost however would be considered limited with $ 43,000 in total damage. Table 4.19 shows the economic losses for various scenarios.

Important findings

Based on the HAZUS-MH scenarios (Hurricane 1938 model), minor hurricane events would not have any impact on Kirby. Starting with a recurrence of 100 years, some minor impacts would be noted. Only major events with a recurrence of 500 or 1000 years would have a more significant impact on Kirby: Per the HAZUS quick assessment report, 136 structures would receive minor damage and merely 5 buildings would receive moderate damage county-wide at a 1000-year event. Table 4.18 shows the economic losses associated with 1938 Hurricane probabilistic model.

[63] Collins, Chris. (2014). "Hurricane Gloria - September 27, 1985." National Weather Service. Retrieved from http://www.weather.gov/mhx/Sep271985EventReview

Table 4.18 Economic Loss Scenarios (1938 Hurricane probabilistic model, county-wide)

Return Period	Property Damage Losses		Business Interruption (Income Losses)
	Residential	Total	
10	0	0	0
20	0	0	0
50	0	0	0
100	426	0	0
200	1380	1392	0
500	4,548	4631	16
1000	9266	9433	11
Annualized (Economic Loss: x1000)	**41**	**43**	**1**

MICROBURST

Description

"A microburst is a downdraft (sinking air) in a thunderstorm that is less than 2.5 miles in scale. Some microbursts can pose a threat to life and property, but all microbursts pose a significant threat to aviation. Although microbursts are not as widely recognized as tornadoes, they can cause comparable, and in some cases, worse damage than some tornadoes. Wind speeds as high as 150 mph are possible in extreme microburst cases."[64]

Several factors can cause microbursts to develop, including mid-level dry air entrainment, cooling beneath the thunderstorm cloud base, sublimation (occurs when the cloud base is above the freezing level), and the existence of rain and/or hail within the thunderstorm. Microbursts can be a combination of these factors while others may only be driven by one factor. "Due to this, microbursts can be subdivided into three primary types - wet, dry, and hybrid. Cooling beneath the thunderstorm cloud base and sublimation are the primary forcing mechanisms with dry microbursts. Dry microbursts typically occur with very little precipitation at the surface or aloft, hence the dry type. Wet microbursts, on the other hand, are primarily driven by entrainment of mid-level dry air and precipitation loading. Hybrid microbursts possess characteristics of both wet and dry microbursts. They are forced in the mid-levels by dry air entrainment and/or precipitation loading and in the low-levels by cooling beneath the cloud base and/or sublimation."[65]

Location

Microburst generally impact localized areas. They are possible anywhere in the planning area. Powerlines in Kirby are located above ground and therefore at risk to high wind events.

[64] Microburst. (2016). National Oceanic and Atmospheric Administration. Retrieved from http://www.srh.noaa.gov/ama/?n=microbursts
[65] Abid.

Previous Occurrences and Extent

News articles were investigated to locate previous occurrences of microburst in the planning area, noting the following:

> *May, 17, 2014*[66]*:* A small localized microburst (65 kts) was reported in Craftsbury, VT (Orleans County, approximately 34 miles from Kirby, VT). Nearly a dozen trees were uprooted, a few greenhouses damaged, roof blown off a barn and a house minor damaged. No injuries were reported.

Thunderstorm wind events were also investigated for possible microburst activity in the area. The National Climatic Data Center reported the following thunderstorm events between 1950 and 2016[67]:

- 76 days with thunderstorm wind events and property damage throughout Caledonia County,
  - Of which 58 showed property damage and
  - 2 resulted in death or injury.
- 15 thunderstorm wind events in the neighboring town of Lyndon,
- 10 events in the neighboring town of Burke (East and West Burke)
- The highest wind magnitude measured was 50 knots (seven events)
- The storms resulted in a total property damage of $ 197,000 (throughout all locations)
- The costliest storm resulted in a damage of $25,000.

No events were listed for Kirby itself. Table 4.19 below lists the thunderstorm wind events in the neighboring towns of Lyndon and Burke between 1950 and 2016. It should be noted that these thunderstorm events are not confirmed as microbursts but were included for reference. Microbursts can have a wind speed of up to 168 miles per hour which aligns them with an EF4 tornado (see Table 4.20). However, as the Craftsbury, VT event in 2014 shows, smaller microbursts with less magnitude can occur as well. Damage may not be as extensive due to the shorter duration and smaller scale of the microburst event.

Table 4.19 Thunderstorm wind events in neighboring towns between 1950 and 2016[68]

Date	Wind Magnitude	Death/ Injuries	Property Damage	Details
8/24/1993	N/A	0/0	5K	East Burke.
8/31/1993	N/A	0/0	5 K	Lyndon
8/31/1993	N/A	0/0	5K	West Burke
4/27/1994	N/A	0/0	5K	East Burke.
7/26/1994	N/A	0/0	5 K	Lyndon
06/26/1997	N/A	0/0	5K	A severe thunderstorm moved through the Lyndon Center, VT area with trees and power lines blown down and small hail. In addition, between 200 and 300 residents were without power.
7/23/1998	N/A	0/0	5K	West Burke. Thunderstorm winds blew down trees.
8/24/1998	N/A	0/0	10 K	In West Burke and Peacham, trees and power lines

[66] Storm Events Database. (2016). National Climatic Data Center: National Oceanic and Atmospheric Administration. Retrieved from http://www.ncdc.noaa.gov/stormevents/eventdetails.jsp?id=242662
[67] Abid.
[68] Abid.

Date	Wind Magnitude	Death/ Injuries	Property Damage	Details
				were blown down. Numerous power outages were reported.
7/5/1999	N/A	0/0	5K	Across the northern half of the county the following towns were greatly impacted with numerous reports of trees and power lines blown down: East and West Burke, Sutton, Sheffield, Lyndon. Over 1000 were without power. In addition, in the town of Sheffield, a pickup truck was destroyed when a tree was blown on top of it.
7/5/1999	N/A	0/0	5K	East Burke. Across the northern half of the county the following towns were greatly impacted with numerous reports of trees and power lines blown down: East and West Burke, Sutton, Sheffield, Lyndon. Over 1 thousand were without power. In addition, in the town of Sheffield, a pickup truck was totaled when a tree was blown on top of it.
6/26/2002	N/A	0/0	5 K	Scattered thunderstorms developed during the afternoon of June 26th, and a few of them reached severe criteria. Thunderstorms in Caledonia county resulted in numerous downed trees and power lines in the Vermont towns Lyndonville and East Burke.
5/31/2006	50 kts	0/0	10 K	The thunderstorms intensified as they moved into Caledonia county during the mid-afternoon with several reports of numerous trees down in the towns of Lyndon, Wheelock and Lower Waterford. Slightly over 5000 customers lost power in northern Caledonia and Essex counties.
8/25/2007	50 kts	0/0	25 K	Numerous trees and power lines down across Lyndonville and Lyndon.
08/16/2007	50 kts	0/0	20 K	One thunderstorm developed in a favorable, highly sheared wind environment which eventually intensified into a supercell thunderstorm in Clinton county, NY. This supercell then proceeded to travel into Vermont affecting numerous communities between Grand Isle (Grand Isle county) and Concord (Essex county). Significant straight-line wind damage (estimated between 60 and 80 mph) in the form of snapped, uprooted and downed trees, downed power lines and some structural damage occurred in Grand Isle, Georgia (Franklin county), Westford (Chittenden county) and Hardwick (Caledonia county).[1]
8/25/2007	N/A	0/0	20 K	East Burke. Severe thunderstorms that produced widespread damaging winds and some large hail across central, southern and eastern Vermont.

Date	Wind Magnitude	Death/ Injuries	Property Damage	Details
7/9/2008	50 kts	0/0	20 K	A severe thunderstorm produced localized damaging winds that knocked down several trees throughout Lyndonville. Several downed and snapped trees in Lyndonville, including Lyndon State College, East Burke Road and Center Road.
6/5/2010	50 kts	0/0	5 K	Scattered thunderstorms developed across Vermont during the afternoon and tapped into an unseasonably strong mid-atmospheric disturbance and wind field, which eventually resulted into a supercell that formed across southeast Franklin county, Vermont. Spruce tree approximately two feet in diameter snapped, as well as other branches and limbs. Mature maple tree snapped around 15 feet above base with diameter approximately 3 feet at property along Kirby road.
5/27/2011	50 kts	0/0	2 K	This supercell produced a brief EF1 tornado in Craftsbury (Orleans county) and resulted in numerous reports of wind damage and large hail, up to golf ball size, downstream in Caledonia and Essex counties.
7/6/2011	N/A	0/0	5K	West Burke. Thunderstorms with numerous reports of wind damage as well as lightning strikes. As a result of these storms, more than 15,000 customers in Vermont lost power. Trees down along Route 5.
9/4/2011	N/A	0/0	5K	West Burke. Along with locally torrential rainfall, an isolated storm or two produced localized wind gusts that knocked down trees and a report of quarter size hail.
6/2/2013	50 kts	0/0	5K	A strong mid-atmospheric disturbance, ahead of a cold front, moved across portions of Vermont and triggered widespread thunderstorms with pockets of damaging winds and large hail. Some of the damage occurred in the Rutland vicinity as well as the Route 2 corridor between Montpelier and Lunenburg. At the peak of the event, roughly 20,000 customers had lost power.
7/19/2013	55kts	0/0	15 K	Widespread wind damage in the form of downed trees and power lines that fell on vehicles and structures across the region. More than 15,000 customers were without power across the state.
7/20/2013	N/A	0/0	5K	West Burke. One isolated thunderstorm produced a localized microburst in Glover and other wind damage in West Burke. Scattered tree damage in West Burke, including on Burke Hill road.

There haven't been any major disaster declarations related to microbursts in Caledonia County.

Probability of Future Events

Limited information was available on previous microburst events in the planning area; therefore thunderstorm events were researched as well. One microburst was reported near the planning area and at least one thunderstorm event showed similar patterns to a small microburst within Caledonia County (see description for the event on 08/16/2007 in Table 4.19). It is certain that microburst events are possible in the planning area but they may not occur annually. Therefor a probability of possible was assigned.

Vulnerability Assessment and Estimated Losses

All current and future buildings and populations should be considered at risk to microbursts. Estimating accurate losses is difficult since it is impossible to predict where a microburst will occur and limited information is available on past occurrences. Microbursts are capable of causing tornado-like damages. Such events are capable of causing catastrophic damage, injuries, and deaths. Additional impacts may include power failure, loss of communications, and downed trees and debris. One mobile generator is located at the Town Garage. Since Kirby has two critical facilities plus the old school house as a meeting location it is assumed that critical facilities could not accommodate power outages completely.

The costliest thunderstorm event close to the planning area which may be related to a microburst resulted in a damage of $25,000.

Climate change impacts could lead to increased frequency of microbursts and more severe occurrences.

TORNADO

Description

"A tornado is a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground"[69]. 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 range from 40 miles per hour to more than 300 miles per hour.[70] "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.[71]

Tornado season in Vermont runs ordinarily from March through August; however, tornadoes can strike at any time of the year if the essential conditions are present. Tornadoes are most likely to form in the late afternoon and early evening. 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

[69] Meteorology Glossary. (2000). American Meteorological Society.
[70] Edwards. (2015). "The Tornado FAQ." Storm Prediction Center: National Oceanic and Atmospheric Administration. Retrieved from http://www.spc.noaa.gov/faq/tornado/
[71] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.

tremendous damage. Damage paths can be in excess of 1 mile wide and 50 miles long. 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.[72] Figure 4.10 below shows the tornado activity in the United States.

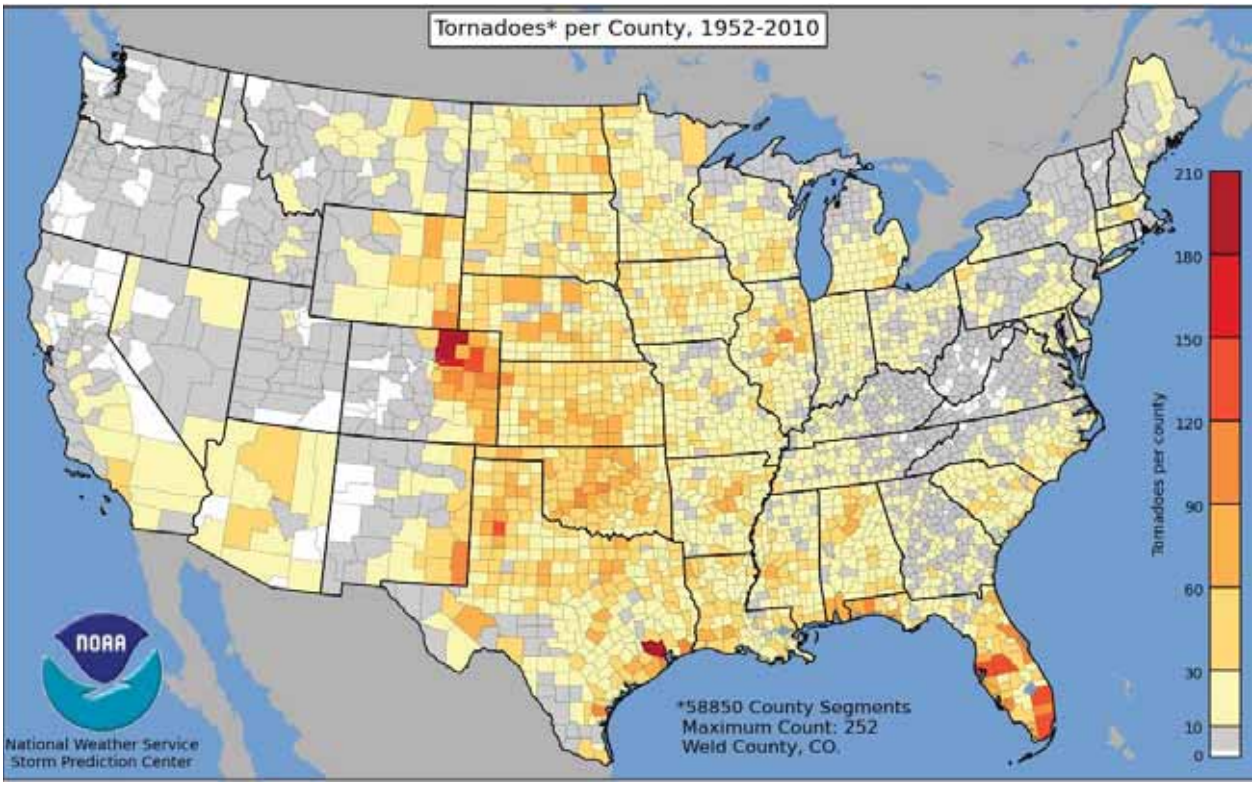


Figure 4.10 Tornado activity in the US per county, 1952 – 2010 (NOAA)[73]

As shown on Figure 4.10, the highest concentration of tornadoes in the US has been in Oklahoma, Texas, Kansas and Florida respectively. Each year, an average of 1,200 tornadoes is reported nationwide.[74]

Tornadic magnitude is reported according to the Fujita and, since 2007 to the Enhanced Fujita Scales. A comparison of these two scales along with a description of the typical damage caused by tornado wind forces is given in Table 4.20.

[72] Edwards. (2015). "The Tornado FAQ." Storm Prediction Center: National Oceanic and Atmospheric Administration. Retrieved from http://www.spc.noaa.gov/faq/tornado/
[73] Edwards. (2015). "Tornadoes County." Storm Prediction Center: National Oceanic and Atmospheric Administration. Retrieved from http://www.srh.noaa.gov/images/hgx/swa/2013_graphs/tornadoes_county.png
[74] Severe Weather 101 – Tornado Basics. (2016). The National Severe Storm Laboratory. Retrieved from http://www.nssl.noaa.gov/education/svrwx101/tornadoes/

Table 4.20 Fujita and Enhanced Fujita scale (tornado wind force)[75]

Enhanced Fujita Scale	Fujita Scale	Typical Damage
EF-0 (65-85 mph)	F0 (45-73 mph)	**Light damage.** Some damage to chimneys, gutters or siding; breaks branches off trees; pushes over shallow-rooted trees; damages to sign boards
EF-1 (86-110 mph)	F1 (73-112 mph)	**Moderate damage.** Roofs severely stripped; mobile homes pushed off foundations or overturned; moving cars pushed off the roads; loss of exterior doors; windows and or glass broken; attached garages may be destroyed.
EF-2 (111-135 mph)	F2 (113-157 mph)	**Considerable damage**. Roofs torn off well-constructed houses; mobile homes demolished; cars lifted off ground; large trees snapped or uprooted; light object missiles generated.
FE-3 (136-165 mph)	F3 (158-206 mph)	**Severe damage.** Roof and some walls torn off well-constructed houses; trains overturned; most trees in forest uprooted.
EF-4 (166-200 mph)	F4 (207-260 mph)	**Devastating damage.** Well-constructed houses leveled; structures with weak foundations blown off some distance; cars thrown and large missiles generated.
EF-5 (>200 mph)	F5 (261-318 mph)	**Incredible damage**. 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 reinforced concrete structures badly damaged.
EF No rating	F6-F12 (319 - 379 mph)	**Inconceivable damage.** These winds are very unlikely. Should a tornado with the maximum wind speed in excess of EF-5 occur, the extent and types of damage may not be conceived. Missiles, such as cars and refrigerators would do serious secondary damage that could not be directly identified as F6 damage.

Location

Tornadoes can strike anywhere and at any hour of the day. All areas in the planning area are at risk. Powerlines in Kirby are located above ground and therefore at risk to high wind events.

Previous Occurrences and Extent

Several sources were investigated to determine past occurrences of tornados in the planning area including the National Climatic Data Center, web searches, news articles and the State Of Vermont Hazard Mitigation Plan.

Statewide more than 40 tornadoes, 14 of magnitude F2 (significant) and 16 of magnitude F1 (moderate) on the Fujita Scale have been reported. Damage from tornadoes has ranged from a few downed trees to seven injuries during a 1970 tornado in Franklin County (located near Lake Champlain at the border to New York State).[76] Property damage has totaled over $8.4 million overall in the State of Vermont due to tornado damage. There have been no deaths as a result of a tornado in Vermont since 1950.[77]

[75] The Tornado Scale. (2016). Tornado Facts. Retrieved from http://tornado-facts.com/the-tornado-scale/
[76] These injuries occurred when a waterspout, a tornado that originates over water instead of land, moved from Lake Champlain to the south part of Swanton, where it struck a cabin.
[77] Storm Events Database. (2016). National Climatic Data Center: National Oceanic and Atmospheric Administration.

One major disaster declaration related to severe storms, tornado and flooding has occurred in Caledonia County in 2008; Table 4.21 gives more information on the pertaining disaster declaration. The tornado referenced in this disaster declaration touched base twice in Cambridge, VT (about 70 miles east of Kirby). This event of a magnitude EF0 and EF1 resulted in a damage of $100,000.[78]

Table 4.21 Disaster Declaration related to a tornado in Caledonia County[79]

Disaster Name (Date of Event)	Disaster Number (Type of Assistance)	Declared Areas
Severe Storms, a Tornado and Flooding (July 18, 2008)	DR-1784	Caledonia, Grand Isle, Lamoille

NCDC reported one tornado event within Caledonia County. Table 4.22 provides more background information on this tornado event.

Table 4.22 Tornado event in Caledonia County[80]

Date	Location	Wind Magnitude (Scale)	Length	Width	Death/ Injuries	Property Damage	Details
8/3/2010	Peacham , VT	EF0	0.14 miles	50 yards	0/0	25 K	Significant wind damage in the form of trees downed, uprooted and some snapped occurred with a convergence debris field pattern indicative of a tornado.

According to a website that lists tornado events near searchable locations, nine tornado events occurred in the proximity of the planning area. The largest tornado of these was an F1 (Gale Tornado, wind speed 40 -72 mph) in 1989 that caused no injuries or deaths.[81] Table 4.23 lists the reported tornado events and their distance from Kirby, VT.

[78] Storm Events Database. (2016). National Climatic Data Center: National Oceanic and Atmospheric Administration.
[79] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.
[80] Storm Events Database. (2016). National Climatic Data Center: National Oceanic and Atmospheric Administration.
[81] Tornado Information for Kirby, VT. (2017). Homefacts. Retrieved from http://www.homefacts.com/tornadoes/Vermont/Caledonia-County/Kirby.html

Table 4.23 Reported tornadoes near Kirby, VT since 1950[82]

DATE	Force	Death(s)	Injured	Distance to Kirby, VT
5/29/2012	0	0	0	21
8/3/2010*	0	0	0	19
6/5/2010	1	0	0	23
9/3/1993	1	0	0	22
8/6/1989	1	0	0	20
8/28/1988	0	0	0	12
5/19/1982	1	0	0	18
6/27/1964	0	0	0	24
5/20/1962	1	0	1	27

*The event on 8/3/2010 is referenced in Table 4.22

Probability of Future Events

The tornado index was consulted to investigate probability. The tornado index indicates that the planning area has an index of 12.29 compared to an index of 27.21 for the state and 136 for the nation. The tornado index value is calculated based on historical tornado events data using USA.com algorithms.[83] It is an indicator of the tornado level in a region. A higher tornado index value means a higher chance of tornado events.

According to the State of Vermont Hazard Mitigation Plan, Vermont has averaged less than one tornado per year since 1950.[84] While no tornado was reported in the planning area itself, 9 events with F0 or F1 were reported within a distance of 12 to 27 miles of the planning area over 66 years (see Table 4.23). According to this, a tornado would have occurred approximately every 7 years resulting in an annual probability of about 14%. According to the NCDC database however only one event was noted over the past 66 years within the County which results in an annual probability of about 1.5%. Taken into consideration the results from Table 4.23, probability is likely lower for the planning area, given a smaller study area. A probability of possible was assigned.

Vulnerability Assessment and Estimated Losses

NCDC databases covering 66 years (from 1950 to 2016) have been consulted. The tornado with the worst impact near the planning area (approximately 65 miles distance from Kirby, VT) was an EF1 tornado (Cambridge, VT in Lamoille County in 2008) causing $100,000 in property damage and no deaths or injuries. One other event was reported with $25,000 damage. An annualized loss with a range of $379 - $1515 from tornado events has been conducted. The impact is considered minor.

Climate change could impact the frequency and severity of tornadoes. 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. 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

[82] Tornado Information for Kirby, VT. (2017). Homefacts. Retrieved from http://www.homefacts.com/tornadoes/Vermont/Caledonia-County/Kirby.html
[83] Tornado index. Retrieved from http://www.usa.com/rank/us--tornado-index--state-rank.htm
[84] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.

been at least one day per year when 32 or more tornadoes occurred on a single day[85]. However the development of a tornado will also depend on local weather patterns. It is assumed that the likelihood for tornadoes to develop in Vermont will remain low.

All current and future buildings and populations should be considered at risk to tornadoes. Tornadoes are capable of causing catastrophic damage, injuries and deaths. Additional impacts may include power failure, loss of communications, and downed trees and debris.

WINTER HAZARDS

Winter hazards include blizzard, hail, ice jams, ice storms, nor'easter, snow events, and extreme cold. Many of these hazards overlap, for instance, blizzard is a type of snow event. Severe winter storms bring the threat of heavy accumulations of snow, cold/wind chills, strong winds, and power outages that result in high rates of damage and even higher rates of expenditures. Severe winter storms develop through the combination of multiple meteorological factors. In Vermont and the northeastern United States, these factors include the moisture content of the air, direction of airflow, collision of warm air masses coming up from the Gulf Coast, and cold air moving southward from the Arctic. Table 4.24 lists terminology related to snowfall events.

Table 4.24 Terminology related to snowfall events[86]

Term	Definition
Snowstorm	A storm with heavy snow
Blizzard	A severe snowstorm with cold temperatures, winds at or above 35 mph, and low visibility (less than ¼ mile)
Heavy Snow	Seven inches or more of snow falling within a 24-hour period
Winter Storm	Heavy snow with sleet and/or freezing rain

The Northeast Snowfall Impact Scale (NESIS) categorizes the severity of a snowstorm based on the amount of snowfall and the population at risk. NESIS provides a numerical measurement of the snowstorm's potential socioeconomic impact compared with past storms and assigns each large storm into one of five categories.[87] Table 4.25 below shows the NESIS categories, values and descriptions. The scale takes into account the size of area that is affected, amount of snow, and population.

Table 4.25 NESIS Definition of Snowstorms[88]

Category	NESIS Value	Description
1	1 – 2.499	Notable
2	2.5 – 3.99	Significant
3	4 – 5.99	Major
4	6 – 9.99	Crippling
5	10.0 +	Extreme

[85] Haughney. 2014.
[86] Glossary. (2016). National Oceanic and Atmospheric Administration: National Weather Service. Glossary. Retrieved from http://w1.weather.gov/glossary/index.php?letter=b
[87] Regional Snowfall Index. (2017). National Climatic Data Center: National Oceanic and Atmospheric Administration. Retrieved from https://www.ncdc.noaa.gov/snow-and-ice/rsi/nesis
[88] Abid.

BLIZZARD

Description

Blizzards are dangerous winter storms that are a combination of low temperatures, blowing snow and winds of 35 miles per hour or more resulting in very low visibilities. Officially, the National Weather Service defines a blizzard as a storm which contains large amounts of snow or blowing snow, with winds in excess of 35 mph and visibilities of less than 1/4 mile for an extended period of time (at least 3 hours). Blizzard conditions often develop on the northwest side of an intense storm system. The difference between the lower pressure in the storm and the higher pressure to the west creates a tight pressure gradient, or difference in pressure between two locations, which in turn results in very strong winds. These strong winds pick up available snow from the ground, or blow any snow which is falling, creating very low visibilities and the potential for significant drifting of snow.[89]

Location

A blizzard will impact the entire planning area. Powerlines in Kirby are located above ground and therefore at risk to high wind and snow and ice events.

Previous Occurrences and Extent

The State of Vermont Hazard Mitigation Plan and National Climatic Data Center (NCDC) database were researched for blizzard events. As blizzards can be associated with a heavy snow event and/or high wind events, we investigated the NCDC database for events of heavy snow and for winter storms events.

a) Heavy snow events

The NCDC reported 8 heavy snow events throughout Caledonia County between 1950 and 2016 resulting in a total property damage of $261,000. One singular heavy snow event in February 2007 known as the Valentine's Day Blizzard resulted in a damage of $200,000 county-wide. Table 4.26 lists all heavy snow events in Caledonia County between 1950 and 2016. The Valentine's Day Blizzard event is described in more detail in the following section.

Table 4.26 Heavy snow events in Caledonia County from 1950 – 2016 (NCDC)[90]

Date	Death/ Injuries	Property Damage	Further Details
12/1/1997	0/0	10 K	10" in Caledonia County
12/25/1997	0/0	15 K	7" in Burke (Caledonia County)
3/14/1998	0/0	5 K	9" in Sutton (Caledonia County)
3/21/1998	0/0	5 K	Storm system; 15-20" (average)
2/27/2002	0/0	1 K	< 7" of snow (in average)
2/14/2007	0/0	200 K	**"Valentine's Blizzard"**; Lyndon/East Burke: 20"
2/5/2014	0/0	10 K	5-12 inches of snow
2/13/2014	0/0	15 K	Winter storm; 13" in St. Johnsbury, 12" in Lyndonville

[89] Blizzards. (2016). National Weather Service Forecast Office. Retrieved from http://www.wrh.noaa.gov/fgz/science/blizzard.php?wfo=fgz
[90] NCDC. NOAA Storm Events Database.

February 2007 ("Valentine's Day") Blizzard Event Details:[91] [92]

The February 2007 North America Winter Storm (otherwise referred to as the Valentine's Day Blizzard) was a massive winter storm that affected most of the eastern half of North America, starting on February 12, 2007 and peaking on Valentine's Day, February 14. Snowfall rates of 2 to 4 inches per hour and brisk winds of 15 to 25 mph caused near whiteout conditions at times, along with considerable blowing and drifting of the snow, making roads nearly impassable in Vermont. Temperatures in the single numbers above zero combined with brisk winds resulted in wind chill values of 10 degrees below zero or colder. While some areas of Vermont received from 28–36 inches of snow in a 24–48 hour period, Lyndon and east Burke, Kirby's neighboring towns received a total of 20 inches.

The deep snow fall and snow drift caused numerous problems including the blocking of numerous heat vents that resulted in the build-up of carbon monoxide and sent dozens of people seeking treatment at area hospitals. There were additional indirect injuries resulting from this storm, including vehicle accidents and cardiac arrests due to overexertion during snow removal. Snow removal operations took several days and up to a week in some urban communities. In addition, the weight of the heavy snowfall on some weaker roofs, resulted in the partial or total collapse of 20 or more barn roofs and the deaths of more than 100 cattle. As indicated above this event resulted in a property damage of $200,000 for Caledonia County. Overall, the Valentine's Day Blizzard resulted in $2,625 million of property damage in the six affected Vermont counties.

b) Winter storm events

Between 1950 and 2016, 102 winter storms and 129 winter weather events were noted throughout Caledonia County resulting in a total property damage of 1,510 million from winter storms and of $649,500 from winter weather (compare snow event section).

Major disaster declarations related to blizzards (i.e. December 1969) occurred on the State level but did not include Caledonia County. The impacts from blizzards were indicated as critical to catastrophic. Some blizzards have resulted in shut down of facilities for several weeks and a high number of deaths. The Valentine's Day blizzard resulted in serious property damage throughout the State.

Probability of Future Events

Only one specific blizzard was noted for Caledonia County. Blizzards are a common winter hazard in the northeast and typically occur during the winter months. The State Plan lists 57 heavy snow events within the State of Vermont and five winter storm events in Caledonia County over a 5-year time span. It can be assumed that some of the heavy snow events (12.5 % annual probability for County) and winter storms (155% annual probability for the County) are related to blizzards. With at least one winter storm and about 11 snow events per year, blizzards are very likely. An annual probability of highly likely for blizzards has been assigned.

[91] Valentine's Day Blizzard. (2007). Retrieved from http://en.wikipedia.org/wiki/February_2007_North_America_blizzard.
[92] Storm Events Database. (2017). National Climatic Data Center: National Oceanic and Atmospheric Administration.

Vulnerability Assessment and Estimated Losses

All current and future buildings and populations are at risk to this hazard. It has a variety of potential impacts. Heavy snow loads may cause roofs and trees to collapse leading to structural damage. Deaths and injury are also possible. Additional impacts may include road closures, power outages, business interruption, business losses (i.e. loss of cow milk due to road closures), hazardous driving conditions, frozen pipes, fires due to improper heating, and second health impacts caused by shoveling (such as a heart attack). One mobile generator with hook-ups is located at the Town Garage. Since Kirby has two critical facilities plus the old school house meeting location it is assumed that critical facilities could not accommodate power outages completely.

Annualized loss from heavy snow in Caledonia County is only about $4,000. However, should a severe blizzard such as the "Valentine's Day Blizzard" occur, damages of $200,000 per county could reoccur. In comparison, statewide annualized property damage from heavy snow is $442 million (with a total property damage of 2,650 million resulting from 57 heavy snow events over 6 years). Annualized damage from winter storms in Caledonia County is calculated with $23 million and from winter weather with approximately $9,840. This evidence suggests that losses from blizzards in the planning area would likely be higher than the existing data shows.

Research indicates that climate change will result in more precipitation in the Northeast. This trend may result in more frequent or more severe blizzards.

HAIL

Description

"Hail is a form of precipitation that occurs when updrafts in thunderstorms carry raindrops upward into extremely cold areas of the atmosphere where they freeze into balls of ice. Hail can damage aircraft, homes and cars, and can be deadly to livestock and people. Hailstones grow by colliding with super-cooled water drops. Super-cooled water will freeze on contact with ice crystals, frozen raindrops, dust or some other nuclei. Thunderstorms that have a strong updraft keep lifting the hailstones up to the top of the cloud where they encounter more super-cooled water and continue to grow. The hail falls when the thunderstorm's updraft can no longer support the weight of the ice or the updraft weakens. The stronger the updraft the larger the hailstone can grow."[93]

Hailstones can range in size from 5 millimeters (mm, approximately pea-sized) to greater than 100 mm (approximately melon-sized). Table 4.27, derived from the website of the "TORnado and Storm Research Organization" (TORRO) shows the typical damage associated with different hail sizes.

Table 4.27 TORRO hailstorm intensity[94]

	Intensity Category	Typical Hail Diameter (mm)*	Probable Kinetic Energy, J-m2	Typical Damage Impacts
H0	Hard Hail	5	0-20	No damage
H1	Potentially Damaging	5-15	>20	Slight general damage to plants, crops
H2	Significant	10-20	>100	Significant damage to fruit, crops, vegetation

[93] Severe Weather 101 – Hail Basics. (2016). The National Severe Storm Laboratory: National Oceanic and Atmospheric Administration. Retrieved from http://www.nssl.noaa.gov/education/svrwx101/hail/

[94] Hail Scale. (2016). Tornado and Storm Research Organization. Retrieved from www. torro.org.uk/site/hscale.php

	Intensity Category	Typical Hail Diameter (mm)*	Probable Kinetic Energy, J-m2	Typical Damage Impacts
H3	Severe	20-30	>300	Severe damage to fruit and cops, damage to glass and plastic structures, paint and wood scored
H4	Severe	25-40	>500	Widespread glass damage, vehicle bodywork damage

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

The National Climatic Data Center reported 36 days with hailstones up to 1.75" in size throughout Caledonia County between 1950 and 2016. Seven 1.50" to 1.75" hail events resulted in property damage and in crop damage; one event caused crop damage. The reported property damage was mostly related to thunderstorms which caused flooding and power outages from damaging winds. However, one hail event in the neighboring town East Burke on 06/05/2010 with 1.75" size hails caused damage to several vehicles and roof shingles (totaling $15,000). Additional damage to outdoor furniture and siding was reported in similar cases. Total damage from hail events over the past 66 years in the county resulted in $87,000. Hail events tend to be highly localized and are limited to a relatively small area.[95]

As shown in Table 4.28, eighteen events took place in the vicinity of the planning area over the last 66 years; damage of up to $15,000 to vehicles and roof shingles was reported. Hailstones ranged in size from 0.88" to 1.75".

Table 4.28 Hail Events in neighboring Towns of Lyndon and Burke from 1950 – 2016

Date	Magnitude	Death/ Injuries	Property Damage	Description
4/27/1994	0.75"	0/0	0	East Burke
7/25/1994	0.88"	0/0	0	East Burke
9/21/1998	1.75"	0/0	0	Lyndon. Golf ball size hail
7/15/2000	n/a	0/0	0	Lyndon. pea to marble size hail
7/10/2001	1.5"	0/0	0	Lyndon.
7/3/2002	0.75"	0/0	0	Lyndon.
5/29/2005	n/a	n/a	1 K	East Burke
5/30/2005	n/a	n/a	1K	East Burke
6/9/2005	1"	0/0	0	Lyndon.
7/1/2006	0.88"	0/0	0	Lyndon. Nickel size hail
6/16/2007	0.88"	0/0	0	West Burke
6/27/2007	1"	0/0	0	Lyndon.
6/27/2007	1"	0/0	0	East Burke
6/5/2010	1"	0/0	0	East Burke.
6/5/2010	1.75"	0/0	15 K	East Burke. Up to golf ball size. Hail resulted in damage to several

[95] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.

Date	Magnitude	Death/ Injuries	Property Damage	Description
				vehicles and roof shingles.
5/16/2012	0.75"	0/0	0	Lyndon. Penny size hail
7/8/2014	0.88"	0/0	0	Lyndon. Nickel size hail and small limbs down due to thunderstorms
8/4/2015	0.88"	0/0	0	Lyndonville. Nickel size hail

There have been no major disaster declarations related to hail in Caledonia County.

An additional website search produced the following recorded hail event:

> "On June 23, 2013, Doppler radar detected half dollar size hail near Lyndonville, VT, Pittsford, VT and Wallingford, VT. This hail storm was traveling ESE at 22.94 mph and produced hail for roughly 4 hour(s). Spotters reported a max hail size of 1.25" and an average hail size of 1.25." There were two spotter report(s) and the volume of hail detected was significant. Based on this information, you can expect to see minor damage to vehicles, tile roofs and crops in isolated areas (Impact Rating 2)."[96]

According to the State of Vermont Hazard Mitigation Plan, 282 hail events took place in the State between 1955 and 2005 typically during the summer months. Most of these events had hail measuring 0.75 inches, but many had hail at least 1.5 inches in size. The largest hail during the period was 3-inch hail that fell in Chittenden County in 1968. Tennis ball-sized hail was reported in the Town of Chittenden during a storm in the summer of 2001.[97]

Probability of Future Events

According to the State of Vermont Hazard Mitigation Plan, hail is relatively infrequent. However, based on the above noted 9 hail events measured each in the neighboring towns of Lyndon and Burke over the last 66 years, an annual probability of 13 % or likely has been assigned for hail events. Although hail events can vary locally, it is assumed that meteorological events such as hail events would encompass similar areas. Therefore a likelihood of likely has been assigned for the planning area.

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, crop and exposed metal and glass.

The reported hail events in the planning area and within the county showed hail events with hailstones up to 1.75" (44 mm) in size. According to the TORRO scale (see Table 4.27) hailstones of 1.5" to 1.75" (38-44 mm) would be classified as H4 or H5 with an associated severe or destructive intensity that can cause wholesale destruction of glass, damage to tiled roofs up to dents in grounded aircraft. While impacts of this extent have not been reported within the planning area or the county, they are possible. According to the Town Plan, 50% of the area is forest and agricultural land and mostly used for dairy cows. Areas with large amounts of farmland are more vulnerable to

[96] 1.25 Inch Hail Near Lyndonille, VT. (2013). Hail strike. Retrieved from http://maps.hailstrike.com/vermont/1-25-inch-hail-near-lyndonville-vt-06-23-2013/

[97] Storm Events Database. (2016). National Climatic Data Center: National Oceanic and Atmospheric Administration.

hailstorms; there have been reports of hailstorms destroying entire hay fields and cornfields. However, hail impacts on dairy production would likely be considered as minor.

Based on previous hail events throughout the county, the annualized cost from hail events is approximately $1,318. The annualized losses from the hail events in the neighboring towns of Lyndon and Burke are $227. The losses in the planning area are likely lower.[98]

Climate change impacts can potentially affect this hazard as it might increase the frequency of hailstorms. Consequently, this may increase associated damages.

ICE JAMS

Description

Ice jams form frequently on northern rivers in the winter and spring. When temperatures rise and river ice begins to break up, it is common for big chunks to block the river channel and form massive "jams." Pieces of floating ice carried with a stream's current can accumulate behind any obstruction to the stream flow. Obstructions include river bends, mouths of tributaries, points where the river slope decreases, as well as dams and bridges. The water held back can cause flooding upstream, and if the obstruction suddenly breaks, flash flooding can occur downstream. Ice jams are most severe when combined with melting snowpack or heavy rainfall.

There are two main types of ice jams: freeze-up ice jams and break-up ice jams. Freeze-up jams happen when extremely cold air temperatures occur over open water. This results in the rapid production of large amounts of river ice that can jam downstream. Break-up jams account for about 2/3 of local ice jams, and occur when rapid thaw and/or runoff entering the river system break the existing ice cover and cause jamming downstream.[99]

According to the State of Vermont Hazard Mitigation Plan, ice jams are ranked as a moderate risk for the jurisdiction of the Northeastern Development Association (regional planning commission for Caledonia County).[100]

Location

Ice jams occur on flowing water such as rivers, streams, and brooks. The Moose River runs in the southeastern portion of the planning area. Ice jams have been reported in the past for Moose River.

Previous Occurrences and Extent

There was a major disaster declaration related to ice jams and flooding in Caledonia County in 1992.

Additionally, the Ice Jam Database maintained by the US Corps of Army Engineers, Cold Region Research, and Engineering Lab (CRREL), a searchable database of historic ice jam events was investigated. Table 4.29 shows the ice jams which were reported upstream from the planning area between 1936 and 2016.[101] The data has been

[98] Storm Events Database. (2016). National Climatic Data Center: National Oceanic and Atmospheric Administration.
[99] Ice Jams. (2016). National Oceanic and Atmospheric Administration: National Weather Service. Retrieved from rsgisias.crrel.usace.army.mil/icejam/ and http://www.crh.noaa.gov/Image/dvn/downloads/backgrounder_DVN_Ice_Jams.pdf
[100] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.
[101] United States Army Corps of Engineers. Retrieved on November 29 , 2016 from https://rsgisias.crrel.usace.army.mil/apex/f?p=524:5:0::NO Ice jams for Moose River at St. Johnsbury are not included.

collected for the Moose River water gage no. 01134500 at Victory, VT. The water gage is located 1.5 miles upstream from Kirby's town boundary. Three ice jam events have been reported at this location. Discharge is calculated in cubic feet per second (cfs).

Table 4.29 Ice Jams on the Moose River near the planning area from 1936 to today[102]

Date	Town	River	Gage No.	Damages	Description	Index No.
2/12/1981	Victory	Moose River	1134500	N/A	Discharge of 1200 cfs (cubic feet per second), affected by an ice jam, (no gage height available), reported at USGS gage Moose River at Victory, on February 12, 1981. Maximum annual gage height of 10.04 feet, affected by an ice jam, reported on February 13, 1981 (no discharge available)	3029
3/7/1979	Victory	Moose River	1134500	N/A	Maximum annual gage height, 9.84 feet due to an ice jam recorded at USGS gage Moose River at Victory, VT on March 7 at 1200 hours. Discharge 1500 cfs.	3028
3/24/1968	Victory	Moose River	1134500	N/A	Maximum annual discharge, about 1,600 cfs (gage height, 8.93 feet due to back water from ice) recorded at USGS gage Moose River at Victory, VT on March 24	3027
2/2/1981	St. Johnsbury	Moose River	1135000	N/A	Maximum annual gage height of 5.79 feet, affected by an ice jam, reported at USGS gage Moose River at St. Johnsbury, at 1830 hours on February 2, 1981. discharge 1800 cfs	3062
3/29/1980	St. Johnsbury	Moose River	1135000	N/A	Maximum annual gage height, 4.49 feet due to an ice jam recorded at USGS gage Moose River at St. Johnsbury, VT on March 29. Discharge 350 cfs	3061
3/6/1979	St. Johnsbury	Moose River	1135000	Up to 1M USD to repair damaged hydro plant	Maximum annual gage height, 5.94 feet due to an ice jam recorded at USGS gage Moose River at St. Johnsbury, VT on March 6. Average daily discharge 800 cfs.	3060
2/5/1978	St. Johnsbury	Moose River	1135000	N/A	Maximum annual gage height, 5.76 feet due to an ice jam recorded at USGS gage Moose River at St. Johnsbury on February 5. discharge 165 cfs	3059
12/31/1977	St.	Moose	1135000	N/A	Maximum annual gage height, 4.75	3058

[102] United States Army Corps of Engineers. Retrieved on November 29 , 2016 from https://rsgisias.crrel.usace.army.mil/apex/f?p=524:5:0::NO Ice jams for Moose River at St. Johnsbury are not included.

Date	Town	River	Gage No.	Damages	Description	Index No.
	Johnsbury	River			feet due to an ice jam recorded at USGS gage Moose River at St, Johnsbury, VT on December 31. Average daily discharge 63 cfs	
1/28/1976	St. Johnsbury	Moose River	1135000	N/A	Maximum annual gage height, 5.00 feet due to an ice jam recorded at USGS gage Moose River at St. Johnsbury, VT. Average daily discharge 350 cfs	3057
3/22/1975	St. Johnsbury	Moose River	1135000	N/A	Maximum annual gage height, 4.54 feet due to an ice jam recorded at USGS gage Moose River at St. Johnsbury, VT. Average daily discharge 600 cfs	3056
1/18/1974	St. Johnsbury	Moose River	1135000	N/A	Maximum annual gage height not determined, occurred due to an ice jam recorded at USGS gage Moose River at St. Johnsbury, VT during the period January 18th -23rd. Average daily discharge 115 cfs, 115 cfs, 115 cfs, 120 cfs, 180 cfs, 120 cfs	3055
1/23/1973	St. Johnsbury	Moose River	1135000	N/A	Maximum annual gage height, 6.19 feet due to an ice jam recorded at USGS gage Moose River on January 23. discharge 450 cfs	3054
3/18/1972	St. Johnsbury	Moose River	1135000	N/A	Maximum annual gage height, 5.77 feet due to an ice jam recorded at Moose River at St. Johnsbury, VT. discharge 250 cfs	3053
2/4/1970	St. Johnsbury	Moose River	1135000	N/A	Maximum annual gage height, 6.39 feet due to an ice jam recorded at USGS gage Moose River at St. Johnsbury, VT. Discharge 350 cfs	3052
12/28/1968	St. Johnsbury	Moose River	1135000	N/A	Maximum annual gage height, 4.61 feet due to backwater from ice recorded at USGS gage Moose River at St. Johnsbury, VT. Discharge 88 cfs	3051

Probability of Future Events

Based on fifteen ice jam events on Moose River near Kirby over 80 years, an annual probability of 18% or likely is given.

Vulnerability Assessment and Estimated Losses

Ice jam events sometimes pass with no significant damage or flooding, while other events may cause major problems. While ice jams are categorized as a winter hazard, their impacts and vulnerability are best aligned with flood impacts. As shown in the flood section, structures in the vicinity of river corridors were analyzed (compare Figure 4.7 Moose River corridor). Past ice jam information was given for the Moose River.

Based on the GIS spatial analysis, structures located in or in vicinity to the river corridor were identified as potentially at risk to flooding from ice jams. Detailed information on localized past flooding events at the Moose River in Kirby was not available. It was assumed that flooding from ice jams may occur localized but would not extend beyond an area of 100 m (328 ft) outside of the river corridor.

No critical facility or dairy farm is located within 100 m (328 ft) from the Moose River corridor. As shown in Table 4.14, eight building structures are located within in the vicinity of Route 2 and the Moose River corridor. Furthermore, a portion of Route 2 runs within 10 m (33 ft) to the river corridor for a length of 500 m (1,640 ft). In addition to this, the rail road runs within 10 m (33 ft) of the Moose River corridor at its closest distance. All these structures may potentially be subject to flooding from ice jams.

Economic losses are difficult to estimate; losses may be associated with localized flood losses (depending on where the ice jam occurs). Ice jams have also caused damage (up to collapsing) to bridges as they float down swollen rivers. Costs in the magnitude of $1 Million were noted to repair a damaged hydro plant after an ice jam in St. Johnsbury (index no. 3060) as can be seen in Table 4.30. However no event has been reported near Kirby and none of Kirby's critical facilities is located near the Moose River. The impact has been estimated as minor.

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 can be 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.

ICE STORMS

Description

According to NOAA's glossary, an ice storm is defined as, "Liquid rain falling and freezing on contact with cold objects creating ice build-ups of 1/4th inch or more that can cause severe damage."[103] With warmer air in the atmosphere above, falling precipitation in the form of snow melts, 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, which we call freezing rain. In the latter case, the re-frozen water particles fall as 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. All of the winter storm elements – snow, low temperatures, sleet, and ice have the potential to cause significant hazard to a community. Even small accumulations, for example one quarter of an inch, can down power lines and trees limbs, creating hazardous driving conditions. Furthermore, communication and power may be disrupted for prolonged periods of time.

[103] Glossary. (2016). National Oceanic and Atmospheric Administration: National Weather Service. Retrieved from http://w1.weather.gov/glossary/index.php?letter=b

Location

Ice storms will impact the entire planning area. Powerlines in Kirby are located above ground and are therefore at risk to ice storms.

Previous Occurrences and Extent

The State of Vermont Hazard Mitigation Plan and National Climatic Data Center reported one ice storm throughout Caledonia County between 1950 and 2016 affecting six counties including Caledonia County[104]:

> An ice storm hit the State of Vermont including Caledonia County in January of 1998; it was later declared a federal disaster (DR-1201; however Caledonia County was not listed). An unusual combination of precipitation and temperature led to the accumulation of more than three inches of ice in many locations, causing closed roads, downed power lines, and damage to thousands of trees. This storm was estimated as a 200–500 year event (elsewhere in the State of Vermont Hazard Mitigation Plan it is called a 100 year event). Power was out up to 10 days in some areas and 700,000 acres of forest were damaged in Vermont. Vermont suffered no fatalities, unlike Quebec where 3 million people lost power and 28 were killed during the same event. Temperatures rose after the storm, causing the ice to melt and permitting crews to reopen roads, which kept many residents from freezing in their unheated homes.

It is unknown whether the Town of Kirby experienced any damage from the major ice storm event of 1998 or similar events.

Table 4.30 gives more information on the 1998 ice storm event.

Table 4.30 1998 Ice storm in Vermont[105]

Date	Affected Areas	Magnitude	Death/ Injuries	Property Damage	Details
1/6/1998	Caledonia, Windsor, Orleans, Orange, Essex, Rutland	<0.75”	0/0	Total of $480; $80 per county	The impact on the region ranged from ice accumulations damaging tens of thousands of trees to downed power lines resulted from the weight of the ice with several thousand people without power. Farmers who lost electricity were unable to milk cows with loss of income and damage to cows. Automobile travel was negatively impacted with a number of roads closed due to ice and fallen trees. There were numerous traffic accidents. INDIRECT injuries were reported due to carbon monoxide poisoning while improperly using generators. Falling tree limbs and other debris was a significant hazard during and following the storm.

The maximum extent of ice reported in the planning area was 0.75 inches or less. However, ice can accumulate up to several inches.

[104] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.; Storm Events Database. (2016). National Climatic Data Center: National Oceanic and Atmospheric Administration.
[105] Storm Events Database. (2016). National Climatic Data Center: National Oceanic and Atmospheric Administration.

No major disaster declarations related to ice storms were issued for Caledonia County itself. According to the State of Vermont Hazard Mitigation Plan, the great ice storm of 1998 (DR-1201) resulted in just under $6 million in damage and affected six counties. Damages were not uniformly distributed throughout the six counties due to the varying intensity of the conditions geographically.

Electricity and telecommunication companies in Vermont, particularly the Vermont Electric Power Company (VELCO), who own high-voltage transmission assets, consider severe ice storms as the largest threat to their business. Severe snow loads during winter storms are being seen as the second largest threat to transmission and communication lines.[106]

Additional web search produced the following ice storm report:

> In December 2013, rain, freezing rain, snow, icing conditions, and near zero temperatures have impacted six Vermont counties including Caledonia, creating power outages affecting 22,000 households at its peak. In addition, fluctuations in icing conditions and the repeated need to clear and remove debris caused multiple outages for some customers. According to Vermont Electric Cooperative which serves northern Vermont and the northern part of the Northeast Kingdom, the storm cleanup and restoration was estimated to cost $2 million a day.[107]

Probability of Future Events

According to the State of Vermont Hazard Mitigation Plan, the Great Ice Storm has an assigned frequency of approximately a 100-year event. However, ice storms are known to be more frequent. This has been shown by the countywide event in December 2013. A probability of possible was assigned.

Vulnerability Assessment and Estimated Losses

All current and future buildings and populations should be considered at risk to ice storm. The State of Vermont Hazard Mitigation Plan estimated $1 million dollars of potential loss per County and $14 million for a statewide incident for a 100-year ice storm based on the losses associated with the 1998 incident. Whatsoever, the NCDC database reports merely a loss of $480,000 statewide and of $80,000 per county for the same event. The reasons for this difference are unknown. However, since these data represent losses for the whole county they are likely an overestimate of annualized losses in the planning area. The Town Hall is equipped with a mobile generator with hook-ups. However with only one generator for three critical facilities, it is assumed that power losses through ice storms could not be accommodated completely.

Climate change will likely make this hazard more frequent.

[106] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.
[107] Robin Smith. State Seeks FEMA help due to Ice Storm. (2013). The Caledonian Record. Retrieved from http://caledonianrecord.com/main.asp?SectionID=180&SubSectionID=778&ArticleID=104622

NOR'EASTER

Description

A Nor'easter is a large weather system traveling from South to North 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.

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. Further, they intensify as they reach the Northeastern Atlantic waters.[108]

The Northeast Snowfall Impact Scale (NESIS) described in the beginning of the section is a scale to measure snowstorms in the Northeast.

Location

The entire planning area is susceptible to the impacts from a Nor'easter. Kirby's power lines are located above ground and are at risk to high wind events.

Previous Occurrences and Extent

Nor'easters are common in New England in the winter months. The NCDC database does not categorize Nor'easter events. Nor'easter impacts would be likely grouped into winter storm or flood hazards in the database. Therefore, NDCD, the State of Vermont Hazard Mitigation Plan and web searches were used to identify significant events of winter storms or flood hazards that have impacted the planning area.

a) Winter storm:

As mentioned in the blizzard section, NDCD reported 102 winter storms throughout Caledonia County between 1950 and 2016. One hundred of those events caused property damage totaling approximately $1,510 million and one event caused property damage of $75,000. Damage resulted from power outages, traffic accidents, collapsing barn roofs (due to the weight of heavy snow), closed roads, and lost milk production due to inaccessible roads.

b) Flood hazards:

The State of Vermont Hazard Mitigation Plan references two major disaster declarations in April and July of 2007 that were related to Nor'easters. In both cases, severe Nor'easters and accompanying rainstorms resulted in major flooding.

[108] Northeast States Emergency Consortium. (2014). Retrieved from www.nesec.org

As shown in Table 4.31, Caledonia County was impacted by Nor'easter events resulting in two disaster declarations:

- On April 16, 2007 a heavy rain event with rainfall exceeding two inches throughout the day caused high water and flooding of low-laying fields adjacent to the Stannard Brook in Caledonia County. A landslide was caused in Orleans County due to the rain event.
- On the July / August 2007 event no further information is available

Table 4.31 Disaster Declarations related to Nor'easters in Caledonia County[109]

Disaster Name (Date of Event)	Date (Disaster Declaration)	Disaster Number (Type of Assistance)	Declared Areas
Severe Storms, High Winds, Flooding	5/4/2007	DR-1698	Bennington, Caledonia, Essex, Orange, Rutland, Windham, Windsor, and Lamoille (added)
Severe storms, flooding	8/3/2007	DR-1715	Orange, Washington, Windsor, Caledonia, Orleans

In addition, web sources referenced the following Nor'easter events in the neighboring Town of Lyndonville:[110]

- 3/30/2014 (Three Day Nor'easter, 03/29 – 03/31)
  Lyndonville, Caledonia County: 0.59" of rain
- 12/27/2010 - Lyndonville, Caledonia County: 5" rain

The extent of Nor'easters varies based on several factors including time of impact and ambient temperature that produces snow or rain. NESIS can also be used to rank severity. Based on the disaster declarations, only one Nor'easter event had a confirmed rating of major. However, stronger nor'easters are possible and may impact the planning area. Nor'easters are capable of producing several feet of snow or several inches of rain that can result in flooding.

Probability of Future Events

Nor'easters are most common in the late fall to early spring from September through April. They typically happen more than once annually, though they vary in degree of severity. Information on previous occurrences above underestimates their frequency, as they are known to occur annually. Therefore, a probability of likely was assigned.

Vulnerability Assessment and Estimated Losses

All current and future buildings and populations should be considered at risk to Nor'easters. Depending on the atmospheric conditions, these coastal storms may bring rain, ice, or snow. Typical impacts include widespread power outages, downed trees and power lines, and business interruption. Rain events typically result in flooding. Hazardous driving conditions and potentially closed roads may not only lead to traffic snarls and delays but also business losses i.e. losses of cow milk. The presence of a mobile generator at the Town Garage would likely help to somewhat accommodate power outages at one specific location. However, given three critical facilities, power

[109] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.
[110] "Springfield snowfall totals 15 inches from Nor'easter." (2010). Springfield Vermont News. Retrieved from http://springfieldvt.blogspot.com/2010/12/noreaster-could-dump-as-much-as-15.html; "Three Day Nor'easter. (2014). Surf Ski Weather. Retrieved from http://surfskiweather.us/three-day-noreaster/

outages could not be accommodated completely. In general, this hazard does have adequate warning time, which helps to alleviate potential deaths and injuries.

Climate change impacts could increase the frequency of severity of Nor'easters.

Determining a reliable loss estimate is difficult given limited information on losses in the planning area. However, most events will require some storm debris cleanup. Losses may range from a few thousand dollars to several million dollars for each event.

SNOW EVENT

Description

Snow event is a broad category that is used in this plan to describe winter storm and heavy snowfall events. 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 four or more inches within the timeframe of 12 hours or less. Associated events such as blizzards and Nor'easters are described in separate hazard profiles. A *winter storm* can range from a moderate snow over a period of a few hours to blizzard conditions with blinding wind-driven snow that lasts for several days. Events may include snow, sleet, freezing rain, or a mix of these wintry forms of precipitation. *Winter weather events* might be large enough to affect several states, while others might affect only localized areas. Occasionally, heavy snow may also cause significant property damages. For instance, roofs on older buildings can collapse, as they are not made to withstand heavy snow loads. [111]

All winter storm events have the potential to present dangerous conditions to the affected area. Larger snowfalls pose a greater risk as they reduce visibility due to blowing snow that make driving conditions difficult. Especially on Kirby's dirt roads in the hilly terrain driving in snow and ice conditions can be hazardous.

NOAA also defines types of public advisory and warnings issued by the National Weather

Service with winter weather (compare Table 4.32)[112]:

Table 4.32 NOAA winter weather categories

NOAA winter weather categories	Description
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 the 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

[111] Glossary. (2013). National Oceanic and Atmospheric Administration: National Weather Service.
[112] Abid.

NOAA winter weather categories	Description
	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 seven or more inches of snow or sleet are 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.

The NESIS method described in the beginning of the section can be used to measure severity of snow events.

Location

Snow events are atmospheric in nature and may impact the entire planning area. Kirby's power lines are located above ground and are at risk to events with high amounts of snow and ice.

Previous Occurrences and Extent

The National Climatic Data Center database and State of Vermont Hazard Mitigation Plan were reviewed for events of heavy snow, winter storms and winter weather.

As shown in Table 4.26 (blizzard section) eight heavy snow events were reported throughout Caledonia County between 1950 and 2016 resulting in a total property damage of $261,000 with the Valentine's Day Blizzard in 2007 being the major contributor.

In addition to snow events, we investigated winter storm and winter weather events. NCDC reported 102 winter storms and 129 winter weather events throughout Caledonia County between 1950 and 2016:[113]

- Of the 102 winter storms only two events did not result in any damage. One Hundred events caused property damage totaling approximately $1,510 million and one event caused property and crop damage totaling $20,000. Damage resulted from power outages, traffic accidents, collapsing barn roofs (due to the weight of heavy snow), closed roads, and lost milk production due to inaccessible roads.
- Of the 129 winter weather events, 116 resulted in damage totaling $649,500. Damage resulted from car accidents, snapped power lines and tree limbs.

Statewide, 505 *winter storms* and 573 *winter weather* events occurred between 2006 and 2012.[114] The winter storms resulted in a property damage of 7,545 million and a crop damage of $145,000. The winter weather events resulted in a property damage of 2,467 million over a period of 6 years.

Table 4.33 below shows an excerpt of 102 winter storm events that took place in Caledonia County between 2005 and 2010. These events stood out as some of the largest events. Fatalities or injuries were not reported from any of these events.

[113] Storm Events Database. (2013). National Climatic Data Center: National Oceanic and Atmospheric Administration.
[114] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.

Table 4.33 Excerpt from winter storm events in Caledonia County from 2005 – 2010

Begin Date	End Date	Property Damage ($)	Description
12/7/1996	12/8/1996	50,000	Fatal traffic accident, power outages
3/5/1997	3/6/1997	30,000	Power outages, traffic accidents
12/29/1997	12/30/1997	20,000	Sutton: 7.4 " of snow w/ sleet and rail; traffic accidents
4/9/2000	4/9/2000	25,000	Ice and snow(Sutton: 9.2"); broken tree limbs; numerous accidents
2/5/2001	2/6/2001	75,000	Minor traffic accidents; barn roof collapsed; Sutton: 14.4"
3/22/2001	3/23/2001	50,000	Power outages; traffic accidents; Sutton: 11.1" of snow
10/25/2005	10/26/2005	50,000	Trees and limbs downed; power outages; Sutton: 9"
2/10/2005	2/10/2005	20,000	Power outages
2/14/2007	2/14/2007	237,192.99*	"Valentine Blizzard"
12/11/2008	12/12/2008	10,000	Snow & freezing rain caused hazardous driving conditions, numerous school closings, civic and government closings, and power outages
2/23/2010	2/25/2010	50,000	Heavy wet snow (Walden: 20") resulted in power outages (>50,000 customers in the region)

There have not been any major disaster declarations related to snow events in Caledonia County. On the state level, however one federal disaster declaration occurred in December 1969 related to a blizzard event.

Probability of Future Events

Eight heavy snow events and 102 winter storms and 129 winter weather events were noted throughout Caledonia County between 1950 and 2016. Snow events and winter storms are very frequent in the region. The reported data suggests for Caledonia County an annual probability of approximately 196% for winter weather and of 155% for winter storms. Future snow events have been assigned a probability of highly likely.

Vulnerability Assessment and Estimated Losses

All current and future buildings and populations are at risk to this hazard. It has a variety of potential impacts. For example, structural damage may occur as heavy snow loads cause roofs and trees to collapse. Large flat roofs i.e. on commercial, retail and school buildings are at highest risk to this occurrence. Death and injuries are also possible. There have been reports from carbon monoxide incidents due to blocked heating vents. Additional impacts include road closures (including blocked emergency access roads), snow drifts, power outages, business interruption and loss (i.e. loss of cow milk), hazardous driving conditions, frozen pipes, fires due to improper heating, secondary impacts caused by shoveling (such as a heart attack), and flooding.

The following annualized losses within Caledonia County can be noted:

- $4,000 from heavy snow
- $22.8 million from winter storms
- ~$9,840 from winter weather.

In comparison, the following annualized statewide losses in Vermont can be noted:

- $1257.5 million (property damage) and $24,167 (crop damage) from winter storms
- $411 million from winter weather.

The dairy farm land houses within the Town of Kirby have a combined value of $2,610,000.[115] These structures are at risk to roof collapsing. No information on potential business losses from the dairy farms was available.

The Town Garage owns a mobile generator; it is assumed that it could somewhat minimize damage from power outages. However, given three critical facilities and many dairy farms, power outages could not be accommodated completely.

EXTREME COLD

Description

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." In Vermont however, extreme cold temperatures can range from temperatures at 0°F to below zero degree over an extended period of time (see Table 4.34). Whenever temperatures drop decidedly below normal and as wind speed increases, heat can leave the body more rapidly. These conditions may lead to serious health problems. Extreme cold is specifically affecting to vulnerable populations, for example those without shelter or who live in poorly insulated or unheated homes. 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.[116]

Location

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

Previous Occurrences and Extent

NCDC reported five extreme cold events for the entire Caledonia County during 1950 and 2016. Table 4.34 provides details on the extreme cold events during that timeframe.

Table 4.34 Extreme Cold Events in Caledonia County from 1950 -2016

Begin Date	Death/ Injuries	Property Damage	Description
1/25/2007	0/0	0	-14 degrees (St. Johnsbury); event lasted 2 days (plus another 2 days)
3/6/2007	0/0	0	-15 degrees (Sutton, Caledonia); event lasted ~2 days
3/9/2007	0/0	0	-23 degrees in St. Johnsbury (Caledonia); 1 night
1/14/2009	0/0	0	- 37 (Sutton, Caledonia); 2 days
1/7/2015	0/0	0	- 25 (Lyndonville); 1 day

Statewide, 31 cold/wind chill events were noted over six years. There have been no major disaster declarations related to extreme cold in Caledonia County.

[115] Town Clerk. Email Communication on February 3, 2017.
[116] Extreme Temperatures. (2011). New York State. Homeland and Emergency Services. Retrieved from http://www.dhses.ny.gov/oem/mitigation/archive/documents/2011/3.11-Extreme-Temperatures-2011.pdf

Probability of Future Events

Statewide, the annualized probability for cold/wind chill events is highly likely. Countywide the probability for extreme cold events is less than 8%. The countywide data are likely an underrepresentation. An estimated annual probability of possible was assigned for extreme cold events in the planning area.

Vulnerability Assessment and Estimated Losses

Extreme cold is an atmospheric hazard and has the potential to impact all existing and future assets, essential facilities, and populations. It may be associated with other winter hazards discussed in this plan. 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 may be impacted. Extreme cold is unlikely to damage structures severely but may result in broken water pipes. It also poses a health threat in terms of hypothermia and frostbite. Vulnerable populations, including the elderly and infants, have an increased risk and lower tolerance for such events. During extreme cold events travel time may be delayed as bridges and secondary roads may be icy and sidewalks and driveways may become slippery. Risk from improper use of heating devices resulting in fire and carbon monoxide poisoning may cause death and injuries.

The Town Garage owns a mobile generator. However with three critical facilities being present, power outages could likely not be accommodated completely.

No losses were reported from this hazard. Future losses are expected to be minimal and would be negligible if annualized over time. Climate change may impact this hazard through increased occurrence and severity.

FIRE HAZARDS

Fire-related hazards include drought, wildfire and lightning for Kirby, VT. Drought and wildfires have not been reported for Caledonia County but are included since they are mentioned in the State of Vermont Hazard Mitigation Plan.

DROUGHT

Description

The National Drought Mitigation Center (NDMC) defines drought conceptually as "a protracted period of deficient precipitation resulting in extensive damage to crops, resulting in loss of yield."[117] In general, drought is defined as "a water shortage with reference to a specified need for water in a conceptual supply and demand relationship. It is a complex phenomenon that is difficult to monitor and assess because it develops slowly and covers extensive areas, as opposed to other disasters that have rapid onsets and obvious destruction. Also unlike most disasters, the effects of drought can linger long after the drought has ended."[118] It is a normal, recurrent climatic feature and can occur at any place at any time. Droughts can have very damaging affects to crops, municipal water supplies, recreational uses and wildlife. High winds, low humidity, and extreme temperatures can all amplify the severity of the drought.

[117] Drought Basics. (2016). National Drought Mitigation Center. Retrieved from http://drought.unl.edu/DroughtBasics/WhatisDrought.aspx
[118] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.

Drought can be described according to meteorological, hydrological, agricultural or socio-economic criteria. Table 4.35 below lists the different drought types along with background information on those.

Table 4.35 Drought types[119]

Drought Type	Description
Meteorological Drought	Meteorological drought is usually based on long-term precipitation departures from normal precipitation pattern in regard to the amount, intensity, or timing of the event as well changes in the temperature, humidity, and wind patterns. The strict threshold differs for every nation; the United States defines meteorological drought as receiving less than 2.5 mm of rainfall in 48 hours. Meteorological drought is the first drought stage detected.
Agricultural Drought	Agricultural drought occurs when there is insufficient soil moisture to meet the needs of a particular crop and non-natural vegetation 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.
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. It is the last stage of drought and is lagged behind meteorological and agricultural drought because water infiltrates down to the groundwater during the latter portion of the hydrological cycle. Subsurface water supply is the last drought component to return to normal when meteorological conditions and aquifer recharge return.
Socioeconomic drought	Socioeconomic drought is what happens when the consequences of the drought start to affect the socioeconomic sector. It occurs when the demand for an economic good is greater than the available supply due to weather-related drought. Examples of such goods include water, hydroelectric power, food grains, meat, dairy, and much more. Socioeconomic drought affects the associated population both individually and collectively.

The severity of a drought depends on the duration, intensity, and geographic extent of the water shortage as well as the demands on the area's water supply. The US Department of Agriculture (USDA) rates droughts from D0–D4, depending on the severity of the drought, the amount of time it will take for vegetation to return to normal levels, and the possible effects of the drought on vegetation and water supply.[120]

There are several ways to measure drought. Figure 4.11 below shows drought severity conditions and selected drought monitor indices. Table 4.36 below shows drought severity conditions.

[119] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont. Adapted
[120] Drought Basics. (2016). National Drought Mitigation Center. Retrieved from at http://drought.unl.edu/DroughtBasics/WhatisDrought.aspx

Table 4.36 Drought Severity Conditions[121]

Description	Possible Impacts	Drought Monitor Indices		
		NDMC* Drought Category	Standardized Precipitation Index (SPI)	Palmer Drought Index
Abnormally Dry / Minor Drought	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	**D0**	-0.5 to -0.7	-1.0 to -1.9
Moderate Drought	Some damage to crops, pastures; streams, reservoirs, or wells low, some water shortages developing or imminent; voluntary water-use restrictions requested	**D1**	-0.8 to -1.2	-2.0 to -2.9
Severe Drought	Crop or pasture losses likely; water shortages common; water restrictions imposed	**D2**	-1.3 to -1.5	-3.0 to -3.9
Extreme Drought	Major crop/pasture losses; widespread water shortages or restrictions	**D3**	-1.6 to -1.9	-4.0 to -4.9
Exceptional Drought	Exceptional and widespread crop/pasture losses; shortages of water in reservoirs, streams, and wells creating water emergencies	**D4**	<2	-5.0 or less

*NDMC – National Drought Mitigation Center

The Drought Management of the State of Vermont Emergency Management Plan uses drought indices which are depicted in the following Table 4.37.

[121] US Drought Monitor. (2017). The National Drought Mitigation Center. Retrieved from at http://droughtmonitor.unl.edu/; adapted

Table 4.37 State of Vermont Drought Indices[122]

Drought level	Wildland fire potential NFDRS*	Groundwater***	Public water supplies and public community water supplies	Surface water
Normal	Low	35% of wells are within the lowest quartile for 2 consecutive months or less **	Less than 1% of PCWS on shortage or outage list. Domestic replacement wells list	The monthly mean is within the lowest quartile for 2 consecutive months or less **
Advisory	Moderate	35% of wells are within the lowest quartile for 3 consecutive months **	1-2% PCWS short or out of water.	The monthly mean is within the lowest quartile for 3 consecutive months **
Watch	High	35% of wells are within the lowest quartile for 4-5 consecutive months **	3-5 % PCWS short or out of water.	The monthly mean is within the lowest quartile for at least 5 out of 6 consecutive months **
Warning	Very High	35% of are within the lowest quartile for 6-7 consecutive months **	6-8 % PCWS short or out of water.	The monthly mean is within the lowest quartile for at least 6 out of 7 consecutive months **
Emergency	Extremely High	35% or more of wells are within the lowest quartile for 8 or more consecutive months **	9 %or greater PCWS short or out of water.	The monthly mean is within the lowest quartile for at least 7 out of 8 consecutive months **

Drought differs from other natural hazards in multiple ways. First, drought is not as obvious as other hazards; it does not have the destructive impact on property of a tornado or hurricane. Second, there is a lack of an exact and universally accepted definition of drought. Finally, the beginning and end of a drought is difficult to determine. In addition, droughts are often spread over a larger geographic area than other natural hazards. Therefore, the economic effects of a drought can be just as devastating as other natural hazards. Human activities can often exacerbate the impact of drought. For example, water use can deplete ground water supply. An increased drought level also increases the risks for wild fires.

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 the planning area is at risk to drought occurrence.

Previous Occurrences and Extent

The State of Vermont usually receives adequate amounts of rainfall which makes droughts low frequency hazards; however the climate is highly variable and unpredictable and droughts occasionally do occur. The State of Vermont Hazard Mitigation Plan reports that moderate and mild droughts are common while several severe droughts were recorded during the last century. A severe protracted drought occurred in 1964 “worsening to extreme in 1965

[122] Drought Management (Incident Annex 6). (2013). State of Vermont Emergency Management Plan; adapted

and 1966." "In the summer of 2003, Vermont experienced drought conditions with many communities reporting the season to be the driest on record."[123]

According to the State of Vermont Hazard Mitigation Plan, two statewide declared droughts occurred in June and July 1995. There have been no major disaster declarations related to drought in Caledonia County. In general, severe droughts are not frequent occurrences in Vermont.[124]

U.S. Drought Monitor Data was gathered from the station nearest to Kirby, St. Johnsbury. The reporting period is January 2000 to December 2016. Records include a weekly drought condition including the percent of the area in each classification of drought. Figure 4.11 below shows the drought indices for St. Johnsbury, VT during 2000 – 2016.

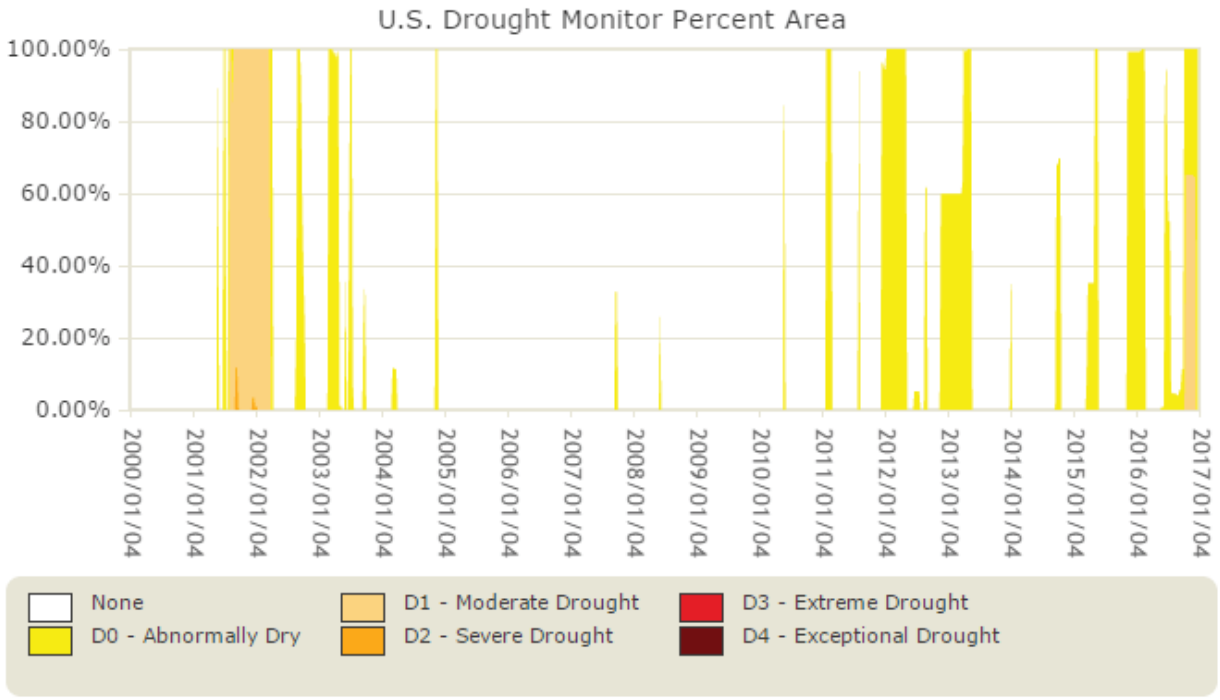


Figure 4.11 Drought indices for St. Johnsbury, VT (2000 – 2016)[125]

The drought data for St. Johnsbury was analyzed and results are presented below by reporting the highest drought classification that occurred each year and the number of weeks at that recorded level. Conditions are reported by category as a percentage in the figure. Table 4.38 shows the drought monitor data for St. Johnsbury (Figure 4.11) aggregated into a table. The table presents the drought category without taking the percentage level into account; all percentages are shown. For example, in 2001 D2 may be reported as the highest level but only a small percentage of the area may have been involved in D2 drought levels throughout the reported time in 2001.

[123] State of Vermont Hazard Mitigation Plan. (2013).
[124] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.
[125] Climate Data for selected stations. (2017). National Drought Mitigation Center: Drought Risk Atlas. Retrieved from http://droughtatlas.unl.edu/Data.aspx

Table 4.38 Drought Monitor data for St. Johnsbury

Year	Maximum Severity
2000	No drought
2001	Up to D2 conditions for 5 weeks
2002	Up to D2 conditions for 2 weeks
2003	Up to D0 conditions for 17 weeks
2004	Up to D0 conditions for 7 weeks
2005	No drought
2006	No drought
2007	Up to D0 conditions for 3 weeks
2008	Up to D0 conditions for 2 weeks
2009	No drought
2010	Up to D0 conditions for 2 weeks
2011	Up to D0 conditions for 11 weeks
2012	Up to D0 conditions for 34 weeks
2013	Up to D0 conditions for 24 weeks
2014	Up to D0 conditions for 8 weeks
2015	Up to D0 conditions for 18 weeks
2016*	Up to D1 conditions for 10 weeks

The extent of drought can be defined in terms of the drought monitor classifications. The highest classification to occur in St. Johnsbury and Caledonia County is D2. However, more severe conditions are possible.

Probability of Future Events

Drought conditions of D0 (abnormally dry or minor drought) or higher have been reported in thirteen out of seventeen years. This results in an approximate of 75 percent, bringing the probability of future minor droughts (D0) 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. Drought tends to have greater economic, environmental, and social impacts. However, the built environment is rarely affected.

Losses from droughts are not estimated to date. A better understanding of economic losses from droughts could be gained by assessing certain losses such as the reduction in agricultural production during droughts, or the costs for additional water supply for farms and communities, and drilling or deepening of wells to capture additional yields during the drought period.[126] It is assumed that the dairy farms may be impacted by a drought.

Climate change may also influence drought. Recent projections from the UMASS Climate System Research Center are showing that the Northeast will warm by 2-3 degrees Celsius and experience more precipitation in the winter months.[127] Warmer temperatures could result in faster evaporation and thus in an increased risk of drought;

[126] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.
[127] "Climate Modelers See Possible Warmer Wetter Winters. (2012). UMass Amherst. Retrieved from http://www.umass.edu/newsoffice/article/climate-modelers-see-possible-warmer-wetterwinters-northeast-2070

however this will depend on the actual weather conditions. In general, droughts may become increasingly common in the future.

WILDFIRE

Description

A wildfire is the uncontrolled burning of woodlands, brush, or grasslands. According to FEMA, there are four categories of wildfires that can occur throughout the United States (compare Table 4.39 below)[128]

Table 4.39 Categories of wild fires

Wildfire Category	Description
Wildfire	Fueled by natural vegetation; typically occur in national forests and parks, where federal agencies are responsible for fire management and suppression.
Interface or Intermix Fires	Urban wildfires in which vegetation and the built environment provide fuel.
Firestorm	Events of such an extreme intensity that effective suppression is virtually impossible; occur during extreme weather and generally burn until conditions change or the available fuel is exhausted.
Prescribed Fires and Prescribed Natural Fires	Fires that are intentionally set or selected natural fires that are allowed to burn for beneficial purposes.

Prescribed Fires and Prescribed Natural Fires: Fires that are intentionally set or selected natural fires that are allowed to burn for beneficial purposes

"Wildfires can be a result of naturally occurring influences such as lightning, extreme drought and heat, and human influences such as a discarded cigarette butt, improperly extinguished campfire, a stray spark from nearby railroad tracks or intentional arson. The potential for threat of wildfires is dependent upon topography and slope, surface fuel characteristics, recent climate conditions, current meteorological conditions, and fire behavior. Wildfire danger can vary greatly season to season and is exacerbated by dry weather conditions or drought. Once a wildfire threatens a community, it is often too late to protect nearby structures, and populations have to be evacuated for their own safety. These fires have damaged structures and utilities as well as hundreds of acres of woodlands."[129] According to the State of Vermont Hazard Mitigation Plan, wildfires are uncommon in Vermont but have increased through extended periods of warming as a result of climate change.

Risk of fires in wild land, rural areas, state forests and parks are linked to dry conditions.

[128] Federal Emergency Management Agency. (1997).
[129] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.

According to the State of Vermont Emergency Management Plan (Drought Management), wildfires can have moderate to severe impacts on natural resources.[130]

Location

According to the Vermont Forest Resources Plan, Kirby is located in a rural residential landscape zone made up from rural residential non-forested and forested area, these are defined as following[131]:

- Non-forested lands are lands less than 50% forested per km square,
- Forested lands are 50% or greater of the area in forest cover per km square.

According to this source, rural and rural residential areas are priority areas at risk for wildfire damage. Thereof the Forested Rural Residential Landscape Zone (FRRLZ) is named to have the highest risk of wildfire due to the density of structures in close proximity to forest cover.

Figure 4.12 gives an overview of the land use area in the planning area.

[130] Drought Management. (2013). Vermont. State of Vermont Emergency Operations Plan.
[131] Vermont Forest Resource Plan. (2010). Vermont Department of Forests, Parks and Recreation: Agency of Natural Resources.

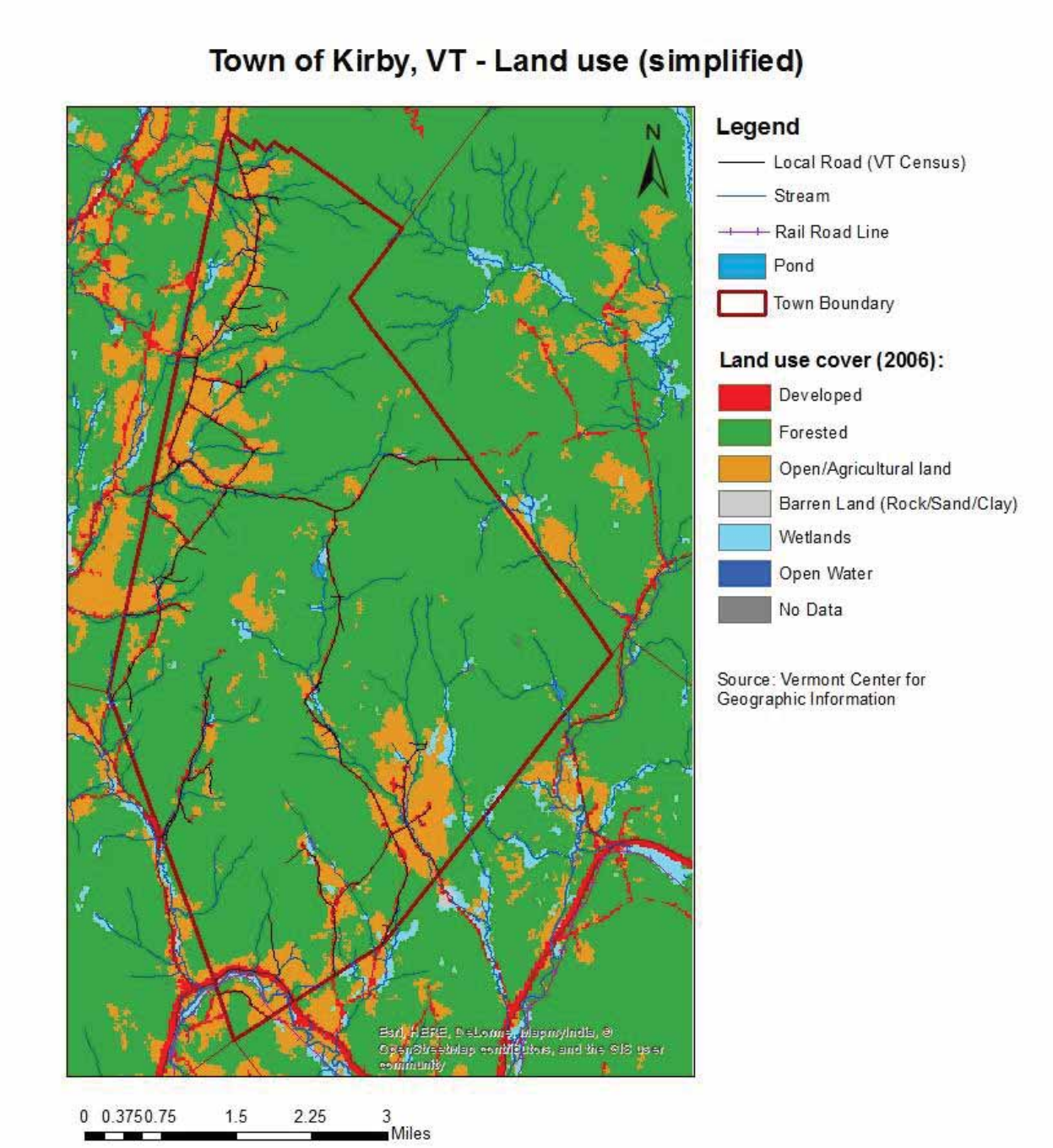


Figure 4.12 Land use in Kirby

Based on the Town Plan, 50% of the area consists of forest and agricultural land. The crop and pastureland is utilized by six farms according to the plan, and forty-one parcels are classified as woodlands.[132]

Based on the GIS data used in Figure 4.12, Kirby's planning area consists of mostly forested area (25.91 acre), open/agricultural land (4.47 acres) and a few portions of developed land (1.09 acres). As shown in Table 4.40, this results in the following land use type percentages:

Table 4.40 Land use types in the planning area

Land use type	Percentage
Forested areas	80%
Open space / agricultural areas	13.8%
Developed areas	3.36%
Wetland areas	2.63%
Barren areas	0.06%
Open Water	0.06 %

As can be seen forested areas made up 80 % and open space / agricultural areas, 13.8% of the planning area.

Fires may be determined by investigating areas where development is near undeveloped areas. The area where urban development meets vegetated, wildfire prone lands is called the Wildland Urban Interface (WUI). The Silvis Lab (University of Wisconsin) has developed the methodology behind wildland urban interface area. The Silvis Lab defines interface areas and intermix areas as follows[133]:

- 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%.

Based on this method we developed the WUI for Kirby. Figure 4.13 on the following page shows the results of the WUI analysis for the planning area. As shown in Figure 4.13, only 2.7 % of the planning area are classified as interface and 16.6 % as intermix areas. It has to be noted that both areas have a low housing density and are therefore associated with a lower risk.

[132] Kirby Town Plan. (2012). Town of Kirby; It shall be noted that only 4 farm operations where noted in recent conversations with the town.
[133] The wildlife urban interface. (2013). Silvis Lab. University of Wisconsin. Retrieved from http://silvis.forest.wisc.edu/maps/wui_main

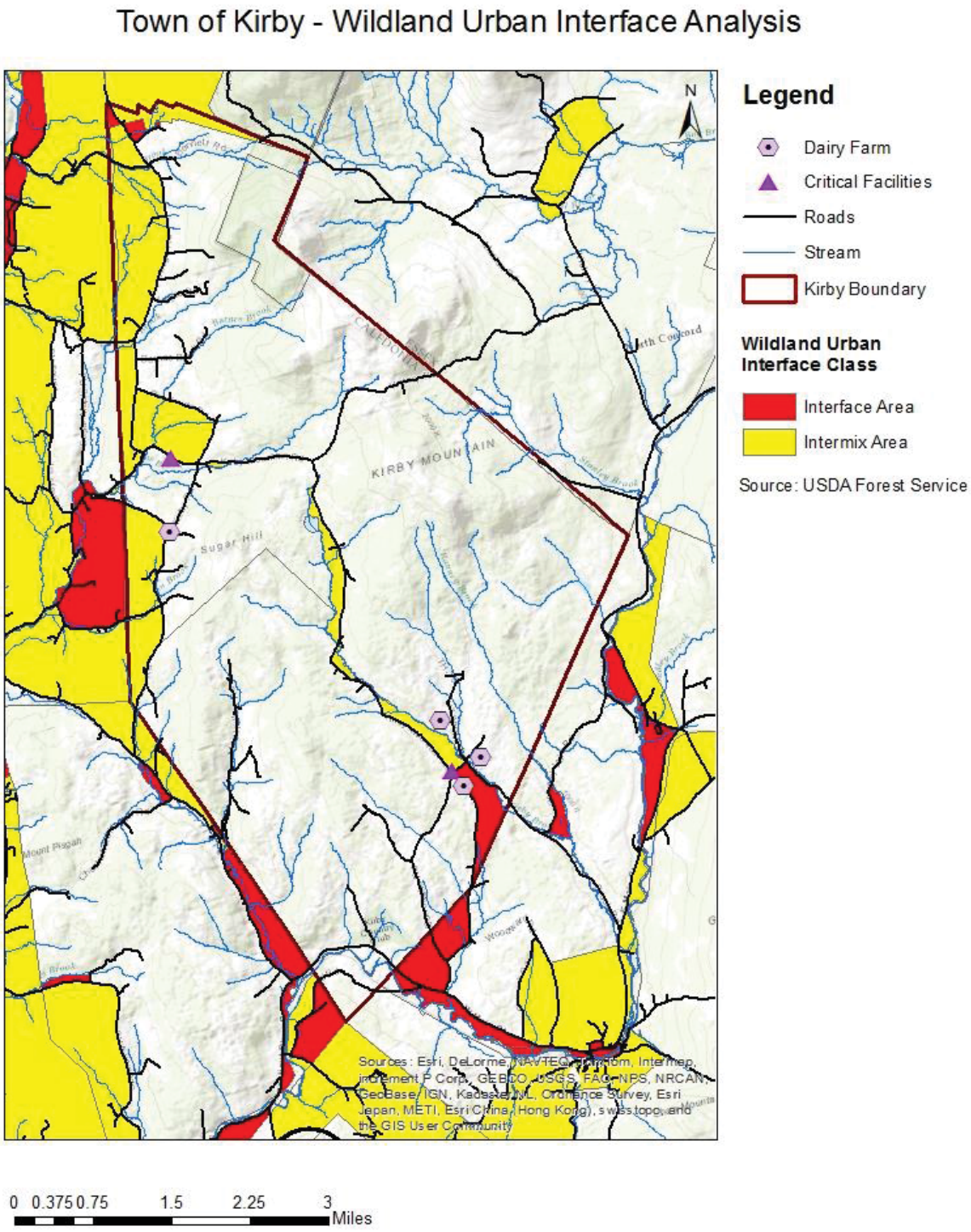


Figure 4.13 WUI for Kirby

Previous Occurrences and Extent

Several sources were investigated to determine wildfires in the planning area. Limited information was available. There have been no major disaster declarations related to wildfire in Caledonia County. The State of Vermont Hazard Mitigation Plan notes that wildfires are generally uncommon in the State of Vermont and the threat of wildfire is rare.

As shown in the drought section, severe droughts occurred in 1964, worsening to extreme in 1965 and 1966. As a result, in 1966 there were 14 Class C wildfires in Vermont ranging from 10 to 100 acres, much larger than the average forest fire in Vermont of 2.5 acres.[134] For the planning area no event has been reported whatsoever.

Given a typical area of up to 2.5 acres for an average forest fire, the extent of a wildfire can be categorized as small. Also, the interface and intermix areas are located in areas with low housing density. This is due to the fact that Kirby's lot sizes are mostly large.

Probability of Future Events

Based on the Vermont Forest Resource Plan, Kirby is located in a zone of low to moderate wildfire risk.[135] According to the State of Vermont Hazard Mitigation Plan, wildfire conditions are typically at their worst either in spring when dead grass and fallen leaves from the previous year are dry and new leaves and grass have not come out yet, or in late summer and early fall when that year's growth is dry. In drought conditions, the risk for wildfire is obviously higher.[136] In addition to drought conditions or low humidity, warm temperatures and strong winds can facilitate a wildfire as well.

Limited reporting on previous occurrences makes it difficult to determine a reliable probability.

There has not been a major wildfire in Vermont in the last 50 years. Overall, Vermont's climate, vegetation type, and landscape discourage major wildfire[137]. The probability has been assessed as possible.

Vulnerability Assessment and Estimated Losses

Wildfire impacts include structural 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. With fire-fighting services not being located in Kirby itself, fires may not be contained as quickly and evacuations may be potentially necessary.

Climate change may also impact this hazard in terms of earlier onset of spring, warmer summer and reduced precipitation (increased burnable area).

Small wildfires up to 2.5 acres can be expected in the planning area. No information on previous losses was available.

All current and future buildings and populations are considered at risk to wildfire. WUI data allows GIS intersection analysis to indicate the risk in this area. As can be seen on Figure 4.13 all critical facilities and dairy farms are all

[134] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.
[135] Vermont Forest Resource Plan. (2010). State of Vermont.
[136] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.
[137] Abid.

located in the vicinity of the interface and intermix area. Furthermore, most of Kirby's building stock is located in vicinity of the WUI area and considered vulnerable to wild fires.

According to the WUI analysis, 19% of the area and approximately 80 % of the population would be at risk to wild fires. Although most of Kirby's land is located away from WUI, the critical facilities and most of the homes are in close vicinity to interface and/or intermix areas. The critical facilities have a building value of $613,441 and a combined value of 773.004. Kirby's dairy farm properties and land have a combined value of $3,040,500 and are considered vulnerable to wild fires as well.[138]

Table 4.41 shows the critical facilities potentially at risk from wildfires due to being located in an interface or intermix area. As can be seen in the table, construction type is frame/wooden material which may be subject to burning depending on the wind and dryness conditions among other criteria.

Table 4.41 Critical facilities at risk to wildfire (per WUI analysis)

Critical Facility	Address	Building Value	Value contents	Area	Built Year	Construction
Town Garage	346 Town hall Rd, Lyndonville	302,189	78,645	2520	1985	Frame
Town Hall / Clerks Office	346 Town hall Rd, Lyndonville	192,649	50,077	1605	1828	Frame
Old South Kirby Schoolhouse	7 Ranney Hill Rd, Lyndonville	118,603	30,841	988	1825	Frame

Based on the WUI analysis the potential impact from a wildfire was assessed as critical.

LIGHTNING

Description

Lightning is a sudden 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. 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. [139]

Lightning typically is less frequent and less intense adjacent to cool ocean and lake surfaces which reduce the intensity of updrafts in thunderstorms.

Location

Figure 4.14 was compiled from data for the years 2005 to 2012 to demonstrate the frequency of cloud-to-ground lightning flashes per square mile per year. As shown, lightning is less frequent in the Northeast and in northern New England compared to the western region on this map. The planning area receives about 0.5 – 2 flashes per square mile per year.

[138] Town of Kirby. Kirby's dairy farm values. Email conversation with Town dating from February 2, 2017.
[139] Lightning. (2017). Wikipedia. Retrieved from https://en.wikipedia.org/wiki/Lightning

It shall be noted that thunderstorms develop more often on slopes than over the highest elevations. Most lightning occurs during June, July, and August. With regard to the time of day, most areas have the most frequent cloud-to-ground lightning activity from afternoon to early evening.[140]

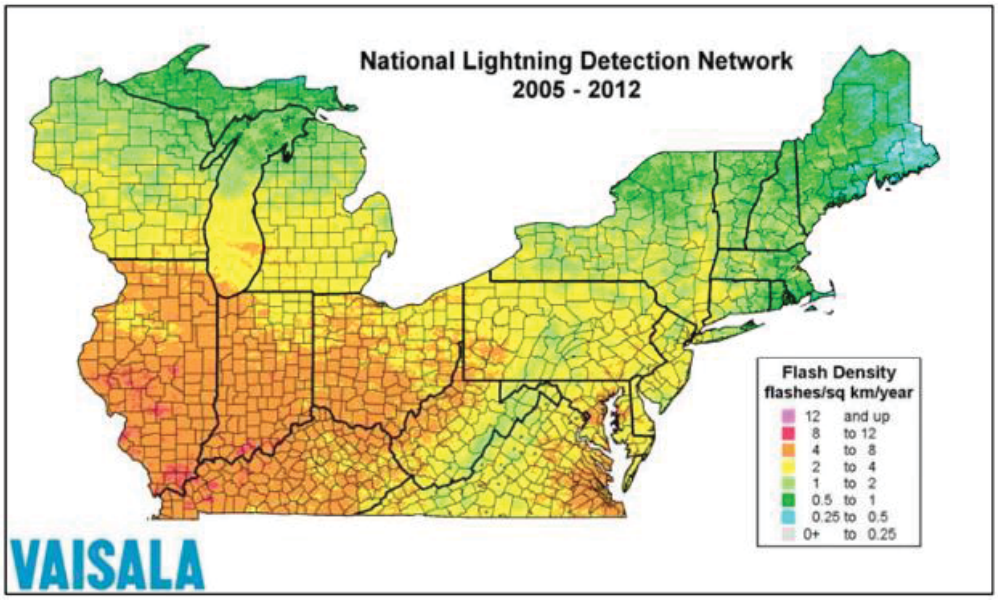


Figure 4.14 Lightning in the Northeast[141]

Previous Occurrences and Extent

The National Climatic Data Center was referenced to determine possible lightning occurrences in Caledonia County. The following events have been reported between 1950 and 2016:[142]

- Eight lightning events occurred in Caledonia County resulting in a total damage of 187,000 USD (from five events).
- Two lightning events occurred in neighboring towns of Kirby:
    - A lightning strike in Lyndonville on 6/29/2003 but caused no death, injuries or loss in property
    - A lightning strike in Burke on 06/05/2010 causing two injuries as it struck two people by lightning along a bike trail in East Burke. No death or loss in property were reported.
- The lightning with the highest loss was reported in St. Johnsbury on 5/11/2007 (damage of 150,000 USD).

[140] VAISALA. (2013).
[141] VAISALA. (2013).
[142] Storm Events Database. (2016). National Climatic Data Center: National Oceanic and Atmospheric Administration.

Probability of Future Events

Based on two lightning strikes in neighboring towns over 66 years, a probability of 12% or possible was assigned. Some lightning strikes throughout the county have resulted in minor damage. However, in the planning area itself no damage has been reported.

Vulnerability Assessment and Estimated Losses

Given that lightning may strike anywhere, all current and future buildings and populations are assumed to be at risk to lightning. In the planning area, losses have not been reported for this hazard. However, lightning caused injuries in the neighboring town of East Burke. Furthermore, similar events resulted in a total damage of $187,000 with one singular event causing $150,000 USD in damage (St. Johnsbury event on 5/11/2007). This equals an average of $37,400 USD per event or an annualized loss of $2,833.

Losses due to lightning include impacts from structural fires and debris cleanup from downed trees and power lines, and electronic equipment damage.

GEOLOGIC HAZARDS

A geologic hazard is an extreme natural event in the crust of the earth that poses a threat to life and property, for example, earthquakes, volcanic eruptions, tsunamis (tidal waves) and landslides. Geologic hazards analyzed for the planning area include earthquakes and landslides.

EARTHQUAKE

Description

An earthquake is a sudden, intense shaking of the ground caused by the sudden movement of large portions of the Earth's crust, potentially causing massive damage to buildings and infrastructure. Earthquakes can occur suddenly at any time, with virtually no warning. Earthquakes in the northeastern United States generally have deep foci (> 10 km).[143]

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. 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. Intensity is most commonly measured using the Modified Mercalli Intensity (MMI) scale based on direct and indirect measurements of seismic effects. The MMI 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 4.43. The Richter Scale is depicted in Table 4.42.

[143] Ebel and Kafka. (1991).

Table 4.42 Richter Scale[144]

Richter Magnitudes	Earthquake Effects
< 3.5	Generally not felt, but recorded.
3.5 - 5.4	Often felt, but rarely causes damage.
5.4 - 6.0	At most slight damage to well-designed buildings. Can cause major damage to poorly constructed buildings over small regions.
6.1 - 6.9	Can be destructive in areas up to about 100 kilometers across where people live.
7.0 - 7.9	Major earthquake. Can cause serious damage over larger areas.
8 or >	Great earthquake. Can cause serious damage in areas several hundred kilometers across.

Table 4.43 Modified Mercalli Intensity (MMI) Scale[145]

Scale	Intensity	Description Of Effects	Corresponding Richter Scale Magnitude
I	Instrumental	Detected only on seismographs.	N/A
II	Feeble	Some people feel it.	< 4.2
III	Slight	Felt by people resting; like a truck rumbling by.	N/A
IV	Moderate	Felt by people walking.	N/A
V	Slight 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.	N/A
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

Vermont is classified as an area with low to moderate seismic activity[146]. Typically, earthquakes occur along fault lines, but these deep faults are not always expressed on the ground surface. (Although there are numerous faults exposed at the ground surface in the northeastern United States, there is no evidence for significant motion along these faults).[147] Therefore location of where earthquakes will occur in the Northeast is still uncertain. The hard

[144] Richter Magnitude Scale. (2017). Wikipedia. Retrieved from https://en.wikipedia.org/wiki/Richter_magnitude_scale
[145] Modified Mercalli Intensity Scale. (2016). U.S. Geological Survey. Retrieved from http://earthquake.usgs.gov/learn/topics/mercalli.php; Mercalli Scale vs Richter Scale. (2016). Diffen. Retrieved from http://www.diffen.com/difference/Mercalli_Scale_vs_Richter_Scale; adapted
[146] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont. Pg.4-91.
[147] Ebel and Kafka. (1991).

bedrock terrain in the northeast permits earthquake energy waves to travel long distances while dissipating slowly which may result in a big impact.

The Northeast States Emergency Consortium (NESEC) indicates that New England experienced 2,403 earthquakes from 1638 through 2007, of which 73 were located in Vermont. The vast majority of these earthquakes were minor in nature. Minor earthquakes, such as those less than 3.0 in magnitude, occur frequently in the region.[148] However they are virtually undetectable and do not cause damage and do not warrant concern.

Although the risk of a major earthquake to occur is low, the effects of a potential major earthquake may be devastating and may affect the entire region. Nearly all critical infrastructure is vulnerable, including roads, bridges, utilities, communications, etc. State and federal emergency response might be delayed or hindered as a result of roads or bridges having been destroyed during the quake or due to damage and debris that might block access roads.

All areas of the planning area are susceptible to an earthquake occurrence. Fault lines, however, are not a sufficient indicator of earthquake location in the Northeast. Figure 4.15 below was used to indicate possible earthquake locations. It shows the location of relative seismic risk for the state of Vermont. This indicates that the planning area is in an approximate zone of 10 to 14 percent g hazard area (correlating to *strong* perceived shaking). Percent g refers to the acceleration due to gravity. Peak acceleration is measured on an intensity scale similar to the Mercalli scale.

Figure 4.15 depicts the risk of damage from earthquakes in the US. Figure 4.16 shows a seismic hazard map for Vermont. As can be seen, Caledonia County, depicted in blue color is located within a region of moderate risk of damage from earthquakes (PGA Hazard of 10-14% g).

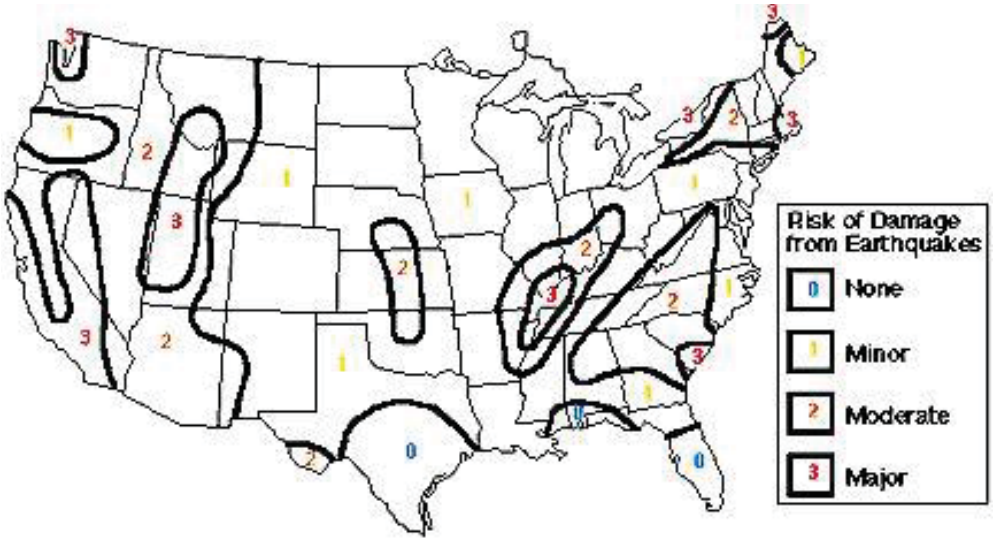


Figure 4.15 Risk of Damage from Earthquakes[149]

[148] Earthquake Hazards. (2017). The Northeast States Emergency Consortium. Retrieved from http://nesec.org/earthquakes-hazards/
[149] Stearns and Miller. (1977); modified

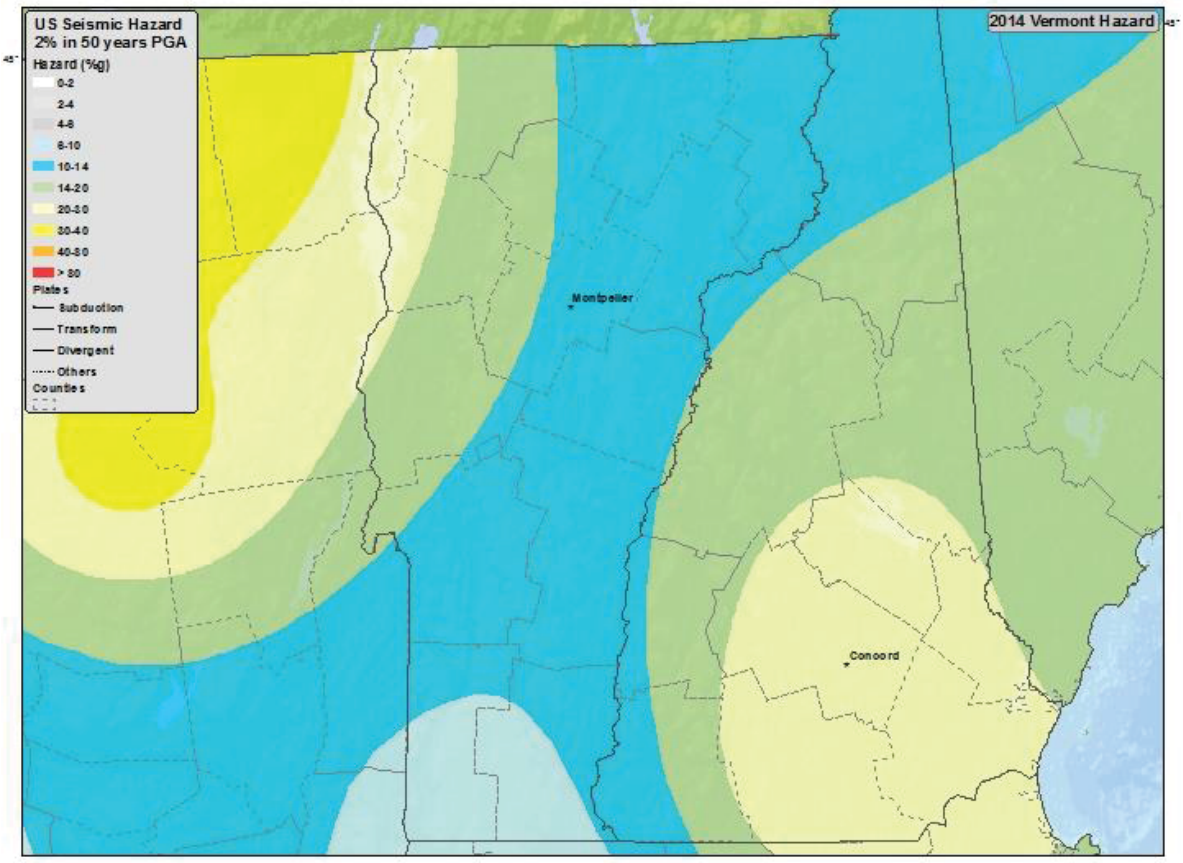


Figure 4.16 Seismic Hazard Map for Vermont[150]

**PGA – peak ground acceleration (mapped on an intensity scale similar to the Mercalli scale*

Previous Occurrences and Extent

There have been no major disaster declarations related to earthquakes in Caledonia County. However, several earthquakes have been located near Kirby, VT. As already mentioned, earthquakes further away can and have caused considerable damage in the planning area.

Figure 4.17 below shows historical occurrence of earthquakes in the Northeast. The figure on the left depicts 1638 to 1974 earthquake occurrences and the figure on the right shows earthquake occurrences from 1975 to 2014. Table 4.44 lists notable historic earthquakes in Vermont from 1638 – 2007 with a magnitude or intensity of 4 or greater.

[150] U.S. Geological Survey. (2014).

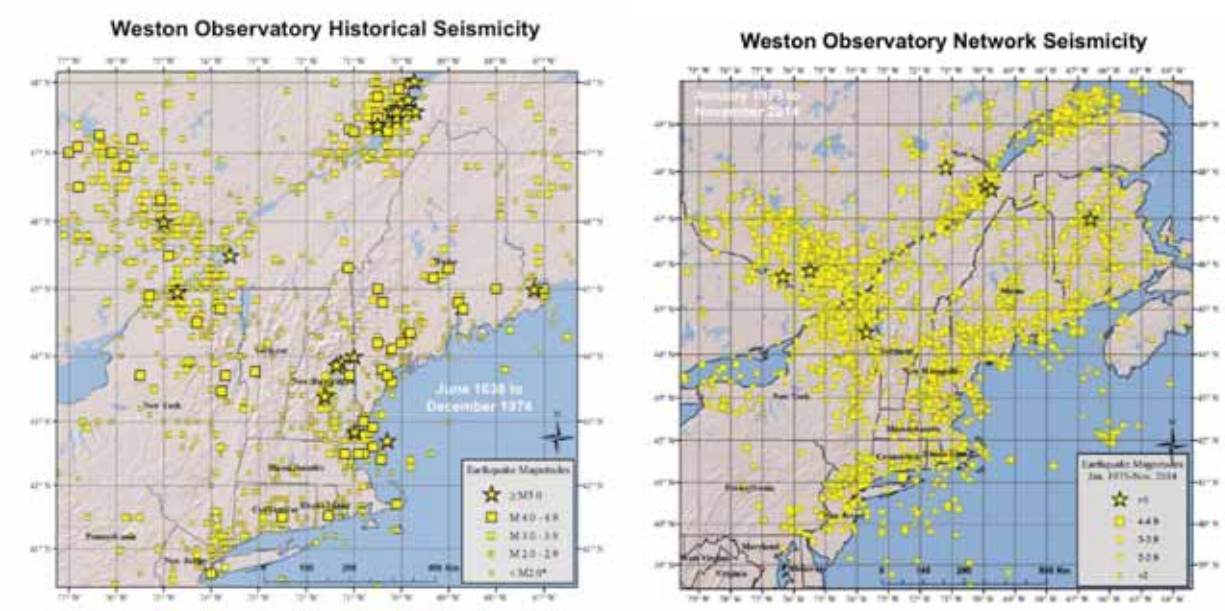


Figure 4.17 Historical Occurrence of Earthquakes in the Northeast[151]

Table 4.44 Notable historic earthquakes in Vermont from 1638 – 2007 (Magnitude or Intensity 4 or greater)[152]

Date	Location	MMI	Magnitude
10-Apr-1962	Middlebury, VT	5	4.1
31-Mar-1953	n/a	5	4
6-Jul-1943	Swanton, VT	4	4.1

The two strongest recorded earthquakes measured in Vermont were of a magnitude 4.1 on the Richter scale. One was centered in Swanton and occurred on July 6, 1943, and the second occurred in 1962 at Middlebury. The 1962 earthquake was felt throughout New England and resulted in broken windows and cracked plaster, while the Swanton earthquake caused little damage. "The total felt region covered about 52,000 square kilometers of Vermont, Maine, Massachusetts, New Hampshire, and New York." The event resulted in broken windows and cracked plaster. The 1943 Swanton earthquake caused only little damage.[153] No further information is known about the 1953 magnitude 4 event.

According to the State of Vermont Hazard Mitigation Plan it is likely that small earthquakes will continue to occur in Vermont in the coming years.

[151] Kafka, Alan L. (2014). "Why Does the Earth Quake in New England?" Boston College: Weston Observatory Network Seismicity. Retrievable from https://www2.bc.edu/~kafka/Why_Quakes/why_quakes.html
[152] Earthquakes, VT. (2017). The National States Emergency Consortium. Retrieved from http://nesec.org/earthquakes-vt/; State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.
[153] U.S. Geological Survey. (2016). Retrieved from http://earthquake.usgs.gov/earthquakes/states/vermont/history.php; State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.

Earthquakes centered outside the state have been felt in Vermont as well:

> New England has had a history of earthquakes including those recorded by the first settlers, and by the Plymouth Pilgrims in 1630. The major earthquake of Cape Ann, MA on November 18, 1755 with a magnitude of 6 affected a very large area (about 777,000 square kilometers) including all of Vermont. Twin earthquakes of 5.5 occurred in New Hampshire in 1940. In 1988, an earthquake with a magnitude of 6.2 on the Richter scale took place in Saguenay, Quebec and caused shaking in the northern two-thirds of Vermont.[154] "On April 20, 2002, a 5.1 magnitude event in Plattsburgh caused shaking in Vermont with damage near the epicenter in New York."[155]

Probability of Future Events

According to the State of Vermont Hazard Mitigation Plan, Vermont is located in a zone of low to moderate seismic activity. A computer earthquake damage simulation (HAZUS-MH program) conducted by the Vermont State Geologist's Office suggests "that there is little earthquake risk in Vermont at 100-year and 250-year recurrence intervals; however, there is a potential risk at the 500-year recurrence level.[156] A probability of possible was assigned.

The HAZUS-MH analysis performed by the Vermont State Geologist's Office is described in the following section.

Vulnerability Assessment and Estimated Losses

It can be assumed that all existing and future buildings and populations are at risk to the earthquake hazard. According to the State of Vermont Hazard Mitigation Plan, impacts from earthquakes are "expected to be minor to catastrophic; building damage and fatalities are possible."[157] Earthquake 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. Climate change is not anticipated to impact losses or impacts for this hazard.

A HAZUS-MH analysis was conducted by Vermont's Geologist's office and is described in the following[158]:

> The analysis is based on a *Report on The Seismic Vulnerability of the State of Vermont* (Ebel, et al., 1995) who postulated six 500-year "strong" earthquake epicenters in the Northeast that could be expected to cause damage in Vermont.
>
> The epicenters and magnitudes of past earthquakes as shown in Table 4.45 were applied and an HAZUS-MH analysis was run for these. Figure 4.18 shows earthquakes with a magnitude greater than 3 that might affect the State of Vermont.

[154] Ebel, et. al. (1995).
[155] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.
[156] Abid.
[157] Abid.
[158] Abid.

Table 4.45 Epicenters and magnitude of past earthquakes with impact on the State of Vermont[159]

Epicenter	Magnitude
Middlebury, VT	5.7
Swanton, VT	5.7
Montreal, Quebec	6.8
Goodnow, New York	6.6
Tamsworth, New Hampshire	6.2
Charlevoix, Quebec, Canada	6.6

Using these epicenters and magnitudes, the Vermont Geologist confirmed through further HAZUS-MH runs that five of the earthquakes (minus Charlevoix) shown in Table 4.45 could cause ground shaking in certain parts of Vermont sufficient to result in millions of dollars in damage:

Five of these six possible 500-year earthquakes have moment magnitudes and epicenters close enough to Vermont to cause *significant damage*. These five earthquakes have predicted peak ground accelerations greater than 0.1 g and would cause widespread damage resulting in tens to hundreds of millions of dollars in structural and economic losses and undetermined casualties.

The Swanton and Middlebury earthquakes were estimated to have PGAs of 0.4 g and total losses exceeding $300 million dollars each (State of Vermont HAZUS-MH projections). In addition to the 5 postulated 500-year earthquakes that would affect Vermont, the recent occurrence of a 5.1 magnitude earthquake near Plattsburgh (Ausable Forks), New York, indicates that this epicenter also would need to be considered.

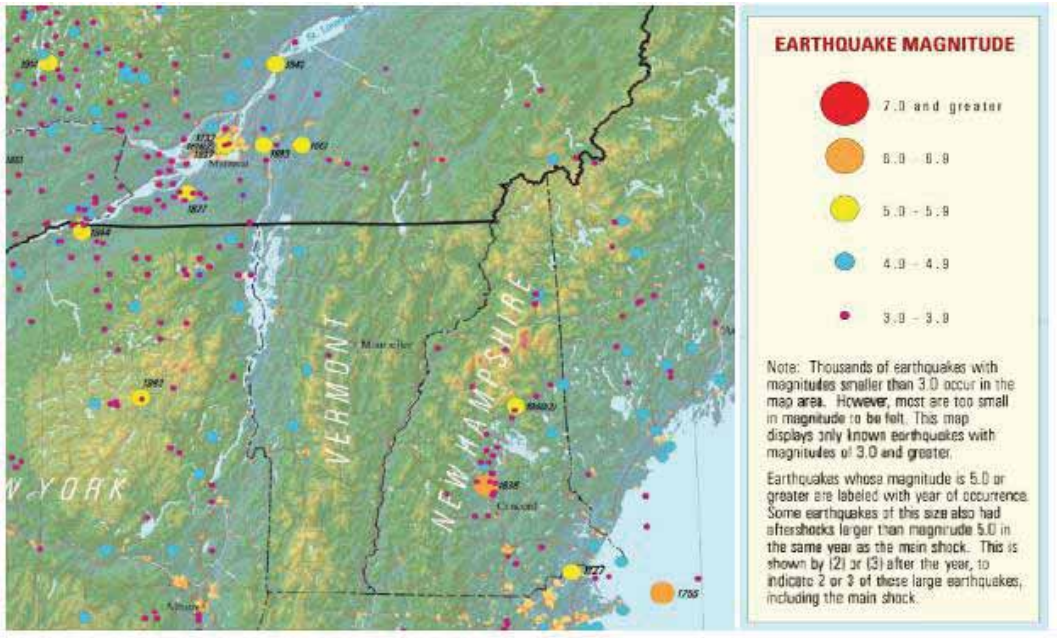


Figure 4.18 Earthquake Magnitude[160]

[159] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.
[160] Abid.

Table 4.46 below shows the results from the described HAZUS-MH analysis. These probable impacts are derived from the worst case earthquake scenarios for the State of Vermont.

Table 4.46 Probabilistic Earthquake Scenarios (HAZUS-MH analysis performed by State Geologist)[161]

Impact		Middlebury, VT	Montreal
Building Design	Moderate damage	>3,600 buildings; 1 school moderately damaged	>3,400
	Severe damage	38 (destroyed)	23 (destroyed)
	Displacement/shelter needs	262 families displaced; 62 in need of shelter	229 families displaced; 56 in need of shelter
Transportation and Utility	Transportation	Minimal disruption	No disruption
	Utility	2,000 households w/out power for up to 3 days	No loss of power
Causalities	Light treatment	69	70
	Severe (hospitalized)	12	12
	Killed	2	2
Economic Loss	Direct	>$308 million; thereof 10% from business interruption	>198 million; thereof 17% from business interruption
	Transportation system	$34 million	$18 million
	Repair of damaged communication systems	$0.21 million	$0.03 million
Government Buildings	Slight damage	14	15
	Moderate damage	6	7
	Extensive damage	1	1

Both of the probabilistic events (Middlebury and Montreal earthquake, see Table 4.46) would damage a considerable amount of buildings equaling 2% of Vermont's overall building stock. Buildings made from un-reinforced masonry (i.e., "red brick") are particularly vulnerable to damage or collapse in the event of an earthquake. The critical facilities are wooden frames and the planning area is mostly made up from wooden structures.

While the State of Vermont has adopted seismic provisions on the state level into their building codes for certain types of construction (1987 BOCA National Building Code (NBC) with the 1988 supplement), only a few municipalities in Vermont have adopted the state code. "Building plans are not reviewed for seismic design in any community except Burlington and at the state level."[162] Kirby does not have a specific building code but follows the State building code.

All critical facilities have been built before 1988 with sixty-six percent or two facilities having been built before 1828. It is assumed that newer buildings are less vulnerable to earthquakes. However, any large earthquake event such as the Middlebury, Swanton or Montreal event could cause severe damage in the area.

[161] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.
[162] Ebel. (1995). Department of Environmental Conservation: State of Vermont. Retrieved at http://www.anr.state.vt.us/dec/geo/ebel.htm.

LANDSLIDES/MUDSLIDES

Description

The term "landslide" describes a wide variety of processes that result in the downward and outward movement of slope-forming materials including rock, soil, artificial fill, or a combination of these. The materials may move by falling, toppling, sliding, spreading, or flowing.[163] Landslides are common on clayey to sandy lacustrine deposits throughout Vermont. In many cases, the displaced material has been at least partially eroded away by stream flow.[164]

Although landslides are primarily associated with mountainous regions, they can also occur in areas of generally low relief. In low relief areas, landslides occur as cut-and-fill failures (roadway and building excavations), river bluff failures, lateral spreading landslides, collapse of mine-waste piles (especially coal), and a wide variety of slope failures associated with quarries and open-pit mines.[165]

Landslides usually result from human-caused or natural changes to groundwater flow that cause pore pressure changes in bank materials or removal of vegetation and human-caused or natural undercutting of steep banks. Landslides can be triggered by one or a combination of factors, including fluvial erosion, soil saturation, natural geologic weathering processes such as the freezing and thawing of soils, human modification of the bank, increases in loading on top of the slope, surface or near surface drainage patterns, and loss of vegetation. Fluvial erosion, causing bed and bank erosion or associated with water flowing along the toe of the slope, removes bank material to over-steepen and potentially under-cut the slope. Fluvial erosion is considered the most important contributing factor to landslides.

Location

According to the State of Vermont Hazard Mitigation Plan, landslides rarely occur in Vermont.[166] Slope failures and slope-failure deposits (landslides) are created when geologic material is displaced down a topographic slope under the influence of gravity. Factors that determine slope-failure occurrence include slope angle, geologic materials, climatic conditions, earthquake shaking and debris flows.

We consulted the USGS landslide susceptibility index and found a very low susceptibility for landslides in the planning area (less than 1.5 % of the area) compare Figure 4.19.[167] Figure 4.20 gives an overview of areas susceptible to landslides within the State of Vermont and Caledonia.

[163]Highland and Bobrowsky (2008). "Landslides"; Landslides 101. (2016). U.S. Geological Survey: Landslide Hazards Program. Retrieved from http://landslides.usgs.gov/learn/ls101.php
[164] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.
[165] Abid.
[166] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.
[167] Landslide Overview Map of the Conterminous United States. (2016). U.S. Geological Survey. Retrieved from http://landslides.usgs.gov/hazards/nationalmap/

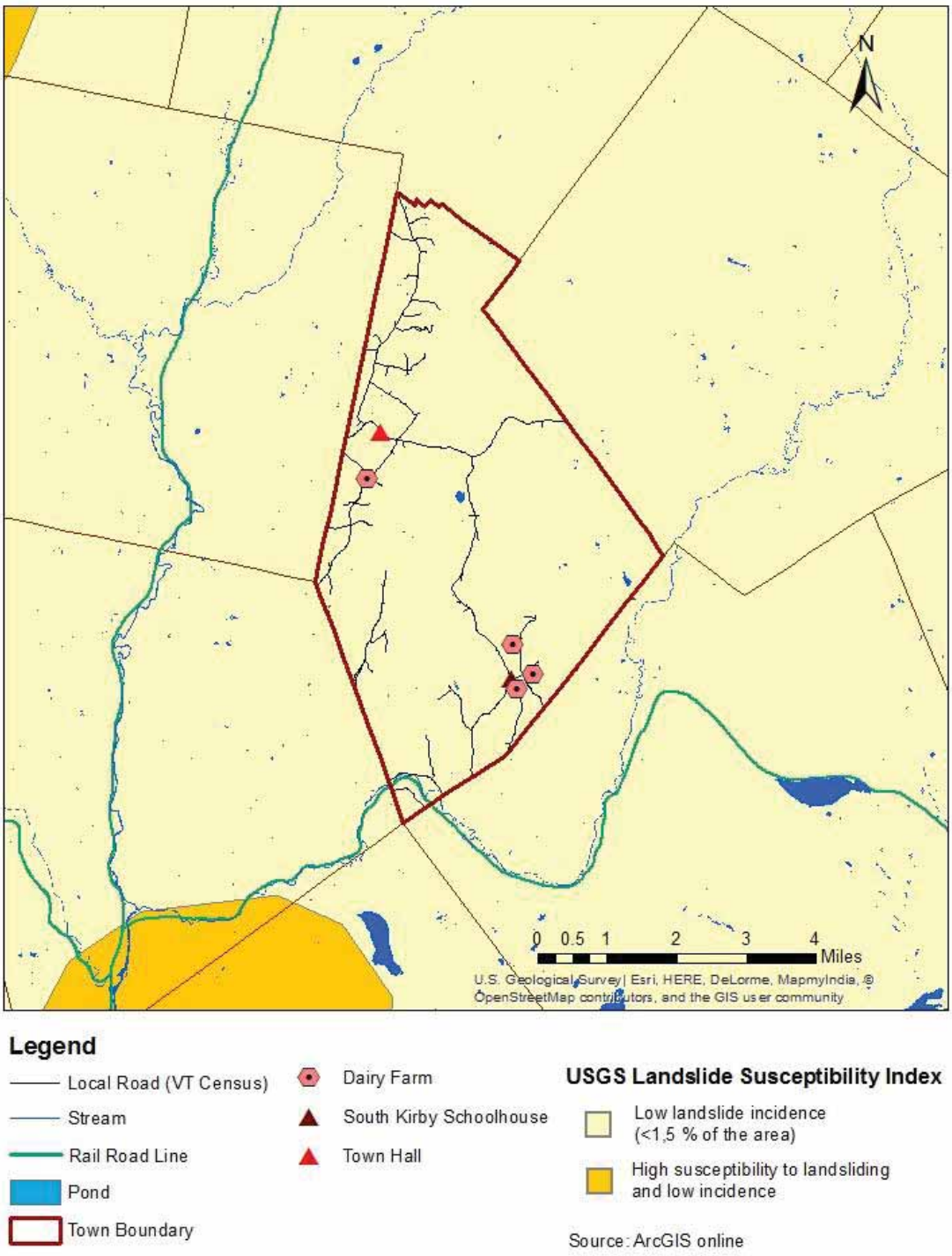


Figure 4.19 (USGS) Landslide susceptibility for the planning area

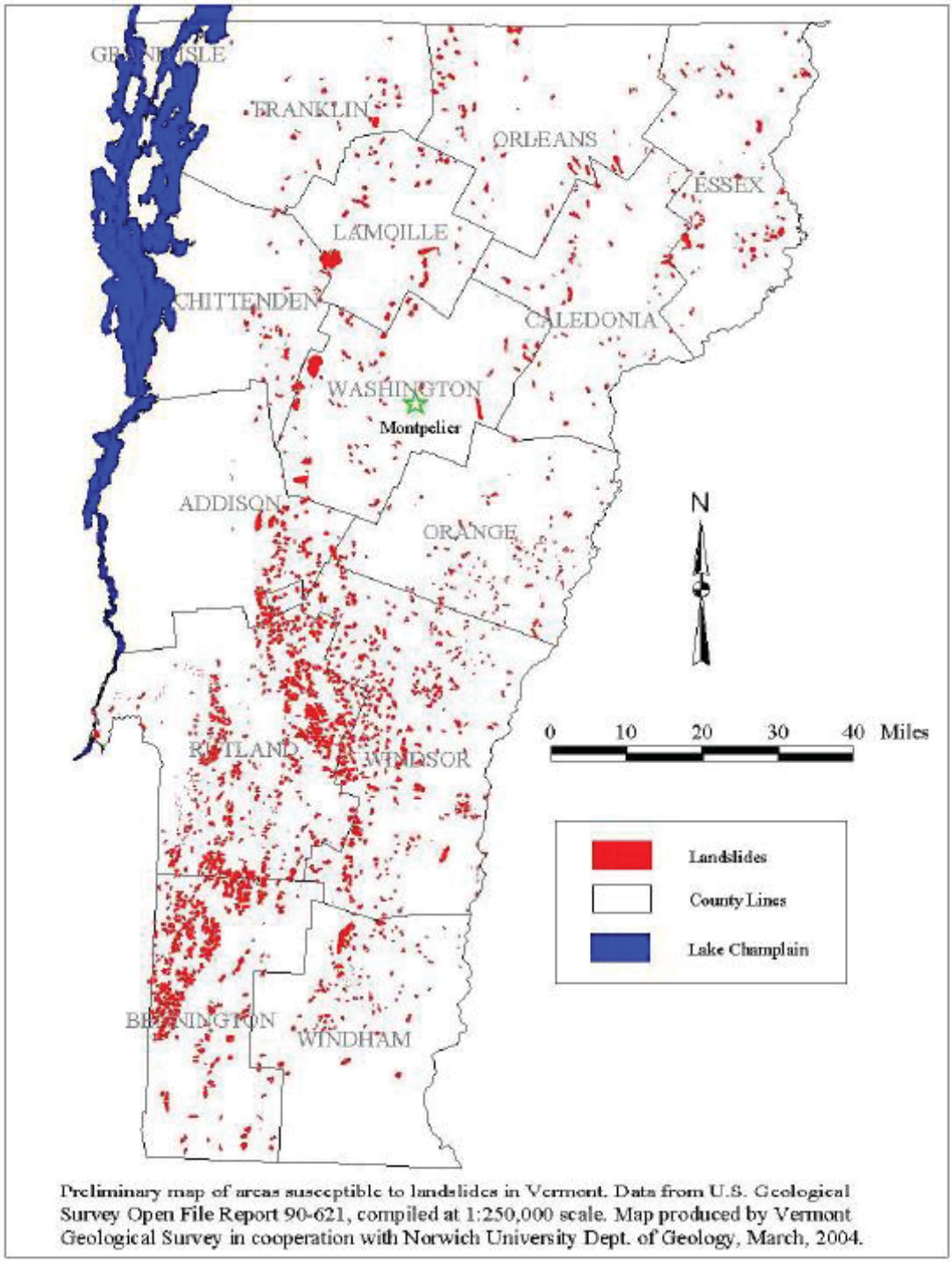


Figure 4.20 Area Susceptible to Landslides in Vermont[168]

[168] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.

This risk assessment has further taken into account topography and soil types.

Topography

The planning area is located on hilly terrain with several steep slopes (compare Figure Elevation Contours, Appendix B). A high slope angle in relation with increased slope instability may potentially result in seismically induced rock falls and landslides or landslides triggered by high precipitation. Five general topography categories are listed in the Town Plan as shown in Table 4.47.

Table 4.47 Topography categories in Kirby[169]

Category	Elevation (ft above sea level)	Description/Location	Percentage of land (%)
1	815 - 1,100	shorelines of Moose River	10
2	1,100 to 1,400	land for homes and farmland	40
3	1,400 to 1,600	mostly forest, some pasture, high slopes hinder utilization; erosion prone land; sensitive soils; "Highlands"	19
4	1,600 to 2,500	severe slopes >15%, ridge areas; watershed areas; land prone to erosion; "Highlands"	30
5	2,500		1

Lands in Category 3 are prone to erosion if development does not take certain precautions. Lands in the fourth elevation category are made up of watersheds to surrounding valleys. These lands are prone to erosion.[170] Loss of vegetation can trigger landslides.

As shown on the Figure in Appendix B (elevation contours), several roads such as Town Hall Road, Kirby Mountain Road (middle and southern part), and Mud Hollow Road follow the flow of creeks and rivers. Soils making up river beds are mostly expansive soils and are described below.

Soil types

Specific soil types, so-called expansive soils are more prone to landslides. Expansive soils are soil types that shrink or swell as the moisture content decreases or increases; samples are clayey soils. Expansive behavior is associated with the soils capability for water infiltration and storage until they are saturated.

As can be seen in Figure 4.5 (soil map / soil type saturation) most of the soils in the planning area are either classified as Hydrologic Soil Group (HSG) C or D and have a slow (C) or very slow (D) rate of water transmission. This characteristic goes along with a high runoff potential. High precipitation on saturated soils i.e. the soils adjacent to the beds of rivers and creeks can trigger landslides and mudslides.

Mudslides can occur on small gullies when rain-saturated soils give way to heavy rainfall and mudslides burst out of the soil threatening buildings in their direct path.

[169] Town of Kirby. (2012). Town of Kirby. Pg. 7
[170] Abid.

Landslides and mudslides in the planning area may potentially be expected within the areas of steep elevation (narrow contour lines) along the creeks and along floodplain area as a result of fluvial erosion.

The critical facilities and dairy farms are located in areas with sandy clay loam or clay soils and are potentially susceptible to landslides. Critical facilities have a combined value of $773,004. Dairy farm properties have a combined value of $3,040,000.

Previous Occurrences and Extent

There have been no major disaster declarations related to landslides in Caledonia County.

Several sources were investigated for previous landslide occurrences including web searches, NCDC, USGS, the Draft Town Hazard Mitigation Plan, and State of Vermont Hazard Mitigation Plan however no data could be retrieved for the planning area.

The State of Vermont Hazard Mitigation Plan lists the following events in Vermont[171]:

- The Jeffersonville slide on the Brewster River (about 64 miles west of Kirby) took place in April 1999. It occurred on steep clayey soils with an overall angle of 34 degree and cost nearly $300,000 in channel and floodplain restoration and buyout of one residence.
- In 2011, extensive landslides occurred due to high water conditions resulting from the melting of the thick snowpack and the heavy spring rains as well as from flash flood event in May 2011 and due to Tropical Storm Irene in central Vermont.

The town reports one previous mudslide (unknown date).

Probability of Future Events

Data on previous landslide occurrences in the planning area has been limited. Therefore it is difficult to assess its future probability. The researched literature and analysis indicate that several areas of the planning area especially along the creeks are susceptible to landslides. Furthermore, landslides triggered by fluvial erosion may be possible in the floodplain area in vicinity of the commercial area along Route 2. The critical facilities and dairy farms are located on soils potentially susceptible to landslides.

In addition, there might be areas that may be more susceptible to landslides. A further analysis with more specific data for the planning area could add more detail. A probability of possible was assigned.

Vulnerability Assessment and Estimated Losses

According to the State of Vermont Hazard Mitigation Plan, landslides rarely occur in Vermont. Landslides commonly occur with other major natural disasters, such as earthquakes and floods as shown in the landslides associated with Tropical Storm Irene (see Previous Occurrences). Reconstruction efforts and development and other land use expansions can also increase landslide related disasters.

[171] State of Vermont Hazard Mitigation Plan. (2013). State of Vermont.

However, areas in the elevation Category 3 and higher are more susceptible to erosion and landslides. Furthermore, expansive soils are present in the planning area which could trigger a landslide or mudslide especially if land is not developed correctly, i.e. if stabilizing layers would be undercut.

The town is aware that lands in higher elevations are more prone to erosion and is aiming to cluster new developments around already built environments within the elevation category 2 (compare Table 4.48). It is recommended to prohibit developments in elevation areas above 1,400 feet due to susceptibility to erosion and landslide (i.e. from undercutting of layers).

Losses from landslides have been reported of up to $300,000 for one single event in Jeffersonville, VT. Although events of this magnitude are unlikely in the planning area, they may occur due to the partly steep terrain and the expansive soils.

Climate change does have the ability to impact the hazard through more frequent and severe events including increased rain, hurricanes, tropical storms, and wildfires. All of these events may increase the risk of landslide occurrence in the planning area.

OTHER POTENTIAL HAZARDS

Other potential hazards that may impact the planning area are extreme heat, water supply contamination and hazardous materials. Invasive species are not an issue in Kirby according to the State Forest Plan.[172]

EXTREME HEAT AND HEAT WAVE

Description

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 high atmospheric pressure traps hazy, damp air near the ground. As a result, both drought and dust storms could occur.[173]

Location

Extreme heat and heat wave are atmospheric hazards and can impact the entire planning area.

Previous Occurrences and Extent

The National Climatic Data Center reported six events of extreme heat throughout Caledonia County between 1950 and 2016. One of these events resulted in a loss of $750,000 whereas the other events did not incur any damages. The event is described in more detail in the following. Table 4.48 lists the heat events in Caledonia County between 1950 and 2016.

[172] Vermont Forest Resource Plan. (2010). Vermont Department of Forests: Parks and Recreation.
[173] Heat Guide. (2016). Centers for Disease Control and Prevention. Retrieved from http://emergency.cdc.gov/disasters/extremeheat/heat_guide.asp

Table 4.48 Heat events in Caledonia County between 1950 and 2016[174]

Date	Death/Injuries	Crop Damage
1/18/1996	0/0	0
1/19/1996	0/0	0
12/7/1998	0/0	0
8/1/2006	0/0	0
7/21/2011	0/0	0
3/17/2012	0/0	750 K

Description of the 3/17/2012 event[175]:

The winter of 2011-12 was largely abnormal with temperatures that averaged 4-5 degrees above normal and snowfall was 40-60 % of normal. On March 17, 2012 temperatures reached the mid-50s to lower 60s in Vermont, temperatures then climbed into the 70s on the 18th with 70s and lower 80s on the 19th through 22nd. In comparison, 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. A preliminary loss of 20 % was calculated. The ski industry experienced loss from early closure.

There have been no major disaster declarations related to extreme heat and heat waves in Caledonia County.

Probability of Future Events

Based on six events over 66 years county-wide, heat events occur about every 11 years.

An estimated annual probability of unlikely was assigned for extreme heat events to occur in the planning area.

Vulnerability Assessment and Estimated Losses

Extreme heat 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 that extends 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 heat is unlikely to damage structures though occasionally buildings buckle due to prolonged high heat exposure. It also poses a health risk in terms of heat stroke and heat exhaustion. Those working or exercising outdoors should exercise caution. Vulnerable populations, including the elderly and babies, have an increased risk and lower tolerance for such events.[176] Extreme heat also poses a health risk to the cows and may result in less dairy yields.

Losses from one event were reported for this hazard. This event was tied to a very early onset of spring / summer and caused losses in the maple and ski industry. The extreme heat event in spring resulted in a damage of

[174] Storm Events Database. (2016). National Climatic Data Center: National Oceanic and Atmospheric Administration.
[175] Abid.
[176] Heat Guide. (2016). Centers for Disease Control and Prevention. Retrieved from http://emergency.cdc.gov/disasters/extremeheat/heat_guide-page-3.asp

$750,000 mostly affecting agriculture. Annualized over time this loss results in a damage of $11,364. The impact was assessed as limited.

Climate change may impact this hazard through increased occurrence and severity.

WATER SUPPLY CONTAMINATION

Description

Water supply contamination is the introduction of point and non-point source pollutants into public groundwater and/or surface water supplies. The causes of water contamination are numerous and range from failing septic systems and leaking underground tanks to improper use of household chemicals.[177] The most obvious concern about an unsafe water supply is the health risks to humans. Water contamination serves as a source of bacteria, viruses, and parasites that can cause gastrointestinal problems or transmit contagious diseases.

In case of a failing septic system, surface and subsurface water may be polluted resulting in pollution of drinking water for agricultural and human use.

Location

The Town of Kirby has no municipal drinking water system. According to the Town Plan, "surface and subsurface water systems, including some drilled wells are used" to fill the residential, commercial and agricultural water needs of the community. According to the Town Clerk, every property owner maintains their own well for drinking water. State regulations for well head setback requirements are enforced. The Town of Kirby has a certificate-of-occupancy program in place to ensure water supply permits are met.[178]

The Town of Kirby has no municipal wastewater facilities. On-site septic systems are in place which are closely regulated by the State of Vermont (10 VSA Chapter 64). Laws and regulations "are aimed at preventing septic pollutants from entering into surface and subsurface waters."[179] Future developments shall not exceed the septic system's ability to support a development based on an area's topography, soil types, wetlands, depth of bedrock and other fragile areas. Kirby has setback requirements in place through their zoning permits.

Soils in topographic Category 3 and 4 are (compare Table 4.48) susceptible to the introduction of surface and sub surface waters. In areas with Category 3 soils this may result in water pollution. Pollution of surface water at elevation level 4 could result in permanent damage to water supplies for the Town. Furthermore, as noted in the Town Plan, many soils in the planning area are marginal as to filtering contaminants out of natural water supply. If an accident happens this may result in contamination of surface and subsurface waters and wells used for drinking water.

[177] Ferrey, Steven. Environmental Law. (2007).
[178] Kirby Town Plan. (2012). Town of Kirby. Pg.12
[179] Abid.

Previous Occurrences and Extent

There have been no major disaster declarations related to water supply contamination in Caledonia County. According to the Town Plan, in 1998 some issues arose associated with dense development in fragile areas which included failing septic systems and setback violations.[180]

Probability of Future Events

Except for the events in 1998, contamination is unknown and has not been reported. Structural damage from this hazard is unlikely. Property owners maintain their own wells and are required to comply with the state regulation regarding setback requirements. It is assumed that standard measures for locking wellheads are in place. It is not known however, how often inspections occur. Given that setback requirements have been violated and septic systems have failed in the past, contamination of the wellheads may occur.

A risk of infiltration of contaminants in the surface and subsurface water from operations at dairy farms is given. A probability of possible has been assigned.

Vulnerability Assessment and Estimated Losses

Detailed data on previous contaminations were not available (except for the events reported in 1998). Therefore it cannot be predicted to what extent potential contaminations might pose a health risk. However, as soils are marginal and cannot filter contaminants out of the water in most parts of the planning area, it is assumed that serious water supply contamination may affect the entire population of the planning area.

Kirby expects their community to grow with seasonal, recreational and year-round homes tied to the growth in St. Johnsbury, Lyndonville and Burke. At the same time, the Town is aware of their sensitive soil and groundwater system and recognizes watersheds, aquifers and steeply sloped areas (over 25%) as unique and fragile areas. Zoning regulations shall protect the rural and agricultural character of Kirby along with its soils and groundwater ("unique and fragile areas"). One measure mentioned in the Town Plan is to focus new (cluster) development on adequate areas in existing developed areas and as such to contain growth within the Town's lower elevations.[181] Adequate development planning focused on developing lower elevations would reduce the likelihood of potential water contamination near the well heads.

CLIMATE CHANGE

Climate change is not a hazard by itself, but many of the natural hazards identified in the planning area are likely to become more frequent and more extreme in the face of a changing climate. Scientists expect that severe storms, hurricanes and tropical storms, severe winter storms, ice storms, heavy rain and flooding will all increase in the coming years. [182]

[180] Kirby Town Plan, (2012). Town of Kirby. Pg.17 – In response to these violations the Town of Kirby increased the lost size from 2 to 5 acres and added zones such as the highland district with stricter development regulations in the 2006 bylaws. The 2012 Town Plan recommends a cluster development in specific high density areas.
[181] Kirby Town Plan. (2012). Town of Kirby. Pg.10.
[182] Climate Change Indicators in the United States. (2015). Environmental Protection Agency. Retrieved on May 22, 2015 from http://www.epa.gov/climate/climatechange/science/indicators/weather-climate/index.html

Historically, Caledonia County has seen many cold-related hazards (such as unseasonal frosts and deep freeze periods in the winter), but there is little associated damage reported. Fewer heat spells have affected the area, but NCDC does report six heat-related hazards in the data it tracks. All six heat waves have occurred since 1996, and the data includes a dry spell in 2012 that resulted in significant crop damage. Droughts may become increasingly common, as may hazards related to invasive species and infectious diseases that thrive in a changing climate.

Climate studies predict that extreme weather events including heat waves and cold spells are likely to become more frequent and more significant as climate change continues; the planning area should expect both more heat spells and more cold snaps, as well as generally more unstable climate patterns in the future. These changes pose risks to property, crops and public safety, but also to the economy and businesses such as ski areas.

CRITICAL FACILITY ANALYSIS

Critical Facilities in the planning area have a combined building replacement value of $773,004. All critical facilities are assumed to be at risk to hurricane, microburst, tornado, blizzard, hail, ice storms, nor'easter, snow events, wildfire, lightning, earthquake, and landslides/mudslides. However, data permits further GIS analysis to determine potential risk to specific buildings based on certain hazard areas including flooding wildfire and landslides. Many hazards do not pose a risk to all critical facilities based on location such as flood related hazards. For example, only critical facilities near rivers or brooks may also be susceptible to flooding including fluvial erosion. The Wildfire Intersection analysis has shown that 19 % of the area and approximately 80% of the population would be at risk to wild fires. While no critical facilities are considered at risk from wild-fires, Kirby's dairy farm properties with a combined value of $3,040,500 are considered vulnerable to wild fires. The landslide risk analysis shows a risk for the critical facilities based on their expansive soils (however further investigations would be required to gain a more complete understanding of this risk.)

Additionally, it should also be noted that not all hazards will cause extensive structural damage including drought, erosion, and extreme temperatures, for example.

SUMMARY OF RISK, PRI RESULTS, 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)

HAZARD RISK SUMMARY

The information below provides a brief summary of the hazards that impact the planning area. Table 4.49 gives a summary of hazards in the planning area. It lists impacts, number of occurrences and associated timeframe, spatial extent, probability and estimated losses to date. In addition, the Table highlights whether or not critical facilities may be at risk.

Table 4.49 Summary of Hazards in Kirby

Hazard	Potential Impacts	Previous Events	Spatial Extent	Probability	Estimation of Pot. Annualized Losses ($)	Critical Facilities at risk?
FLOOD						
Beaver Dams	Dam breach, flooding	Unknown	Locally around beaver dams	Unlikely to possible	N/A	No
Flooding	Route 2 and rail road are in vicinity to river corridor; 11% of structures within 100 m adjacent to river corridor	5 events > 10 ft (flood stage) in 10 years (reporting period)	Along creeks and Moose River (Rt.2)	Likely	N/A	No
Flooding from Heavy Rain Storms and Snowmelt	Road washout, dangerous driving conditions, limited access to emergency care and schools	Several in neighboring towns; one in Kirby (4/152014)	Problem culvert areas; roads intersecting with creeks	Highly likely	N/A (lost travel time; lost business from road closure; delayed emergency care)	No
WIND HAZARDS						
Hurricanes	Power outage, high wind, flooding, property damage (blown off roofs);	Tropical Storm Irene (9/1/2011), Floyd (1999), Gloria (1985), 1938 Hurricane	Town-wide	Possible	$43,000 (Gloria HAZUS model)	Yes
Microburst	Similar to tornado and thunderstorm wind; Power outage, high wind, property damage (blown off roofs); vegetative debris	05/2014 (34 miles from Kirby)	Town-wide	Possible	Unknown but debris damage expected; $25K in damage from costliest thunderstorm	Yes
Tornadoes	Power outage, high wind, property damage (blown off roofs, blow out windows, trees on houses); debris; vegetative debris	9 (within 27 miles); 1 county-wide	Town-wide	Possible	$379 to 1,515 (annualize)	Yes
WINTER HAZARDS						
Blizzard	Power outage, high wind, heavy snow; hazardous driving; property damage (blown off roofs, blow out windows, trees on houses); debris; vegetative debris; downed power lines	8 heavy snow events including "Valentine Blizzard" 2007;	Town-wide	Highly likely	Up to $23M (county wide); 200,000 from one event (county)	Yes
Hail	Property damage (Roof and cars)	18 in neighboring towns (Lyndon, Burke)	Town-wide	Likely	1,318 (county), 227 (Lyndon, Burke)	Yes
Ice Jams	Road closure, collapsing bridges	15 events in 80 years in victory and St. Johnsbury	Small	Likely	Minor; up to $5M (hydro plant; St. Johnsbury)	No
Ice Storms	Power outages (potentially days), downed power lines and trees; hazardous driving conditions;	1998 (dr-1201); 2013	Town-wide	Possible	$80,000 to 1M (county; "100 year snow storm")	Yes

Hazard	Potential Impacts	Previous Events	Spatial Extent	Probability	Estimation of Pot. Annualized Losses ($)	Critical Facilities at risk?
	vegetative debris; business interruption; death/ injury					
Nor'easter	High winds, heavy rain or snow, ice; hazardous driving conditions; travel snarls; power outages; roof collapse; vegetative debris; death/injury	Annual	Town-wide	Likely	Unknown but should be expected (snow removal, debris)	Yes
Snow Events	Hazardous driving conditions; travel snarls; power outages; roof collapse; death/injury	Annual	Town-wide	Highly likely	Up to $23M (county wide, winter storms)	Yes
Extreme Cold		5 (over 65 yrs.)	Town-wide	Possible	Not assessed	No
FIRE HAZARDS						
Drought	Water conservation measures; elevated wildfire risk; minimal structural impacts	2 statewide D0 (1995, 1964-66); D1 conditions for 10 weeks (2016)	Town-wide	DO likely	Not assessed	No
Wildfire	Property damage; Smoke impacts (driving and air quality hazard); Increased emergency rescue/response time	None, a few statewide	Town-wide	Possible	None reported	Yes
Lightning	Electrical damage; Structure fire; Wildfire	6/29/2003 (neighboring town of Lyndon); 8 county-wide (1950 – 2014)	Town-wide (but strikes are localized)	Possible	$2,922	*Yes*
GEOLOGICAL HAZARDS						
Earthquake	Damage possible, especially to older building stock; broken windows and dishes; collapsed chimneys; death/injury	Middlebury, VT (1962, 4.1), Swanton, VT (1962, 4.1)	Town-wide	Possible	>$300M (for 4.1 M event	Yes
Landslide/ mudslide	Blocked or damaged roads	One event	Expansive soils & areas of steep terrain	Possible	Small	Yes
OTHER POTENTIAL HAZARDS						
Extreme Heat and Heat Wave	Health impacts on vulnerable populations; buildings may buckle	6; 1 with damage	Large	Unlikely	$750,000 (one event)	No
Water Supply Contamination	Contamination of ground and drinking water; dairy farm operations	1998: failed septic tanks (setback violations)	Town-wide	Possible	Not assessed	No

PRI RESULTS

The PRI results are presented in the following Table 4.50. This information was used to rank the hazards presented in Table 4.49 (Summary of Hazards in Kirby). Table 4.51 shows the ranked hazards according to their PRI score.

Table 4.50 PRI results

Hazard	Category / Degree of Risk					
	Probability	Impact	Spatial Extent	Warning Time	Duration	PRI score
FLOOD						
Beaver dams	Unlikely - possible	Minor	Small	>24 h	<6 hrs.	1.55
Flooding /fluvial erosion	Likely	Limited	Small	12-24 hrs.	>24 hrs.	2.4
Flooding from heavy rain storms and snowmelt	Highly likely	Limited	Small; locally on roads	>24 h	>24 hrs.	2.6
WIND HAZARDS						
Hurricanes	Possible	Limited	Large	>24 h	< 24 h	2.2
Microburst	Possible	Limited	Small	<6 hrs.	<6 hrs.	1.8
Tornadoes	Possible	Minor	Small	<6 hrs.	<6 hrs.	1.8
WINTER HAZARDS						
Blizzard	Highly likely	Critical - catastrophic	Large	>24 h	Up to 24 - 48 hr.	3.45
Hail	Likely	Minor	Negligible	<6 hrs.	<6 hrs.	1.90
Ice jams	Likely	Limited	Small	>24 h	< 1wk	2.30
Ice storms	Possible	Critical - catastrophic	Large	<24 h	< 24 hr.	2.8
Nor'easter	Likely	Critical - catastrophic	Large	>24 h	< 24 hr.	3.45
Snow events	Highly likely	Limited	Large	>24 h	< 24 hr.	3.2
Extreme cold	Possible	Minor	Large	>24 h	1 week	2.1
FIRE HAZARDS						
Drought	Likely (D0)	Minor	Large	>24 h	>1 week	2.5
Wildfire	Possible	Critical	Small	<6 hrs.	<24 hrs.	2.5
Lightning	Possible	Minor	Negligible	<6 hrs.	<6 hrs.	1.6
GEOLOGICAL HAZARDS						
Earthquake	Possible	Minor - catastrophic	Large	<6 hrs.	<6 hrs.	2.5
Landslide/mudslide	Possible	Limited	Small - moderate; areas of steep slope; river banks	<6 hrs.	<6 hrs.	2.1

Hazard	Category / Degree of Risk					
	Probability	Impact	Spatial Extent	Warning Time	Duration	PRI score
OTHER POTENTIAL HAZARDS						
Extreme Heat and Heat Wave	Unlikely	Limited	Large	>24 h	< 24 h	2
Water Supply Contamination	Possible	Limited	Moderate	12-24 h	< 24 h	2.3

HAZARD RANKING

The ranking of hazards was based on the PRI results. Table 4.51 shows the ranking of hazards based on the performed risk assessment and a qualitative assessment. The State's hazard ranking is included for reference. All hazards in the planning area were ranked according to their PRI score. This initial ranking was based on quantitative analysis. Upon review of the PRI results, the Town's Hazard Mitigation Committee provided their expertise. The results from this qualitative assessment are depicted in the 2nd column. As can be seen in Table 4.51, the quantitative and qualitative assessment differ only gradually overall.

Table 4.51 Ranking of Hazards in Kirby (For discussion)

Ranking	Hazards		
High Hazards	Blizzard	Flooding from heavy rain storms and snowmelt	Flooding
	Nor'easter	Ice Storms	Earthquakes
	Snow Events	Blizzard	Hurricanes/ Tropical Storms
		Nor'easter	
		Snow Events	
Moderate Hazards	Ice Storms	Flooding /fluvial erosion	Tornadoes
	Flooding from heavy rain storms and snowmelt	Water Supply Contamination	Landslides/Rockslides
	Earthquake	Hurricanes	Severe Thunderstorms
	Drought (D0)	Extreme Cold	Wildfires
	Wildfire	Microburst	Dam Failure
	Flooding /fluvial erosion		Severe Winter Storms
	Water Supply Contamination		Hail
	Ice Jams		Ice Jams
Low Hazards	Hurricanes	Earthquake	Droughts
	Extreme Cold	Drought	Extreme Temperatures
	Landslide	Wildfire	
	Extreme Heat and Heat Wave	Tornadoes	
	Hail	Hail	
	Microburst	Beaver dams	
	Tornadoes	Landslide	

Ranking	Hazards		
Very low hazards	Lightning	Ice Jams	
	Beaver dams	Extreme Heat and Heat Wave	
		Lightning	

In summary, all of the hazards addressed in this plan pose a threat to the Town of Kirby, including the assets and population within. The hazards of greatest concern are blizzards,

Nor'easters, snow events, followed by ice storms, earthquakes, flooding (heavy rain and snow melt), drought, wildfire, flooding/fluvial erosion, water supply contamination and ice jams. Of lesser concern are hurricanes, extreme cold, landslides, extreme heat and heat wave, hail, microbursts, and tornadoes. Lightning, and beaver dams pose the least concern.

CHAPTER 5

CAPABILITY 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?[183]
2. Does the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate?[184]

The capability assessment includes a comprehensive examination of the following capabilities as summarized in Table 5.1.

Table 5.1 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.

[183] 44 CFR 201.6(c)(3)
[184] 44 CFR 201.6(c)(3)(ii)

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 like FEMA's Worksheet 4.1[185] 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 5.2 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.
Kirby Local Emergency Operations Plan, 2016	Yes – Drought, Flood, Fire, Winter Storm, Ice Storm, Power Outage, Infectious Disease, and Hazardous Materials plus others.	No	The Culvert on Lynhill – Mud Hollow Road is listed as a major high hazard or vulnerable site. It also includes a list of residents identified as High Risk with their addresses.
Kirby Town Plan, November 2012	Yes – The Town Plan includes reference to the Floodplain Zone in the Land Use Regulations Sections.	The Town Plan references goals and objectives that include "preserving the Town's natural resources."[186]	No – But the plan was used to develop mitigation actions. For instance, one of the goals in the Town Plan is "Maintaining a convenient and efficient transportation system through superior maintenance of Town roads." Multiple mitigation actions were developed to mitigate risk to the roads.
Town of Kirby Zoning Regulations (Draft October 2016)	Yes – Special Flood Hazard District	No	It may be used to support not building in high hazard areas.
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.

[185] Capability Assessment Worksheet 4.1. (2013). Local Mitigation Planning Handbook. Federal Emergency Management Agency.
[186] Kirby Town Plan, November 2012. P.4

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?
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.

The Planning Team found the review of the above documents very useful in terms of developing this plan. The State Hazard Mitigation Plan was reviewed for identified hazards, mitigation actions and mitigation priorities. This plan is consistent with the State Plan. The Kirby Emergency Operations Plan indicated a group of residents with special needs. This recognition, was discussed in both Hazard Mitigation Committee meetings and at each public meeting. These discussions led to a couple of mitigation actions included in the next chapter, including:

- Update local first responders annually with information regarding residents with special needs, and
- Develop neighbors helping neighbors program for outreach to vulnerable residents during power outages and other disasters.

The Kirby Town Plan was carefully reviewed for priorities regarding land use and development in Kirby. It was also used and quoted throughout this plan regarding background information for Kirby. The Kirby Zoning Regulations do not include language specific to building in high hazard areas. The process of updating the Zoning Regulations occurred simultaneously to the development of this plan. However, changes were not made specific to hazard mitigation. The Zoning Board intends to make these changes in the next revision. The Northeast Kingdom Regional Plan and the Planning for Flood Recovery and Long-Term Resiliency plan were each reviewed for flood mitigation techniques.

The Town of Kirby currently does not have the plans in places listed in Table 5.3. The Town Plan does include many of the components often found in some of these plans.

Table 5.3 Plans not specifically in place

Plans Not Specifically In Place	Description
Capital Improvements Plan	The town's budget includes funding specifically for roads. This plan includes a mitigation action to rename that budget line item to Roads and Hazard Mitigation.
Economic Development Plan	Kirby does not have a plan for economic development. Dairy is the only business in Kirby.
Continuity of Operations Plan	The LEOP functions as the "disaster plan" and Kirby does not have a specific Continuity of Operations Plan.
Transportation Plan	Transportation is by personal vehicle including children to school.
Stormwater Management Plan	Kirby does not have a specific stormwater management plan and flooding and erosion are managed through the roads budget.
Community Wildfire Protection Plan	The State of Vermont has a Wildlife Protection Regulation that Kirby adheres to.

ZONING AND LAND USE REGULATIONS

The Town of Kirby has re-written their Zoning Regulations. As of February 2017, the Zoning Regulations were in draft form. The Kirby Zoning Regulations include the following districts:

- Residential District
- Commercial/Light Industry District
- Special Flood Hazard Area
- Highlands District

With respect to the intent of the Zoning Regulations, "the intent of these Zoning Regulations is to provide for orderly community growth by furthering the purposes established in Section 4302 of the Act, and by acknowledging and providing for Kirby's social, economic and environmental needs as they are described in Kirby's Municipal Plan."[187]

The goals of the Town Plan are to help the Town in "preserving and maintaining its rural character and scenic beauty by providing a summary of factual information and data that provide a basis for review and analysis, and support the following objectives:

- Continued development of a strong and diverse economic base through the promotion of commercial development along Route 2 and home occupations throughout the Town.
- Maintaining and enhancing rural character, and protection of key scenic areas.
- Maintaining a convenient and efficient transportation system through superior maintenance of Town roads.
- Preserving the Town's natural resources by:
    - Encouraging recreational opportunities
    - Encouraging continued use and development of agricultural and forest- based resources."[188]

The town's goal is to protect their quality agricultural land, scenic resources and other unique and fragile areas. Development in areas above 1,600 feet in elevation is "strongly discouraged" since "erosion control and subsurface water confinement are severely hampered at these elevations".[189] "If construction is to take place at these levels, consideration will be given to requiring a soils study and an impact study on scenic vistas and ecosystems" prior to construction approval.[190]

The Zoning Regulations do support hazard mitigation. The Town does not have an adequate zoning district map. This effort has become part of a mitigation action called NVDA Hazard Mapping Support. The Town Plan includes protecting "unique and fragile areas" such as wetlands, watersheds, aquifers, steeply sloped areas and ponds, rivers and streams.[191]

[187] Zoning Regulations. (2016). Town of Kirby. Pg.1.
[188] Kirby Town Plan (2012). Town of Kirby. Pg.4.
[189] Kirby Town Plan (2012). Town of Kirby. Pg.10.
[190] Kirby Town Plan (2012). Town of Kirby. Pg.11
[191] Kirby Town Plan (2012). Town of Kirby. Pg.10.

The Planning Team completed Table 5.4 to more succinctly detail land use and zoning ordinances in relation to hazard mitigation.

Table 5.4 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	Town of Kirby, Zoning Regulations, October 2016. The Zoning Regulations are administered by the Zoning Administrator. This positions reviews setbacks and size of permit requests.
C & S = Highway Codes and Standards	Yes	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	No	This may be created in future Zoning Regulations.
Floodplain ordinance	Yes	The Zoning Regulations refer to a Special Flood Hazard Area. 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 Highlands District
Flood insurance rate maps	Yes	Paper maps dated 1974 are available from FEMA and a mitigation action is included to request digitized maps. Another mitigation action includes collaborating with NVDA for GIS support. In addition, a mitigation action includes requesting a move from the NFIP Emergency Phase to the NFIP Regular Program.
Acquisition of land for open space and public recreation uses	No	

In addition to zoning regulations, the planning area has building code and site plan requirements as show in Table 5.5.

Table 5.5 Building Code and Site Plan Requirements

Building Code, Permitting, and Inspections	Yes/ No	Are codes adequately enforced?
Building Code	Yes	The Town of Kirby adheres to the State Building Code Standards for public buildings. For individual homes compliance is not overseen. 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

Building Code, Permitting, and Inspections	Yes/ No	Are codes adequately enforced?
		those codes, such as using existing State and local permit processes to encourage compliance.[192]
Fire Department ISO Rating	N/A	The Town of Kirby relies on support from Lyndonville Fire Department/Concord Fire Department and St. Johnsbury Fire Department.
Site plan review requirements	Yes	Kirby Zoning Regulations

ADMINISTRATIVE AND TECHNICAL CAPABILITIES

Table 5.6 outlines Worksheet 4.1 from FEMA's Local Mitigation Planning Handbook.[193] It was used by the Planning Team to review administrative and technical capabilities of the Town of Kirby. 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 Hall functions as the primary Emergency Operation Center (EOC), back up locations are not included. The Town Hall does include a generator hook-up and there is a portable generator on site. The Selectboard has the responsibility of communications, emergency management, mass care and public information. The Highway Department is responsible for public works and engineering. The rest of the Local Support Functions are designated for agencies outside of Kirby.

Table 5.6 Administrative and Technical Capabilities

Administration	Yes/ No	Describe capability Is coordination effective?
Community Planning Commission	Yes	The Planning Commission functions to determine Zoning Regulations, the Town Plan and function as the Board of Adjustments.
Mitigation Planning Committee	Yes	This Committee was organized for the purposes of completing and implementing this plan.
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 including roads, trees and stormwater systems such as culverts.
Mutual aid agreements	Yes	Mutual Aid Agreements are in place with surrounding communities for fire safety.
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	No	
Floodplain Administrator	No	The Selectboard would serve this function.

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

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

Emergency Manager	Yes	Selectboard Clerk.
Community Planner	Yes	The Planning Board serves this role.
Civil Engineer	No	
GIS Coordinator	Yes	A member of the Listers has GIS skills that he uses to benefit the Town.
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	
Hazard data and information	Yes	Kirby has received FEMA and state funding for past disasters. Detailed records are in the appendices. The town office has a vault to protect public records from damage or theft/vandalism.
Grant writing	Yes	Selectboard Clerk
Hazus analysis	No	A mitigation action has been included to seek support from NVDA for GIS and hazard analysis that may include HAZUS.

FINANCIAL CAPABILITIES

Table 5.7 outlines Worksheet 4.1 from FEMA's Local Mitigation Planning Handbook.[194] It was used by the Planning Team to identify eligibility and access to hazard mitigation funding.

Table 5.7 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	Yes	Funding has been collected for equipment, buildings and roads.
Authority to levy taxes for specific purposes	Yes	If approved during a vote, the Town may levy taxes for a specific purpose. This has been done in the past for schools, roads and the cemeteries.
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

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

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?
		electric service from either Lyndonville Electric or Green Mountain Power.
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	FEMA 2011 and 2014Disaster
State funding programs	Yes	Received funding for roads and schools in the past.

EDUCATION AND OUTREACH CAPABILITIES

Table 5.8 outlines Worksheet 4.1 from FEMA's Local Mitigation Planning Handbook.[195] It was used by the Planning Team to identify education and outreach programs used to implement mitigation activities. When discussing the process for making Kirby 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:

Table 5.8 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	No	
Local citizen groups or non-profit organizations focused on environmental protection, emergency preparedness, access and functional needs populations, etc.	Yes	The Kirby Quilters assume responsibility for most public activities in the Town. They organize meetings and distribute information. It is recommended that this group be used to implement future emergency preparedness education activities.
Ongoing public education or information program (e.g., responsible water use, fire	No	Several mitigation actions have been included to remedy the lack of public education.

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

Program/Organization	Yes/No	Describe program/organization and how relates to disaster resilience and mitigation. Could the program/organization help implement future mitigation activities?
safety, household preparedness, environmental education)		
Natural disaster or safety related school programs	No	N/A since Kirby does not have a school.
StormReady certification	No	
Public-private partnership initiatives addressing disaster-related issues	No	This may be useful in the future since Kirby relies on first responders from adjacent communities.

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 Kirby has an NFIP status of Emergency Phase. They entered the NFIP in 1974. The flood insurance rate map is in paper form and has not been reviewed since 1974. According to the Expanded Community Report for Kirby (shown in the Appendices). According to this report, there is one flood insurance policy in the Special Flood Hazard Area, however according to FEMA's Policy and Claim Statistics there are no flood insurance policies in Kirby. According to responses in survey used during the planning process, two people responded that they have flood insurance. It is not clear if this response represents two households or one. The Selectboard Clerk and Town Clerk were aware of the Flood Hazard Map but not of their NFIP status when the mitigation planning process began.

Through collaboration with NVDA and then the Vermont Department of Environmental Conservation (VDEC), it was determined that the Town of Kirby can move from Emergency Phase to the Regular Program by expressing their desire to do this by way of a letter from the Selectboard to Sacha Pealer, Regional River Scientist & Floodplain Manager at VDEC. A mitigation action has been added to seek this improved NFIP status.

Details regarding participation in the NFIP by property owners are outlined in Table 5.9. 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 Selectboard Clerk is responsible for NFIP compliance. They will adhere to the NFIP Requirements Checklist provided by FEMA and included in Appendix C. It should be noted that most flooding in Kirby impacts roads and some basements.

Table 5.9 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	0

NFIP Topic	Source of Information	Comments
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	No claims have been filed since 1978.[196]
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	
What are the barriers to running an effective NFIP program in the community, if any?	Community FPA	
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 issues (i.e., current violations)?		No
When was the most recent Community Assistance Visit (CAV) or Community Assistance Contact (CAC)?		
Is a CAV or CAC scheduled or needed?		N/A
Regulation		
When did the community enter the NFIP?	Community Status Book (Link: http://www.fema.gov/ national-flood-insurance-program/national-flood-insurance-program- community-status-book)	12/13/1974 entered the NFIP[197]
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	
Provide an explanation of the permitting process.	Community FPA, State, FEMA NFIP	Building permits are requested from the Zoning Administrator who checks

[196] Loss Statistics. (2016). Federal Emergency Management Agency: National Flood Insurance Program. Retrieved on March 1, 2017 from https://bsa.nfipstat.fema.gov/reports/1040.htm#50

[197] Communities Participating in the National Flood Program. (2017). Federal Emergency Management Agency: Community Status Book Report, Vermont. Retrieved March 1, 2017 from https://www.fema.gov/cis/VT.html

NFIP Topic	Source of Information	Comments
	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)	the Zoning Regulations 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
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?		This plan meets multiple CRS requirements. However, the Town is not in a position to participate in the CRS.
Does the plan include CRS planning requirements	Community FPA, FEMA CRS Coordinator, ISO representative CRS manual (http:// www.fema.gov/library/ viewRecord.do?id=2434)	Yes – see table below for details

CAPABILITY ASSESSMENT CONCLUSIONS

In terms of preparing for a disaster, most respondents to the Natural Hazards Preparedness Survey reported that they have installed smoke and carbon monoxide detectors and about half 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.

The obvious gaps in the Town's ability to mitigate risk are their small staff size, limited technical resources and defined budget. At the same time, these are also their strengths. The Town of Kirby works together and many residents donate time to the Town. Some residents living along roadways clear the road of debris if trees or limbs fall. While increasing paid staffing is not likely, the opportunity to collaborate with adjacent communities does exist, as does the ability for the Town to implement a variety of education methods that will translate to residents mitigating risk in the Town.

An issue impacting the Town is the school budget. The Town of Kirby does not have a school and all students can choose the school they wish to attend. Bussing is not provided. Eighty percent of the Kirby budget is spent on schools. The Town voted at Town Meeting, March 7, 2017 to join the NEK Choice School District. The Kirby Town School District will cease to exist after July 1, 2018. This is part of the State of Vermont's Act 46. Kirby has had school choice since the 1970's. It is a big reason the housing continues to grow in Kirby and why housing costs more than in surrounding towns. New students moving into Kirby, cost the town $15,000 a year.

In conclusion, the Town of Kirby can 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 Kirby, but

it is not expected to impact the Town's long-term resilience. In fact, nothing was identified that limits Kirby's long-term resilience to natural hazards. The Selectboard and Hazard Mitigation Committee recognize the need to update this plan annually on an informal basis and to conduct a formal update every five 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 Kirby is well positioned to implement their identified mitigation actions.

CHAPTER 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 6.1 includes problem statements based on the risk assessment, capability assessment, and discussions and interviews with stakeholders. These statements are of interest regarding primary hazards of concern, geographic areas of concern, and vulnerable community assets. This analysis helped summarize risks and identify realistic solutions.

Table 6.1 Problem Statements

Primary Hazards
Tree-related hazards: Widespread during hurricane/tropical storm and severe winter storm events, particularly downing electrical lines, and when falling and blocking roads that isolate home owners throughout town and pose life/safety threat due to limited emergency access.
High Winds: High winds frequently accompany severe winter storms and have been known to blow
Flooding: There is limited development in the floodplain, however, riverine flooding remains a concern, especially at crossings with roadways and in areas of undersized culverts. The Town of Kirby experiences increased problems when the weather changes dramatically. A sudden thaw that melts the snow pack creates flooding especially along roadways.
Blizzards, Nor'easters, Snow Events: Northern Vermont is known for long cold winters full of snow. Treating the roads is imperative but made difficult by the location of the Town sand pile away from the Town Garage. The amount of snow may block ventilation from furnaces and other utilities increasing the chance of carbon monoxide poisoning. High winds and winter storms may knock down trees blocking roadways and damaging powerlines. Given the length of the winter and amount of severe cold in northern Vermont this presents a problem to homeowners without adequate supplemental power. It also makes roadways impassible isolating parts of Kirby.
Geographic Areas of Concern
The highest hazard area are the roads in Kirby. Specific roadway problems are addressed in the list of mitigation actions. Including the Culvert on Lynhill/Mud Hollow Road, Ridge Road, Kirby Corners, Burroughs Road/Cross Road, Brookside, Mud Hollow Road, Hayes Road, Willey Farm Road, and Apple Tree Lane.
Vulnerable Community Assets
Roads: The roads in Kirby are primarily dirt and the most vulnerable asset in Kirby. They are at risk to most of the atmospheric hazards particularly, winter storms, flooding and high winds.
Town Hall and Town Garage: These assets share one portable generator. During a power outage, the Town would need to choose which facility to power.
Old School House: This facility is not frequently used. However, if it had a generator, it could be used as a heating, cooling or meeting location during power outages. About 30% of Kirby's population lives in South Kirby near the Old School House.
Dairy Farms/Homes: The dairy farms in Kirby are privately owned and other than small home-based businesses, the only business in Kirby. The farms rely on clear and open roads to move milk daily to market.

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 goal statements developed by the Planning Team and the Hazard Mitigation Committee, with consent by the public, reflect the priorities of the Town of Kirby to protect their citizens as well as their property and infrastructure. The goals are broken into five categories which represent the themes the Hazard Mitigation Committee is devoted to in their long-term vision of mitigating risk to natural hazards.

1. Save Lives
    - Reduce the loss of life and injury resulting from all hazards.
2. Protect Property and Infrastructure
    - Mitigate financial losses incurred by the Town, residents and commercial establishments due to natural disasters.
    - Reduce the damage to roads resulting from all hazards.
3. Incorporate All-hazard Planning
    - Incorporate all-hazard mitigation planning concepts as a part of the municipal planning process.
4. Regional Collaboration
    - Build capacity for hazard mitigation through regional collaboration.
5. Public Awareness
    - Increase public awareness of hazards by implementing outreach and education programs.

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 6.2, taken from the Local Mitigation Planning Handbook, clearly defines each of these mitigation types and provides examples.[198] 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 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.

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

Table 6.2 Mitigation Action Types[199]

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 preserve or restore the functions of natural systems.	• Sediment and erosion control • Stream corridor restoration • Forest management • Conservation easements
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 the hazards profiled in the risk assessment. Table 6.3 indicates each hazard with its corresponding summary of the mitigation actions.

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

Table 6.3 Range of Specific Mitigation Actions for Each Hazard Identified

Hazard		Mitigation Actions
High Hazards	• Flooding from heavy rain and snow melt • Ice Storms • Blizzard • Nor'easter • Snow Events	While winter storms are most prevalent in Kirby, but the biggest threat in Kirby is a result of heavy rain and snow melt that creates flooding. Climate change has increased the number of quick temperature changes throughout the season which often leads to snow melt. Flooding in Kirby impacts roadways and this may be mitigated through multiple road mitigation actions included in this plan. These include ditching along roadways, applying Stamatt and clearing culverts. After flooding, the risk to Kirby is winter storms. These may create power outages or damage trees that block roadways. Similarly, to flooding, multiple mitigation actions are included to keep the roads and power lines clear.
Moderate Hazards	• Flooding/fluvial erosion • Water Supply Contamination • Hurricanes • Extreme Cold • Microburst	The Town of Kirby is committed to protecting its streams and rivers from contamination by preventing building in the Highlands District and close to waterways. Road maintenance is another way to prevent flooding and is included in multiple mitigation actions. Microbursts and Hurricanes are high wind events and pose the biggest threat to roadways and power lines. Kirby has included multiple methods to keep the roads clear and the power lines unencumbered. Extreme cold is a fact of life in Northern Vermont. To mitigate this risk, Kirby has included education and awareness activities as well as strategies to protect their most vulnerable citizens.
Low Hazards	• Earthquake • Drought • Wildfire • Tornadoes • Hail • Beaver Dams • Landslide	Mitigating the earthquake risk is directly related to safe building practices. Drought may severely impact the amount of hay and grass available to farm animals. Drought increases the risk for wildfires. Mitigating these risks includes monitoring conditions and adjusting behavior appropriately. Tornadoes and Hail are high wind events that may impact roads and power lines by destroying trees and power lines. Multiple mitigation actions are included to protect roadways and power lines. Beaver Dams pose a small threat to Kirby and will be managed as necessary. The Landslide risk is addressed through multiple roadway mitigation strategies including, applying Stamatt, dredging the edges of roads and keeping roads clear of debris.
Very Low Hazards	• Ice Jams • Extreme Heat and Heat Wave • Lightning	Mitigating the Ice Jam risk includes flood mitigation measures and land use management. The mitigation actions regarding the Old School House and the Town Hall address the potential need for a cooling center, these include purchasing a generator and a generator hook up. Lightning mitigation includes protecting power lines from potential tree debris by tree trimming and road widening.

During the development of the Town's Hazard Mitigation Plan, the Planning Commission was ready to adopt and publish updated zoning regulations. Through the Hazard Mitigation Committee and Public Meetings held in March 2017 it was suggested that the regulations include hazard mitigation concepts. The conversation during these meetings educated the group about using Local Plans and Regulations to reduce hazard risk.

The Town of Kirby has written this Hazard Mitigation Plan 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.[200] Act 16 includes land use regulations that state municipal plans must encourage "flood resilient communities" and lists the following specific goals.[201]

200 State of Vermont Hazard Mitigation Plan, (2013). Vermont Department of Public Safety – Division of Emergency Management and Homeland Security. Pg.3-20
201 Act 16. (2014). Vermont General Assembly. Retrieved from http://www.leg.state.vt.us/docs/2014/Acts/ACT016.pdf

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."[202] The same study also recommends "easy ways to improve resilience"[203]

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.

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:[204]

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

202 Planning for Flood Recovery and Long-Term Resilience in Vermont. (2014). Environmental Protection Act. Pg.3.
203 Planning for Flood Recovery and Long-Term Resilience in Vermont. (2014). Environmental Protection Act. Pg.9.
204 Flood Resilience: Northeast Kingdom Regional Plan. (2015). Northeastern Vermont Development Association. Retrieved August 3, 2015 from http://www.nvda.net/files/ Flood%20Resilience.pdf.

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 considered FEMA's mitigation action categories and identified risks and vulnerabilities specific to the Town of Kirby. Many of the mitigation actions in this Plan relate to road condition, a primary concern in the Town of Kirby.

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 now. 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.
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 regarding how much of each hazard's impact would be mitigated.
- **Cost effectiveness** – 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.

Table 6.4 Mitigation Actions

Priority	Mitigation Action	Description	Hazards Mitigated	Mitigation Category	Responsible Department	Costs	Funding Source	Timeline
Very High	Culvert on Lynhill – Mud Hollow Road	Culvert has rotted. Replace with 18" culvert to prevent clogging and flooding.	Flooding	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2017 – December 2017
Very High	Ridge Road Culvert Replacement	Replace culvert with 18" culvert to prevent clogging and flooding.	Flooding	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	June 2018 – June 2019
Very High	Kirby Corners – Blind corner from North Kirby Road	Need to dig down road. It is higher than surrounding land and snow blows onto it and sits there.	Snow Events	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2017 – June 2018
Very High	Ridge Road Paving	Needs to be re-paved and needs ditching along the corner near the sand pile. This road is so broken up and a quick change in temperatures degrades the road further. The holes fill with water and ice causing flooding and a dangerous situation.	Flooding	Structure and Infrastructure Projects	Road Foreman Road Commission	High	Town VTrans	June 2018 – June 2019
Very High	Apply Stamatt	Stamatt is applied to dirt roads to harden them and prevent the road from degrading. When dirt roads break down they are vulnerable to flooding and erosion. It is also more difficult to plow and salt/sand a road already in poor condition. Apply Stamatt as needed.	Flooding/fluvial erosion Snow events	Structure and Infrastructure Projects	Road Foreman Road Commission	Medium	Town VTrans	April 2019 – October 2019
Very High	Mitigate landslides and erosion by digging trenches along Kirby Road and on the South Side near Taylor Farm to allow for water flow.	By giving snow run-off and heavy rains a place to drain, landslides may be prevented.	Flooding/fluvial erosion Landslides	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	March 2018 – June 2020
Very High	Collaborate with Lyndonville Electric and Green Mountain Power for tree clearing	Road obstruction and downed power lines are two of the biggest concerns in Kirby. Collaborate with the Lyndonville Electric and Green Mountain Power to keep trees trimmed and roads clear is essential to keep the roads free of debris and the power on.	Flooding Blizzard Nor'easter Snow Events Hurricanes Microburst Tornadoes Hail	Local Plans and Regulations	Road Foreman Road Commission	Low	Town Electric Companies	July 2017 – June 2022
High	Install a culvert at Burroughs Road and Cross Road.	This section is always wet and ruts in the road become deeper than two feet. An 18" culvert here would alleviate flooding. Needs property owner's permission.	Flooding	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2017 – September 2018
High	Brookside	Culverts here are undersized and the road needs ditching on both sides to prevent flooding.	Flooding	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2017 – September 2018

Priority	Mitigation Action	Description	Hazards Mitigated	Mitigation Category	Responsible Department	Costs	Funding Source	Timeline
High	Dig bedrock along Mud Hollow Road to allow for water flow.	Mud Hollow Road sits on bedrock and needs an excavator to dig out the rock and create a channel for water to flow along the sides of the road. As it is now, water pools on the road. The box culvert previously added is not enough to remedy the problems.	Flooding	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2017 – November 2017
High	Apply Stamatt to Hayes Road	Hayes Road is very steep and water runs on the road and creates big ruts. As the road deteriorates it becomes harder to travel along.	Flooding	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2017 – November 2017
High	Willey Farm Road needs ditching on either side to prevent flooding.	This road needs excavation along each side to prevent flooding.	Flooding	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2017 – September 2018
High	Apple Tree Lane widening and ditching.	Needs widening and ditching to prevent flooding.	Flooding	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	April 2018 – June 2019
High	Plan for and maintain adequate road and debris clearing capabilities.	Keeping the roads clear of debris is necessary for safety. Some residents will stop and remove tree debris if possible from the road. A plan for maintaining clear roadways is necessary.	Blizzard Nor'easter Snow Events Hurricanes Microburst Tornadoes Hail	Local Plans and Regulations Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2017 – December 2017
High	Widen roads to allow for snow build-up and drainage.	In conjunction with other road projects, the roads should be widened to allow for snow build-up and drainage. Preventing roads from getting too narrow for cars to pass is a method for keeping them safe and mitigating the risk of accidents from snow build-up and flooding.	Flooding from heavy rain storms and snow melt Snow Events	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2018 – December 2020
High	Increase the capacity of stormwater drainage.	Culvert cleaning increasing the capacity for stormwater drainage and prevents flooding. All of the culverts in Town need cleaning.	Flooding from heavy rain storms and snow melt Flooding/fluvial erosion	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town HMGP VTrans	July 2017 – December 2017
High	Develop a Road Erosion Inventory	Act 64 requires this inventory by 2019.	Flooding from heavy rain storms and snow melt Flooding/fluvial erosion	Local Plans and Regulations	Road Foreman Road Commission	Low	Town VTrans	July 2017 – December 2017
High	Maintain Culverts and Roadways to VTrans Standards.	Develop a culvert survey. Replace poor roadways, cut vegetation along roadways and improve ditching along roads ways to keep the roads up to VTrans standards.	Flooding from heavy rain storms and snow melt Flooding/fluvial erosion	Structure and Infrastructure Projects	Road Foreman Road Commission	Low	Town VTrans	July 2017 – June 2022

Priority	Mitigation Action	Description	Hazards Mitigated	Mitigation Category	Responsible Department	Costs	Funding Source	Timeline
High	Educate homeowners at Town Meeting about floods, how to shelter-in-place, how to access emergency information and other natural hazards.	The Hazard Mitigation Committee has prioritized education as one of the best methods to mitigate risks in Kirby. 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 Foreman to clear the roads and first responders to move about.	Flooding Winter Storms Power Outages	Education and Awareness Programs	Selectboard	Low	Town	July 2017 – June 2020
High	Send pamphlets with annual tax bills to educate all homeowners regarding the necessity of carbon monoxide detectors and the necessity to vent all fuel-burning equipment to the outside.	The Hazard Mitigation Committee has prioritized education as one of the best methods to mitigate risks in Kirby.	Hazards that create Power Outages such as winter storms Extreme Cold Extreme Heat	Education and Awareness Programs	Planning Commission	Low	Town	August 2017 – annually with tax bills
High	Purchase a permanent generator for the Town Hall.	The generator will allow the Town Hall to function as a shelter instantly and for the portable generator to be used at the Town Garage or Old Schoolhouse.	Hazards that create Power Outages such as winter storms Extreme Cold Extreme Heat	Structure and Infrastructure Projects	Selectboard	Low	HMGP	January 2019 – December 2019
High	Incorporate mitigation principles into future Town Plans and updated Zoning Regulations.	Incorporating mitigation principles will ensure that future growth in the town is consistent with this plan's findings.	All Hazards	Local Plans and Regulations	Planning Commission	Low	Town	August 2017 – December 2018
High	Establish Town Hall as a hazard information center.	Host educational meetings regarding mitigation here as well as maintain information.	All Hazards	Local Plans and Regulations	Selectboard	Low	Town	July 2017 – December 2018
High	Update FEMA Flood Maps	Encourage FEMA to update and digitize floodplain maps for the Town. This will provide a great resource for land use planning as preventing flooding.	Flooding/fluvial erosion	Local Plans and Regulations	FEMA Planning Commission	Low	FEMA	September 2017 – June 2022
High	NVDA Hazard Mapping Support	Kirby would like a clear zoning map so the Zoning Regulations may be updated. They also would like to overlay an updated floodplain map with the zoning map.	All Hazards	Local Plans and Regulations	Planning Commission	Low	Town NVDA	September 2017 – June 2022

Priority	Mitigation Action	Description	Hazards Mitigated	Mitigation Category	Responsible Department	Costs	Funding Source	Timeline
Medium	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. Need to find and purchase property to house a sand and salt shed.	Ice Storms Blizzard Nor'easter Snow Events Hail	Structure and Infrastructure Projects	Selectboard	High	HMGP	January 2020 – December 2020
Medium	Collaborate with VTrans	Roadway projects should be conducted to VTrans standards.	Flooding from heavy rain storms and snow melt Ice Storms Blizzard Nor'easter Snow Events Flooding/fluvial erosion Hurricanes Microburst Tornadoes Landslide	Local Plans and Regulations	Road Foreman Road Commission	Low	Town VTrans	July 2017 – December 2017
Medium	Update local first responders annually with information regarding residents with special needs.	This information is shared by way of the Local Emergency Operations Plan.	All Hazards	Local Plans and Regulations	Selectboard	Low	Town	Annually in May, beginning May 2017
Medium	Develop neighbors helping neighbors program for outreach to vulnerable residents during power outages and other disasters.	Residents with special needs may need someone to take them to a heating center or check on them during a disaster.	All Hazards	Education and Awareness Programs	Kirby Quilters	Low	Town	July 2017 – December 2018
Medium	Educate home owners about safe building practices for snow load, flooding, high winds, and bank erosion.	When residents drop off building permit applications, the Town will give them pamphlets and other information regarding safe building practices. The Town does not utilize building inspectors, as is typical in Vermont, so this is a way to ensure safe buildings.	Flooding/fluvial erosion Nor'easters Hurricanes Snow Events Earthquake Tornadoes	Education and Awareness Programs	Town Clerk Volunteer	Low	Town	July 2017 – December 2017
Medium	Install a quick connect generator hook-up at the Old Schoolhouse.	This would enable this publicly owned building to be used during disasters and function as a back-up should the Town Hall become disabled.	Ice Storms Blizzard Nor'easter Snow Events Hurricanes Extreme Cold Microburst Wildfire Tornadoes Hail Extreme Heat	Structure and Infrastructure Projects	Selectboard	Low	HMGP	July 2018 – December 2019

Priority	Mitigation Action	Description	Hazards Mitigated	Mitigation Category	Responsible Department	Costs	Funding Source	Timeline
Medium	River Corridor – adopt river corridor model recommendations for development in areas along river corridors and erosion areas to meet ERAF Standards.	Adopt a river corridor protection bylaw that meets or exceeds state model regulations and guidelines. This will prevent flooding and erosion along streams and rivers.	Flooding/fluvial erosion	Local Plans and Regulations	Planning Commission	Low	Town	June 2020 – December 2021
Medium	Amend the Road Project Budget to be for road projects and hazard mitigation.	Rename to Highway and Road Mitigation. This is part of adding to the culture of mitigation.	Flooding from heavy rainstorms and snow melt Snow Events Hurricanes	Local Plans and Regulations	Selectboard	Low	Town	January 2018 – December 2018
Medium	Restrict development in higher elevations by enforcing the Highlands District Zoning Regulations.	Per the Town Plan, new developments should not be undertaken in the higher elevation categories as to prevent any harmful introduction of pollutants close to wellheads into surface and sub surface waters which may result in groundwater and drinking water pollution.	Water Supply Contamination	Local Plans and Regulations	Planning Commission	Low	Town	July 2017 – December 2018
Medium	Develop a stream buffer ordinance to avoid building in floodplain areas.	The Planning Commission will review VT River Corridor studies for guidelines.	Flooding/fluvial erosion	Local Plans and Regulations	Planning Commission	Low	Town	January 2018 – December 2018
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. This data is necessary when conducting future benefit-cost analysis for mitigation grant funding.	All Hazards	Local Plans and Regulations	Road Foreman Town Clerk	Low	Town	July 2017 – June 2022
Medium	Remediate Beaver Dam Issues as They Arise	Prevent flooding caused by beaver dams.	Flooding/fluvial erosion	Structure and Infrastructure Projects	Road Foreman Game Warden	Low	Town	July 2017 – June 2022
Low	Improve NFIP Status from Emergency Phase to Regular Program	When the Town is a full member of the NFIP it will be easier for residents to get flood insurance if they so desire. Town government is interested in being a regular program member.	Flooding/fluvial erosion	Local Plans and Regulations	Town Clerk Selectboard	Low	FEMA Town	July 2017 – December 2017
Low	Get a generator for Town Garage	To maintain power in the building especially during evening disasters.	Ice Storms Blizzard Nor'easter Snow Events Hurricanes Extreme Cold Microburst Tornadoes Hail	Structure and Infrastructure Projects	Selectboard	Low	HMGP	January 2019 – December 2019

Priority	Mitigation Action	Description	Hazards Mitigated	Mitigation Category	Responsible Department	Costs	Funding Source	Timeline
Low	Send Hazard Mitigation Pamphlets	Send annually with tax bills in first week of August as a way to educate home owners about hazard mitigation.	All Hazards	Education and Awareness Programs	Town Treasurer	Low	Town	August 2017 – every August until 2022

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[205]

Table 6.5 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 because 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 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.

205 State of Vermont Mitigation Strategy, State of Vermont Hazard Mitigation Plan, 2013. P. 5-47-5-48.

Table 6.5 Summary of Federal Funding Sources that support Hazard Mitigation Projects in State of Vermont

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 jurisdictions	Post-disaster	DEMHS
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)[206]

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 Kirby. It also includes a letter from Jeb Spaulding, Secretary of Administration regarding how Vermont community's eligibility for funding.

The Town of Kirby 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

The Town of Kirby, intends to be eligible for 17.5% by:

- **Protect River Corridors** from new encroachment; or, protect their flood hazard areas from new encroachments and participate in the FEMA Community Rating System.

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

CHAPTER 7

PLAN IMPLMENTATION

CHAPTER 7. PLAN IMPLEMENTATION

The Town of Kirby 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 Selectboard Clerk 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 Kirby 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 2017 Hazard Mitigation Plan 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.

- The Selectboard Clerk or a member of the Hazard Mitigation Committee will update residents at Town Meeting (held annually the first Tuesday in March) on the status of the Hazard Mitigation Plan and the implementation of mitigation actions. Comments made regarding the Plan will be documented for inclusion in the next version of the Plan.
- Key stakeholders who are not living or working in Kirby, such as the local fire departments and other first responders will be informed quarterly via email or phone on the status of mitigation actions. The Hazard Mitigation Committee recognizes the importance of keeping these folks up to date, especially with information regarding road conditions and residents at high risk.
- Town of Kirby website (http://kirbyvermont.org) will contain a copy of the plan and all plan updates. The public may submit comments or questions regarding the plan to the Selectboard Clerk by email from the website. All comments submitted will become part of the public record and considered in 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 at the Town Hall as well as at entrances to Town.
- 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 Hall 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))

To review the Mitigation Plan on a periodic basis, the Hazard Mitigation Committee has agreed to meet quarterly. The Selectboard Clerk will schedule and host these meetings at the Town Hall.

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

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 Selectboard Clerk 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. Most likely this will be the Road Foreman or the Town Clerk. This Worksheet will include project status and identify obstacles or problems to implementation.

The Selectboard Clerk will distribute the *Mitigation Action Progress Report Worksheet* to each responsible department at the start of each quarter with instructions to complete the Worksheet. At the quarterly meeting, the Selectboard Clerk, 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 the mitigation actions identified in this plan. The Selectboard Clerk 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 constituencies in the Town of Kirby. It is their responsibility to monitor the progress of this plan's implementation. The Selectboard Clerk 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 Kirby 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 Selectboard Clerk assumes the grant writing responsibility. This is a heavy burden for a small town with leaders assuming multiple responsibilities. Receiving grant funding is part of a competitive process that is beyond the control of Town leaders.

EVALUATING

The Selectboard Clerk and Hazard Mitigation Committee will use the *Plan Update Evaluation Worksheet* (shown in Appendix D) to evaluate this Plan and make recommendations for future 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 Selectboard Clerk 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 Selectboard Clerk will coordinate a Hazard Mitigation Committee meeting on a bi-annual basis, to look at the plan and discuss possible updates and to add or subtract mitigation actions. When working on updates to the Plan, the Hazard Mitigation Committee will review the Town Plan and the Zoning Regulations to make sure all town plans remain consistent and include hazard mitigation. When the Town Plan or the Zoning Regulations are updated, the Selectboard Clerk will make sure that hazard mitigation elements are incorporated into those plans.

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 Selectboard and the Hazard Mitigation Committee. They will each work in collaboration with the Zoning Administrator and the Board of Adjustments. 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 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.

Future versions of the Town Plan will emphasize flood resilience, and river corridor flood mitigation. The symbiotic relationship between the Hazard Mitigation Plan and the Town Plan 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 Kirby 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.

The development of this Hazard Mitigation Plan is an opportunity for the Town of Kirby 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 planning efforts including their comprehensive, emergency operations and disaster response plans, as well as the Town Plan. It will also integrate with future updates to town bylaws and ordinances.

APPENDIX

ACRONYMS AND ABBREVIATIONS

AMS	American Meteorological Society
CFS	Cubic feet per second
CRREL	Cold Region Research and Engineering Lab
DEMHS	Division of Emergency Management and Homeland Security
Dept	Department
Div	Division
EMS	Emergency Management System
EOC	Emergency Operation Center
EPA	US Environmental Protection Agency
FEH	Fluvial Erosion Hazard
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FRRLZ	Forested Rural Residential Landscape Zone
HAZMAT	Hazardous Materials
HAZUS-MH	Hazards Software
Inc	Incorporated
ISAC	Invasive Species Advisory Committee
K	Thousand
Km	Kilometers
Kts	Knots
m	Meter
M	Million
MH	MultiHazard
MHIRA	Multi-Hazard Identification and Risk Assessment
MMI	Modified Mercalli Intensity
MPH	Miles Per Hour
N/A	Not Applicable
NBC	National Building Code
NCDC	National Climatic Data Center
NDMC	National Drought Mitigation Center
NESIS	Northeast Snowfall Impact Scale
NESEC	Northeast State Energy Consortium
NFIP	National Flood Insurance Program
NISC	National Invasive Species Council
NOAA	National Oceanic and Atmospheric Administration
NSSL	National Severe Storm Laboratory
NWS	National Weather Service
PCWS	Public Community Water Supply
PGA	Peak Ground Acceleration
PRI	Priority Risk Index
SHMP	Vermont State Hazard Mitigation Plan
SPI	Standardized Precipitation Index
TRI	Toxic Release Inventory
TORRO	Tornado and Storm Research Organization
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Service
VANR	Vermont Agency of Natural Resources
VT DEC	Vermont Department of Environmental Conservation
VELCO	Vermont Electric Power Company
VFW	Veterans of Foreign Wars
WUI	Wildland Urban Interface

RESOURCES

1.25 Inch Hail Near Lyndonville, VT. (2013). Hail strike. Retrieved from http://maps.hailstrike.com/vermont/1-25-inch-hail-near-lyndonville-vt-06-23-2013/

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

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

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

Best Management Practices for Handling Human-Beaver Conflicts in Vermont. (2004). Vermont Agency of Natural Resources. Fish and Wildlife Department.

Blizzards. (2009). National Weather Service Forecast Office. Retrieved from http://www.wrh.noaa.gov/fgz/science/blizzard.php?wfo=fgz).

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

Centers for Disease Control and Prevention. Retrieved from http://emergency.cdc.gov/disasters/extremeheat/heat_guide.asp.

Charns, David. (2013). Ice jams prompting flooding fears. WPTZ. Retrieved from http://www.wptz.com/news/vermont-new-york/burlington/ice-jams-prompting-flooding-fears/23616300.

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

Climate Data. (2014). National Drought Mitigation Center. Retrieved from http://droughtatlas.unl.edu/Data.aspx

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.

Collins, Chris. (2014). Hurricane Gloria September 27, 1985. National Weather Service. Retrievable from http://www.weather.gov/mhx/Sep271985EventReview.

Community Facts. (2010) United States Census Bureau. Retrieved from http://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml.

DEMHS. (2013). State of Vermont Hazard Mitigation Plan. Vermont Dept. of Public Safety, Div. of Emergency Management and Homeland Security. Retrievable from http://vem.vermont.gov/sites/vem/files/VT_SHMP2013%20FINAL%20APPROVED%20ADOPTED%202013%20VT%20SHMP_scrubbed_cleanedMCB.pdf.

Disaster Declarations. (2015) Federal Emergency Management Agency. Retrieved from https://www.fema.gov/disasters.

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

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.

Drought Basics. (2017). National Drought Mitigation Center. Retrieved from at http://drought.unl.edu/DroughtBasics/WhatisDrought.aspx.

Ebel et al. (1995). A report on the seismic vulnerability of the State of Vermont.

Ebel, J.E. and A.L. Kafka. (1991). Earthquake activity in the northeastern United States. In Decade of North American Geology, Vol. GSMV-1,Neotectonics of North America.

Edwards. (2015). Storm Prediction Center. Retrieved from http://www.spc.noaa.gov/faq/tornado/

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

Environmental Protection Agency. Climate Change Indicators in the United States. Retrievable from http://www.epa.gov/climate/climatechange/science/indicators/weather-climate/index.html.

Essex County Natural Resources Conservation District. (2009). Phase I Stream Geomorphic Assessment Moose River; Essex and Caledonia Counties. East St. Johnsbury, Concord, Victory, Granby, East Haven, Waterford, Kirby; Vermont.

Expanded Community Report. (2016). Floodready. Retrieved from http://www.Floodready.vermont.gov.

Extreme Temperatures Hazard Profile. (2011). New York State Department of Homeland Security and Emergency Services. Retrieved from http://www.dhses.ny.gov/.

FEMA 386-4 – Bringing the Plan to Life: Implementing the Hazard Mitigation Plan. (2003). Federal Emergency Management Agency (FEMA).

FEMA 433 – Using HAZUS-MH for Risk Assessment: How-to Guide. (2004). Federal Emergency Management Agency (FEMA). Retrieved from http://www.fema.gov/medialibrary/assets/documents/5231?id=1985.

Ferrey, Steven. (2007). Environmental Law.

Flood Ready Atlas Search for Kirby, VT. Flood Ready Vermont. Retrieved from http://floodready.vermont.gov/assessment/vt_floodready_atlas

Flood Ready Vermont – Community Reports. (2016). Vermont Agency of Natural Resources, Department of Environmental Conservation. Retrieved from http://floodready.vermont.gov/assessment/community_reports.

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

Geologic Soils – County Surveys in Waterbury, VT. (2011). Natural Resource Conservation Service. County Soil Survey Data. Retrieved from http://dware.vcgi.org/search_tools/moreinfo.cfm?catalog_id=1&layer_id=100&layer_name=GeologicSoils_SO

Glossary. (2009). National Oceanic and Atmospheric Administration: National Weather Service. Retrieved from http://w1.weather.gov/glossary/index.php?letter=b.

Glossary. (2017). US Geological Survey. Retrieved from http://landslides.usgs.gov/learn/glossary.php#e.

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

Haughney, Kathleen. (2014). New Research links tornado strength, frequency to climate change. Florida State University News. 24/7. 2014. Accessed from http://news.fsu.edu/More-FSU-News/24-7-News-Archive/2014/August/New-research-links-tornado-strength-frequency-to-climate-change.

Hazus. (2014). Federal Emergency Management Agency. Retrieved from https://www.fema.gov/hazus.

Hazus-US Software. (2014). Federal Emergency Management Agency (FEMA).

High Risk Dam Inundation Areas. (2008). Vermont Center for Geographic Information. Retrieved from http://vcgi.vermont.gov/warehouse/theme_index.

Highland and Bobrowsky (2008). The landslide handbook – a guide to understanding landslides. Available at http://pubs.usgs.gov/circ/1325/.

Homefacts. Tornadoes within your area. Retrieved from http://www.homefacts.com/tornadoes/Vermont/Caledonia-County/Lyndon.htm

Ice Jams. (2016). National Oceanic and Atmospheric Administration: National Weather Retrieved from http://www.crh.noaa.gov/Image/dvn/downloads/backgrounder_DVN_Ice_Jams.pdf.

Ice Jam Database. (2015). US Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Ice Engineering Research Group. Retrieved from https://rsgisias.crrel.usace.army.mil/apex/f?p=524:1.

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

Kim, Jon. (2014). Hazard evaluation at the Jeffersonville Landslide Site. Department of Environmental Conservation, Vermont. Retrieved from http://www.anr.state.vt.us/dec/geo/pdfdocs/HazRpts/JeffLandslide2014.pdf.

Landslides 101, Landslide Hazards Program. (2016). US Geological Survey. Retrieved from http://landslides.usgs.gov/learn/ls101.php.

Landslide Overview Map of the Conterminous United States. (2017). US Geological Survey. Retrieved from http://landslides.usgs.gov/hazards/nationalmap/.

Local Mitigation Planning Handbook. (2013). Federal Emergency Management Agency.

Meteorology Glossary. (2000). American Meteorological Society. Retrieved from http://www.fema.gov/hazard-mitigation-planning-resources.

Microburst. (2016). National Oceanic and Atmospheric Administration. Retrievable from http://www.srh.noaa.gov/ama/?n=microbursts).

Mitigating Flood-Related Fluvial Erosion Hazards (FEH) Using River Corridor Protection Factsheet. (2016). Vermont Agency of Natural Resources, Department of Environmental Conservation. Retrieved from http://www.watershedmanagement.vt.gov/rivers/docs/nfip/rv_Mitigating_Flood_Related_FEH_Using_CP_Fact_Sheet.pdf.

Moose River at Victory, Vermont. (2016). National Water Information System: US Geological Survey. Retrievable from http://waterdata.usgs.gov/nwis/inventory/?site_no=01134500&agency_cd=USGS.

Multi-Hazard Identification and Risk Assessment. (1997). Federal Emergency Management Agency (FEMA).

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

Municipal Plan of Kirby. (2012). Town of Kirby.

Murray, Sharon. (2014). Highway Statute: Class 4 Roads. Vermont Planners Association. 168. Retrieved from http://legislature.vermont.gov/assets/Documents/2014/WorkGroups/House%20Government%20Operations/Bills/S.168/S.168~Karen%20Horn~Class%20Four%20Roads~4-2-2014.pdf.

National Hurricane Center. (2009). National Oceanic and Atmospheric Administration. Retrieved from www.nhc.noaa.gov/.

National Inventory of Dams. (2016). U.S. Army Corps of Engineers. Retrieved from http://geo.usace.army.mil/pgis/f?p=397:1:10147282542258::NO

National Oceanic and Atmospheric Administration. (2009).

National Severe Storms Laboratory. Severe Weather 101. Hail Basics. Retrieved from http://www.nssl.noaa.gov/education/svrwx101/hail/

National Weather Service Glossary. (2016). National Oceanic and Atmospheric Administration, National Weather Service. Retrieved from http://w1.weather.gov/glossary/index.php.

NEK Choice School District, Act 46 Study Committee, Final Report and Articles of Agreement, December 20, 2016.

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

Northeast States Emergency Consortium. (2014). Retrieved from www.nesec.org.

Northeast U.S. Lightning Data from National Lightning Detection Network. (2013). VAISALA. Retrieved from http://www.vaisala.com/Vaisala%20Documents/Corporate-mediakits/NLDN%20Northeast%20US.pdf

Olson, S.A.. (2009). Estimation of flood discharges at selected recurrence intervals for streams in New Hampshire: U.S. Geological Survey Scientific Investigations Report 2008–5206.

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

Regional Snowfall Index. (2014). National Oceanic and Atmospheric Administration: National Climatic Data Center. Retrieved from https://www.ncdc.noaa.gov/snow-and-ice/rsi/nesis

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

Severe Weather 101 – Hail Basics. (2016). National Severe Storm Laboratory. Retrievable from http://www.nssl.noaa.gov/education/svrwx101/hail/.

Snowmelt – the water cycle. (2016). US Geological Survey. Retrievable from http://water.usgs.gov/edu/watercyclesnowmelt.html.

Springfield Vermont News. (2010). Nor'easter could dump as much as 15 inch. Retrieved from http://springfieldvt.blogspot.com/2010/12/noreaster-could-dump-as-much-as-15.htm.

Smith, Robin. (2013). State Seeks FEMA help due to Ice Storm. The Caledonian Record. Retrievable from http://caledonianrecord.com/main.asp?SectionID=180&SubSectionID=778&ArticleID=104622

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

Storm Events Database. (2016). National Oceanic and Atmospheric Administration: National Climatic Data Center. Retrieved from http://www.ncdc.noaa.gov/stormevents/.

Springfield Vermont News. (2010). Retrieved from http://springfieldvt.blogspot.com/2010/12/noreaster-could-dump-as-much-as-15.htm.

Surfskiweatherman. (2014). Three Day Nor'easter. Retrieved from http://surfskiweather.us/three-day-noreaster/.

The Great Hurricane of 1938. (2014). National Weather Service. Retrieved from weather.gov/box/1938hurricane

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

The wildlife urban interface. (2016). Silvis Lab – University of Wisconsin. Retrieved from http://silvis.forest.wisc.edu/maps/wui_main.

Tornado County. (2014). Natonal Oceanic and Atmospheric Administration – Storm Prediction Center. Retrieved from http://www.srh.noaa.gov/images/hgx/swa/2013_graphs/tornadoes_county.png

Thunderstorm Glossary (2012). American Meteorological Society. Retrieved from http://glossary.ame tsoc.org/wiki/Thunderstorm

Urban Hydrology for Small Watersheds Technical Release. (2017). US Department of Agriculture. Engineering Division of the Natural Resource Conservation Service.

Vermont: Population and Housing Unit Counts. (2010). U.S. Department of Commerce: Economics and Statistics Administration – 2010 Census of Population and Housing.

Vermont Flood Ready Atlas. (2016). Vermont Agency of Natural Resources: Department of Environmental Conservation. Retrieved from http://floodready.vermont.gov/assessment/vt_floodready_atlas.

Vermont Forest Resource Plan. (2010). Vermont Department of Forests, Parks and Recreation. Agency of Natural Resources. Retrievable from http://fpr.vermont.gov/sites/fpr/files/Forest_and_Forestry/Vermont_Forests/Library/VT%20Forest%20Resources%20Plan.pdf.

Vermont Earthquake Information. (2014). US Geological Survey: Earthquake Hazards Program. Retrieved from http://earthquake.usgs.gov/earthquakes/states/vermont/history.php.

Vermont National Historic Landmarks. (2014). Inventory and Status Report.

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

State of Vermont Emergency Operations Plan. (2013). State of Vermont: Drought Management (Annex 6).

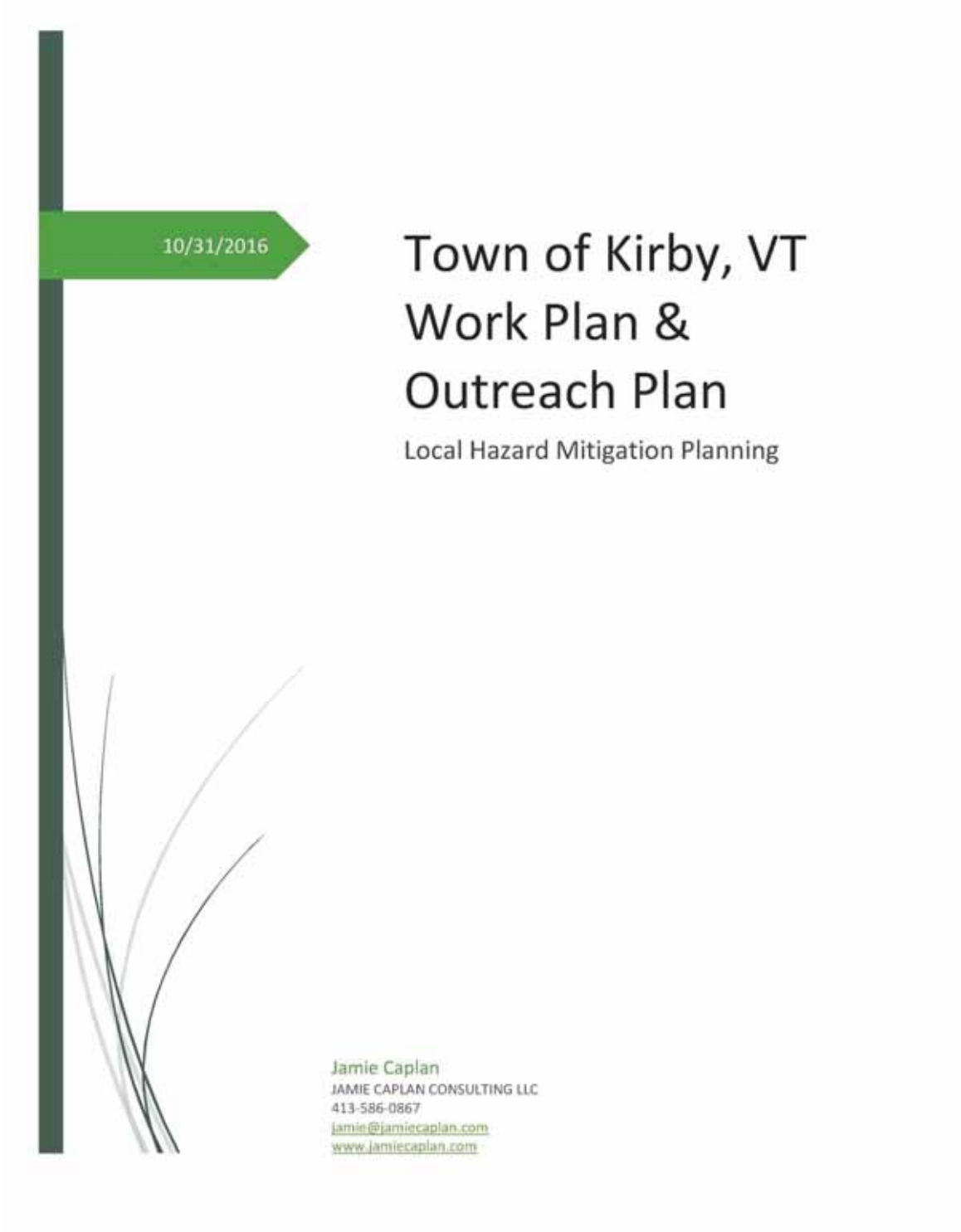
Walsh and Wuebbles. (2014). Changes in Hurricanes. National Climate Assessment – U.S. Global Change Research Program. Retrieved from http://nca2014.globalchange.gov/report/our-changingclimate/changes-hurricanes.

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

Weather Fatalities. (2014). National Weather Service. (2014). Retrieved from www.nws.noaa.gov/om/hazstats/resources/weather_fatalities.pdf.

APPENDIX A: PLANNING PROCESS SUPPORTING MATERIALS

WORK PLAN



WORK PLAN

Objective: Create a FEMA-approved Local Hazard Mitigation Plan for the Town of Kirby, Vermont.

1	**Assemble Planning Team**	**October 2016**
Roles	**Responsibilities**	
Consulting Team	• Develop agendas for all calls. • Lead meetings and calls. • Aid in identifying Planning Team and Committee participants.	
Town of Kirby	• Participate in the meeting. • Assist with identifying and contacting potential planning team members. • Post documents to the web.	
Deliverables		
• Assembled Planning Team with bi-monthly call schedule. • Identify Hazard Mitigation Committee members. • Invite email to committee members explaining project and their commitment.		

2	Develop Work Plan	October 2016
Roles	**Responsibilities**	
Consulting Team	• Develop Work Plan. • Lead meetings and calls. • Aid in identifying Planning Team and Committee participants.	
Town of Kirby	• Provide feedback on the Work Plan, Outreach Plan and Preparedness Survey. • Distribute the survey.	
Deliverables		
• Documented Work Plan agreed upon by Planning Team. • Documented public outreach strategy agreed upon by Planning Team. • Public Preparedness Survey developed.		

3	Review Hazard Information	November – December 2016
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.	
Town of Kirby	• Identify contacts with potential data. • Assist with data collection. • Share available GIS data. • Distribute the Survey.	
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	Review Hazard Data/Public Meeting #1	November – December 2016
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.	
Town of Kirby	• 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 and meeting materials. • Hazard Mitigation Committee Meeting and associated outreach and meeting materials.		

5	Complete Vulnerability Assessment November – December 2016
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. • Review land use policies. • Assist with team collaboration and map review. • Develop risk and vulnerability assessment for multiple hazards.
Town of Kirby	• Provide feedback on hazard ranking and provide information on land use and development trends. • Distribute the survey.
Deliverables	
• Completed risk assessment that meets all state and FEMA requirements.	

6	Identify Mitigation Strategies December 2016 – February 2017
Roles	**Responsibilities**
Consulting Team	• Develop a capability assessment that clearly indicates the Town's pre- and post-disaster capabilities. • Develop viable mitigation actions using risk assessment, capability assessment results, research and public participation.
Town of Kirby	• Provide additional mitigation actions and feedback on those identified by the consulting team. • Work with local agencies to determine if cost estimate is available. • Assist with mapping of mitigation actions. • Distribute the survey.
Deliverables	
• Mitigation actions identified and prioritized.	

7	Review Mitigation Strategies/Public Meeting #2 January – March 2017
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. • Collect a sign-in sheet at the meeting and take minutes.
Town of Kirby	• Assist with outreach and logistics for the public meeting. • Participate in the Hazard Mitigation Committee and public meeting. • Distribute the survey.
Deliverables	
• Public Meeting and associated outreach and meeting materials. • Hazard Mitigation Committee Meeting and associated outreach and meeting materials.	

8	Submit plan to DEMHS and Revise Accordingly April 2017
Roles	**Responsibilities**
Consulting Team	• Prepare plan for submission to DEMHS for compliance review. • Address public and planning team comments. • Address any state required revisions.
Town of Kirby	• Publicize draft for public review. • Submit the plan for State review.
Deliverables	
• Digital draft final version of plan provided for review.	

9	Submit Plan to FEMA, Revise if necessary and Adopt Plan May 2017
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.
Town of Kirby	• 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, two hard copies of the plan will be mailed to Kirby upon request. • Copies of all GIS shape files and databases developed in ESRI ARC Info format.	

PROJECT SCHEDULE

The nine steps below will overlap somewhat, as that is the nature of mitigation planning. The project will be complete in May 2017. 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	Oct 2016	Nov	Dec	Jan 2017	Feb	Mar	Apr	May
1	Assemble Planning Team and Kick-off Meeting	X	X						
2	Develop Work Plan	X	X						
3	Hazard Data Review		X	X					
4	Review Hazard Data/Public Meeting #1		X	X					
5	Complete Vulnerability Assessment		X	X					
6	Identify Mitigation Strategies			X	X	X			
7	Review Mitigation Strategies/Public Meeting #2				X	X	X		
8	Submit Plan to DEMHS and Revise Accordingly							X	
9	Submit Plan to FEMA, Revise if necessary and Adopt Plan								X
Meetings									
Kick-off Meeting, Assemble Planning Team		X							
Planning Team Calls – twice a month as necessary		X	X	X	X	X	X	X	X
Planning Team In-Person Meetings				X			X		
Stakeholder Meetings, Tour Kirby		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 Kirby.
- 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 Kirby. 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 November or early December 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 March and focus on the mitigation strategy and specific mitigation actions. The Consulting Team will prepare PowerPoint presentations for each meeting. The Town of Kirby will handle all logistics and outreach for the meetings.

PUBLIC PREPAREDNESS SURVEY

A Public Preparedness Survey will be drafted to provide an opportunity for individuals in the Town of Kirby to participate in the mitigation planning process. The information provided may 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 the Town of Kirby 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. The Town of Kirby will send the press releases to all relevant media sources.

Website

The Town of Kirby 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 Town of Kirby webpage.

PUBLIC MEETING SUPPORT MATERIALS

Mud Hollow Road, Kirby, VT

-Photo by Barbara Burrington, 2011

NOVEMBER 29, 2016

DISASTER PLANNING MEETING

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

Town Hall
346 Town Hall Road,
Lyndonville, VT

11/29/16
6:30 pm -7:30 pm

Fires, Floods and Winter Storms

Share Your Ideas for Reducing Risk

Preparing a Hazard Mitigation Plan For FEMA Approval

MORE INFORMATION CONTACT

Rebecca Hill-Larsen

Selectboard, Town of Kirby

802-626-9386

beccanterry@gmail.com

Town of Kirby, Vermont

MEDIA RELEASE

For Immediate Release **Contact: Rebecca Hill-Larsen**
November 17, 2016 Phone: 802-626-9386

Public Meeting – Disaster Planning

The Town of Kirby 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 November 29, 2016 from 6:30 pm – 7:30 pm to share your ideas for reducing risk and becoming less vulnerable to natural hazards such as floods, hurricanes and winter storms. At the meeting you will learn about the process of developing the Kirby Mitigation Plan and have the opportunity to contribute your ideas for making Kirby more resilient to natural hazards. The meeting will be held at the Town Hall, 346 Town Hall Road, Lyndonville, Vermont.

The purpose of the Hazard Mitigation Plan 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 Kirby 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 Kirby eligible for federal and state mitigation grant funding pre-disaster.

The Town of Kirby was awarded a grant from DEMHS to develop the Hazard Mitigation Plan. The Town of Kirby hired Jamie Caplan Consulting LLC to work with them to develop the Hazard Mitigation Plan. Jamie Caplan Consulting is based in Northampton, MA. They provide comprehensive emergency management services for all phases of disaster management with an emphasis on mitigation planning.

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 Rebecca Hill-Larsen, Selectboard Clerk, Town of Kirby at 802-626-9386 or beccanterry@gmail.com.

MEETING SIGN-IN SHEET

Project:	Kirby Hazard Mitigation Plan	**Meeting Date:**	November 29, 2016
Facilitator:	Rebecca Hill-Larsen, Jamie Caplan	**Place/Room:**	Kirby Town Offices

Committee Mtg

Name	Relationship to Town	Phone	E-Mail
Bruce Melendy	Emergency Mgt. NVDA	802-434-1420	bmelendy@nvda.net
Rebecca Hill-Larsen	Selectboard	802-626 6847	beccanterry@gmail.com
Karen Moore	Planning Commission	748-8498	moore.karen65@gmail.com
John + Anne McClaughry	residents	695 2555	annem@kingcm.com
Edward Rolliois	1st Constable	695-4419	[illegible]
Mary Etter	planning commission	695-8834	mary.etter@lsc.vsc.edu
M Reeve	planning commission	745.7757	reevedog@gmail.com

Public Mtg

Name	Relationship to Town	Phone	E-Mail
Marla Waring	Ass. Town Clerk	626-9228	marla1waring@gmail.com
Tom DeCarlo	Resident	802-274-6074	tom15875@gmail.com

Page 1 of 2

Name	Relationship to Town	Phone	E-Mail
Jim Dam	Resident	626-0426	jamesldam@yahoo.com
Wanda Grant	Town Clerk	626-3646(home) 626-9356(office)	Wandainvt@gmail.com townclerk.kirbyvermont@gmail.com
John Rood	Rood	229 8496	
DAVE Chase	selectboard	695-1137	
STEVE BAKER	SELECTBOARD	748-9417	

The Record • Tuesday, November 22, 2016

Caledonian-Record

FOR THE RECORD

Dining Do's And Don'ts – Respecting Your Dog's Eating Space

BY PAT JALICH

One of the more common causes of dog bites occurs when Fido feels that his food supply is threatened. If you adopt a dog as a puppy you can condition his behavior and teach him that his food will not be taken away and he does not need to protect it. However, if you adopt an older dog you need to determine his level of comfort with any perceived efforts to remove his food before he has finished it. Each dog has an individual personality and you must be mindful that no two dogs will respond identically. Some dogs are perfectly comfortable with the owner who takes major responsibility for keeping the food dish filled. Others distrust not only the food distributor but also any other human who approaches during mealtime. It is important to keep young children at a distance when you feed your pet. Children's shorter stature makes

ones we can be grateful for companionship, good health, and a safe environment. When necessary, there are care givers to look after us and tend to our needs. Good food is available to us, medical care is nearby, and shelter keeps a roof over our heads and protects us from cold wintry weather and summer's heat. These are basic things that sustain us and make our lives livable.

Now consider Thanksgiving from a companion animal's standpoint. Having an owner/forever home provides the love and nurturing needed to maintain good emotional health. A responsible owner sees to it that veterinary care is provided to the animal or animals in his or her care and assures that exercise is a part of everyday living. Spaying or neutering pets will prevent unwanted litters and aid the animal in living a long healthy life. Appropriate accommodations to insulate against winter's cold and summer's heat

NEWS BRIEFS

Town Of Kirby Disaster Planning Meeting

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

Join the Hazard Mitigation Committee on Nov. 29, from 6:30 to 7:30 p.m. to share your ideas for reducing risk and becoming less vulnerable to natural hazards such as floods, hurricanes and winter storms. At the meeting you will learn about the process of developing the Kirby Mitigation Plan and have the opportunity to contribute your ideas for making Kirby more resilient to natural hazards. The meeting will be held at the Town Hall, 346 Town Hall Road, Lyndonville, Vermont.

The purpose of the Hazard Mitigation Plan 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 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 Kirby eligible for federal and state mitigation grant funding pre-disaster.

Kirby was awarded a grant from DEMHS to develop the Hazard Mitigation Plan. The town hired Jamie Caplan Consulting LLC to work with them to develop the Hazard Mitigation Plan. Jamie Caplan Consulting is based in Northampton, Mass. They provide comprehensive emergency management services for all phases of disaster management with an emphasis on mitigation planning.

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 Rebecca Hill-Larsen, Selectboard Clerk, Town of Kirby at 802-626-9366 or beccanterry@gmail.com.

http://www.caledonianrecord.com/news/local/kirby-working-on-hazard-mitigation-plan/article_fd056438-bc0d-592c-850c-ef3858764cff.html

Kirby Working on Hazard Mitigation Plan

Amy Ash Nixon Dec 2, 2016

KIRBY — A disaster planning committee was held at the town hall on Tuesday evening as a first step toward the town having a hazard mitigation plan.

Select board member Rebecca Hill-Larsen said the meeting on Tuesday was to inform residents of the planning process and organize the town's plan around mitigating potential natural disasters in the future.

The town has hired a consultant, Jamie Caplan, using a grant the select board received.

Caplan, who runs Caplan Consulting, addressed the town's Hazard Mitigation Committee, on which members of the select board, zoning board, listers and other town leaders are serving, said Hill-Larsen.

After Caplan's presentation to officials, she held an public forum, to explain the need to plan for potential natural disasters and what the community can do.

"Both times (the consultant) had maps of Kirby for people to circle areas they felt could be hazards, like streams that overflow, roads that get real muddy or culverts that are too small," Hill-Larsen said of Tuesday's meeting. "She was looking for input from people who live in Kirby about what is important to Kirby."

Hill-Larsen said of the session, "It became very clear that our roads are our most important asset. We would need them to leave or for help to arrive in case of an event."

"Residents had questions about cell towers, electricity, helping neighbors who might need aid and how to inform people of the resources before an event occurs," she added.

Hill Larsen said of the process, "The town of Kirby is working on their hazard mitigation plan. We received a grant to hire a consultant to help us plan for hazard mitigation - think Mud Hollow."

Mud Hollow suffered a great deal of flooding damage following spring washouts in 2011 and 2014, and the town replaced the culvert with a new bridge.

The town is conducting a survey of residents, given out on Election Day, and so far has received back 27 completed surveys. Surveys are still available at the town clerk's office and can be turned into the town during the next few months, Caplan said on Wednesday.

According to Caplan, "Kirby was awarded a grant from the Vermont Division of Emergency Management and Homeland Security (DEMHS)."

"The Federal Emergency Management Agency (FEMA) requires that local governments have FEMA approved Hazard Mitigation Plans to be eligible for pre-disaster grant funding," said Caplan on Wednesday. "The process of developing a hazard mitigation plan is as valuable to a community as the plan itself because the process brings together a diverse group of stakeholders to conduct a risk assessment and develop a list of mitigation actions, or projects, the community can implement to become less vulnerable to hazards such as floods, winter storms and high winds."

Caplan said, "Residents and those interested in the planning process can participate by completing the Natural Hazards Preparedness Survey."

Residents are also encouraged to attend future planning meetings which will be announced in the Caledonian-Record as well as on the Kirby town website and on flyers and signs at town entrances.

Caplan said, "We anticipate holding the next meeting in January or February 2017. When the planning is near completion, an opportunity will be available for residents to review and comment on the draft plan, this is expected in April or May 2017."

http://www.caledonianrecord.com/news/local/help-kirby-plan-for-weather-related-disaster/article_3e49b00f-98aa-5f2b-b356-75a39024ce3f.html

Help Kirby plan for weather-related disaster

Feb 8, 2017

The town of Kirby is currently engaged in the development of a Hazard Mitigation Plan and public participation is needed. Participate by attending the second disaster planning meeting and by completing the Kirby Public Preparedness Survey.

The meeting is Feb. 15, from 6:30 to 7:30 p.m. at the Town Hall, 346 Town Hall Road, Lyndonville, Vermont. Join the Hazard Mitigation Committee and share your ideas for reducing risk and becoming less vulnerable to natural hazards such as floods, hurricanes and winter storms. The survey is available in the Town Hall and online at https://www.surveymonkey.com/r/KirbyVT.

The purpose of the Hazard Mitigation Plan 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 Kirby 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 Kirby eligible for federal and state mitigation grant funding pre-disaster.

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 Rebecca Hill-Larsen, Selectboard Clerk, Town of Kirby at 802-626-9386 or beccanterry@gmail.com.

MARCH 27, 2017

2ND PUBLIC DISASTER PLANNING MEETING

Participation is needed! Come learn about hazard mitigation. Kirby is working to identify ways to mitigate the impacts of natural hazards such as floods and severe winter weather. Share your ideas for reducing risk!

Town Hall
346 Town Hall Road, Lyndonville, VT

3/27/17
6:30 pm -7:30 pm

Fires, Floods and Winter Storms

Share Your Ideas for Reducing Risk

Preparing a Hazard Mitigation Plan for FEMA Approval

MORE INFORMATION CONTACT

Rebecca Hill-Larsen

Selectboard, Town of Kirby

802-626-9386

beccanterry@gmail.com

Town of Kirby, Vermont

MEDIA RELEASE

For Immediate Release
March 9, 2017

Contact: Rebecca Hill-Larsen
Phone: 802-626-9386

2nd Public Disaster Planning Meeting and Public Preparedness Survey

The Town of Kirby is currently engaged in the development of a Hazard Mitigation Plan and public participation is essential! Participate by attending the 2nd Public Disaster Planning Meeting and by completing the Kirby Public Preparedness Survey.

The meeting will be held on March 27, 2017 from 6:30 pm – 7:30 pm at the Town Hall, 346 Town Hall Road, Lyndonville, Vermont. Join the Hazard Mitigation Committee and share your ideas for reducing risk and becoming less vulnerable to natural hazards such as floods, hurricanes and winter storms. The survey is available in the Town Hall and online at https://www.surveymonkey.com/r/KirbyVT.

At the meeting, you will learn about the work done to date toward developing the Kirby Mitigation Plan. This includes a natural hazard risk assessment and identification of actions Kirby can take to reduce hazard risk. You will have the opportunity to contribute your ideas for making Kirby more resilient to natural hazards.

The purpose of the Hazard Mitigation Plan 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 Kirby 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 Kirby eligible for federal and state mitigation grant funding pre-disaster.

The Town of Kirby was awarded a grant from DEMHS to develop the Hazard Mitigation Plan. The Town of Kirby hired Jamie Caplan Consulting LLC to work with them to develop the Hazard Mitigation Plan. Jamie Caplan Consulting is based in Northampton, MA.

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 Rebecca Hill-Larsen, Selectboard Clerk, Town of Kirby at 802-626-9386 or beccanterry@gmail.com.

MEETING SIGN-IN SHEET

Project:	Kirby Hazard Mitigation Plan	**Meeting Date:**	March 27, 2017
Facilitator:	Rebecca Hill-Larsen, Jamie Caplan	**Place/Room:**	Kirby Town Offices

	Name	Relationship to Town	Phone	E-Mail
Committee	Karen Moore	Planning Commission	748-8448	moore.karen65@gmail.com
	Wanda Grant	Town Clerk/Treasurer	626-9386	townclerk.kirbyvermont@gmail.com
	Edward DeMola	PLANNING COMMISSION 1ST. CONSTABLE	695 4619	
	Rebecca Hill-Larsen	select board	626-6847	beccanterrye.gmail.com
	Anne McClaughry	JP	695-2555	annem@KINGCON.COM
Public	Marla Waring	Asst. Town Clerk	626-3538	marlaL Waring@Gmail.com
	Erik Waring	Resident	626-3538	

JUNE 6 – 20, 2017

REVIEW KIRBY'S HAZARD MITIGATION PLAN

Kirby's Hazard Mitigation Committee invites members of the public to review Kirby's Hazard Mitigation Plan. The plan was created to reduce the negative impacts and costs from damages associated with natural hazards, such as flooding, winter storms and hurricanes. Approved by FEMA, the plan allows the Town to apply for mitigation grant funding.

Hazard Mitigation Plan Available for Public Review

June 6-20, 2017

View the plan online at kirbyvermont.org or in hard copy at Town Hall

Leave comments by phone or email to Rebecca Hill-Larsen
802-626-9386
beccanterry@gmail.com

MORE INFORMATION CONTACT

Rebecca Hill-Larsen

Selectboard, Town of Kirby

802-626-9386

beccanterry@gmail.com

PUBLIC PREPAREDNESS SURVEY – BLANK SURVEY

Town of Kirby, VT — Natural Hazards Preparedness Survey

The Town of Kirby 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 Rebecca Hill-Larsen, Selectboard Clerk at 402-218-9819 or beccanterry@gmail.com.

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

- ○ Yes
- ○ No

2. 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

3. 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			

1

Town of Kirby, VT Natural Hazards Preparedness Survey

I have experienced	Hazard	I am Very concerned	I am Neutral	I am Not concerned
	Ice Jams			
	Invasive Species			
	Landslides/Rockslides			
	Severe Thunderstorm			
	Severe Winter Storm			
	Tornadoes			
	Wildfires			

4. Where do you live?

- ○ Town of Kirby
- ○ Other

5. Do you have flood insurance?

- ○ Yes
- ○ No
- ○ I don't know
- ○ I never considered it

6. 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

7. Do you live in a floodplain?

- ○ Yes
- ○ No
- ○ I'm not sure

8. 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)

2

Town of Kirby, VT Natural Hazards Preparedness Survey

	Very Important	Neutral	Not Important
9. How important are each of the following community assets to you?			
Town Hall			
Town Garage			
Town Roads			
South Kirby Schoolhouse			
	Very Important	Neutral	Not Important
10. 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			
Promoting cooperation among public and private agencies			
	Have done	Plan to	Not done
11. What have you done to prepare for a disaster?			
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			
Discussed utility shutoff procedure in the event of a disaster			
Have a generator for temporary power			

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

- ○ Yes – Please contact me, my contact information is below.
- ○ No thank you.

Name Email Phone #

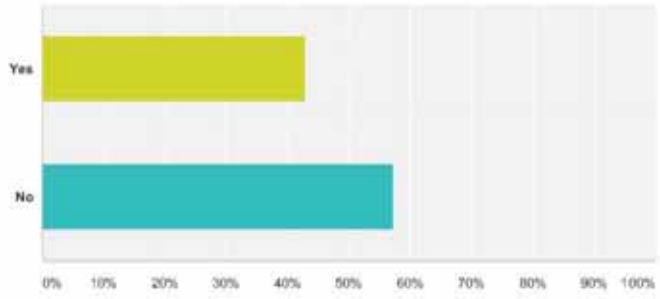
3

PUBLIC PREPAREDNESS SURVEY – SURVEY RESULTS

Kirby, VT Natural Hazards Preparedness Survey

Q1 Have you ever been impacted physically, financially or emotionally by a natural disaster in Kirby?

Answered: 35 Skipped: 1



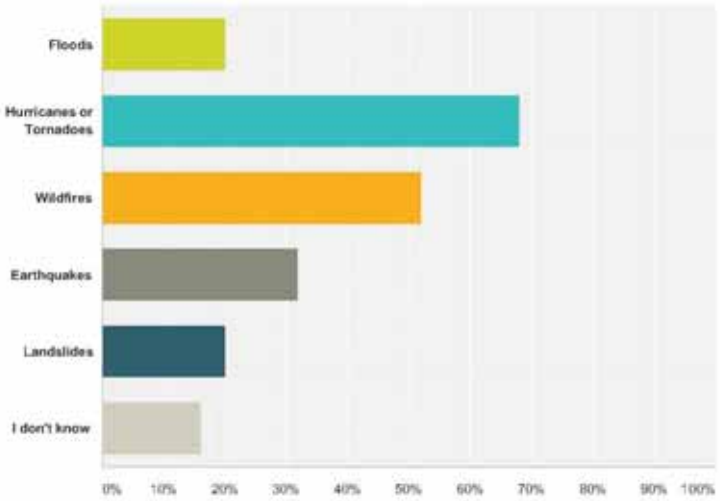
Answer Choices	Responses	
Yes	42.86%	15
No	57.14%	20
Total		35

1 / 13

Kirby, VT Natural Hazards Preparedness Survey

Q2 Is your home at risk to any of the following hazards? Check all that apply.

Answered: 25 Skipped: 11

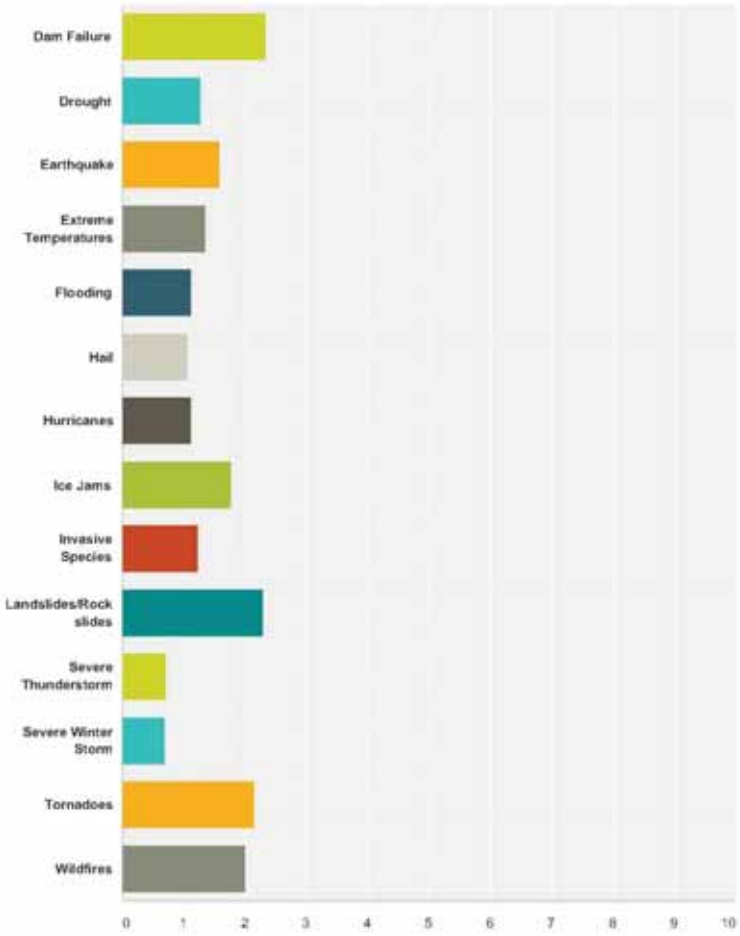


Answer Choices	Responses	
Floods	20.00%	5
Hurricanes or Tornadoes	68.00%	17
Wildfires	52.00%	13
Earthquakes	32.00%	8
Landslides	20.00%	5
I don't know	16.00%	4
Total Respondents: 25		

Kirby, VT Natural Hazards Preparedness Survey

Q3 Which of these disasters have you experienced? How concerned are you about each of them?

Answered: 30 Skipped: 6



	I have experienced	I am VERY concerned	I am neutral	I am Not concerned	Total	Weighted Average
Dam Failure	22.22% 2	0.00% 0	0.00% 0	77.78% 7	9	2.33
Drought	53.33% 8	6.67% 1	0.00% 0	40.00% 6	15	1.27

3 / 13

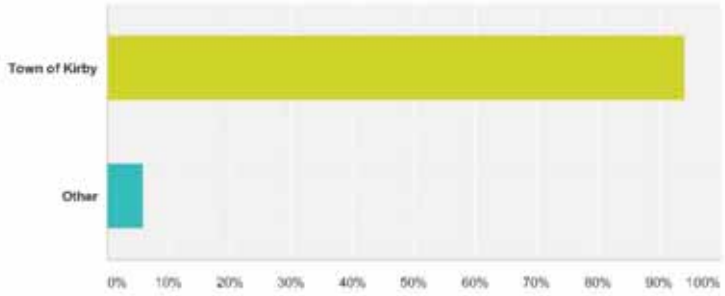
Kirby, VT Natural Hazards Preparedness Survey

Earthquake	**41.67%** 5	**8.33%** 1	**0.00%** 0	**50.00%** 6	12	1.58
Extreme Temperatures	**50.00%** 7	**7.14%** 1	**0.00%** 0	**42.86%** 6	14	1.36
Flooding	**53.33%** 8	**13.33%** 2	**0.00%** 0	**33.33%** 5	15	1.13
Hail	**58.82%** 10	**5.88%** 1	**5.88%** 1	**29.41%** 5	17	1.06
Hurricanes	**53.33%** 8	**13.33%** 2	**0.00%** 0	**33.33%** 5	15	1.13
Ice Jams	**33.33%** 3	**11.11%** 1	**0.00%** 0	**55.56%** 5	9	1.78
Invasive Species	**53.85%** 7	**7.69%** 1	**0.00%** 0	**38.46%** 5	13	1.23
Landslides/Rockslides	**14.29%** 1	**14.29%** 1	**0.00%** 0	**71.43%** 5	7	2.29
Severe Thunderstorm	**73.91%** 17	**4.35%** 1	**0.00%** 0	**21.74%** 5	23	0.70
Severe Winter Storm	**76.00%** 19	**0.00%** 0	**4.00%** 1	**20.00%** 5	25	0.68
Tornadoes	**28.57%** 2	**0.00%** 0	**0.00%** 0	**71.43%** 5	7	2.14
Wildfires	**25.00%** 2	**12.50%** 1	**0.00%** 0	**62.50%** 5	8	2.00

Kirby, VT Natural Hazards Preparedness Survey

Q4 Where do you live?

Answered: 34 Skipped: 2

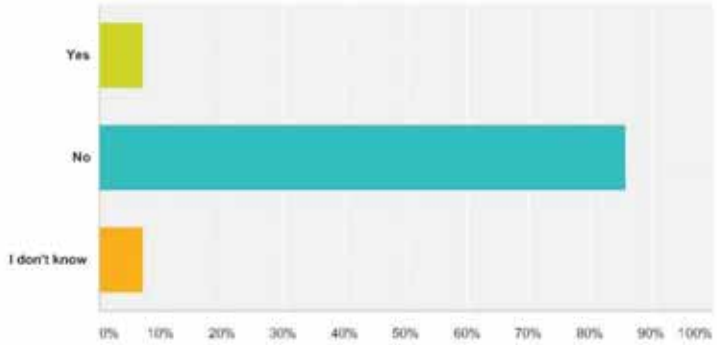


Answer Choices	Responses	
Town of Kirby	94.12%	32
Other	5.88%	2
Total		34

Kirby, VT Natural Hazards Preparedness Survey

Q5 Do you have flood insurance?

Answered: 28 Skipped: 8

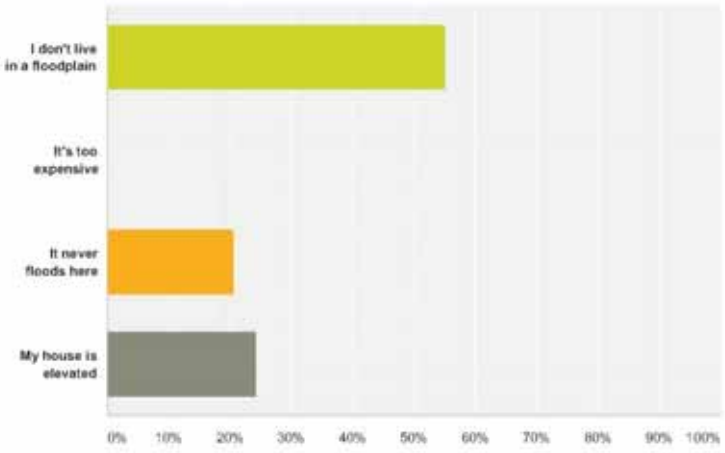


Answer Choices	Responses	
Yes	7.14%	2
No	85.71%	24
I don't know	7.14%	2
Total		28

Kirby, VT Natural Hazards Preparedness Survey

Q6 If you do NOT have flood insurance, why not?

Answered: 29 Skipped: 7

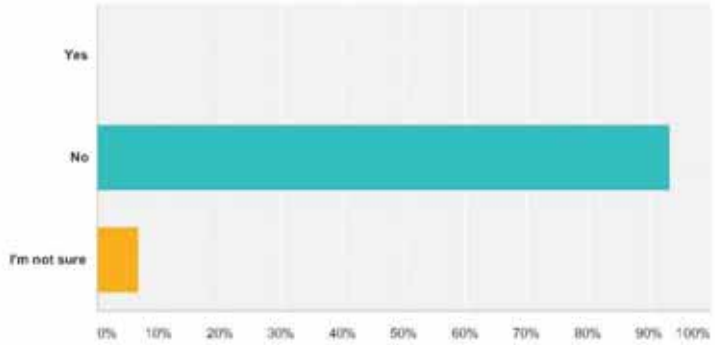


Answer Choices	Responses	
I don't live in a floodplain	55.17%	16
It's too expensive	0.00%	0
It never floods here	20.69%	6
My house is elevated	24.14%	7
Total		29

Kirby, VT Natural Hazards Preparedness Survey

Q7 Do you live in a floodplain?

Answered: 30 Skipped: 0

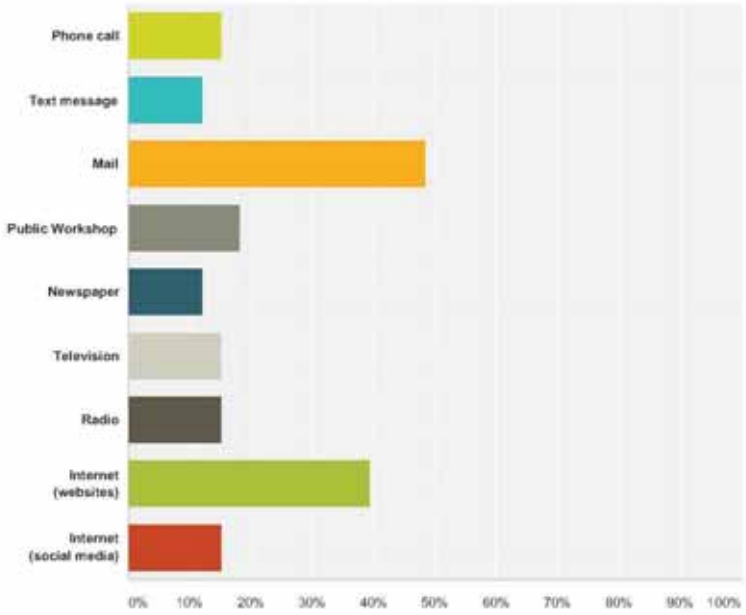


Answer Choices	Responses	
Yes	0.00%	0
No	93.33%	28
I'm not sure	6.67%	2
Total		30

Kirby, VT Natural Hazards Preparedness Survey

Q8 What is the most effective way for you to receive information about how to make your home and town more resilient to natural hazards? Check all that apply.

Answered: 33 Skipped: 3

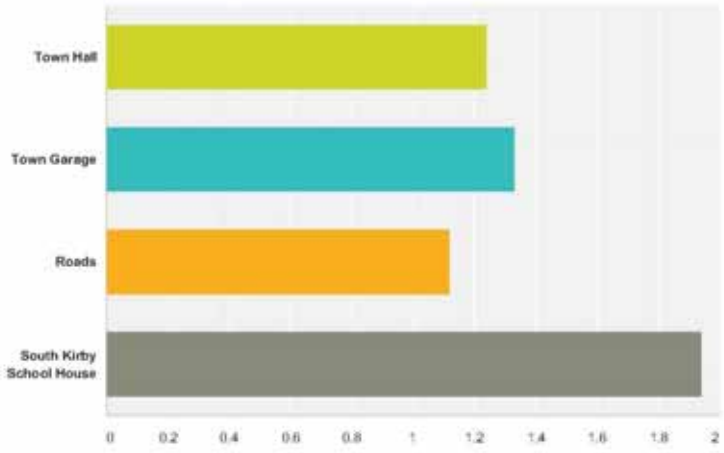


Answer Choices	Responses	
Phone call	15.15%	5
Text message	12.12%	4
Mail	48.48%	16
Public Workshop	18.18%	6
Newspaper	12.12%	4
Television	15.15%	5
Radio	15.15%	5
Internet (websites)	39.39%	13
Internet (social media)	15.15%	5
Total Respondents: 33		

Kirby, VT Natural Hazards Preparedness Survey

Q9 How important are each of the following community assets to you?

Answered: 33 Skipped: 3



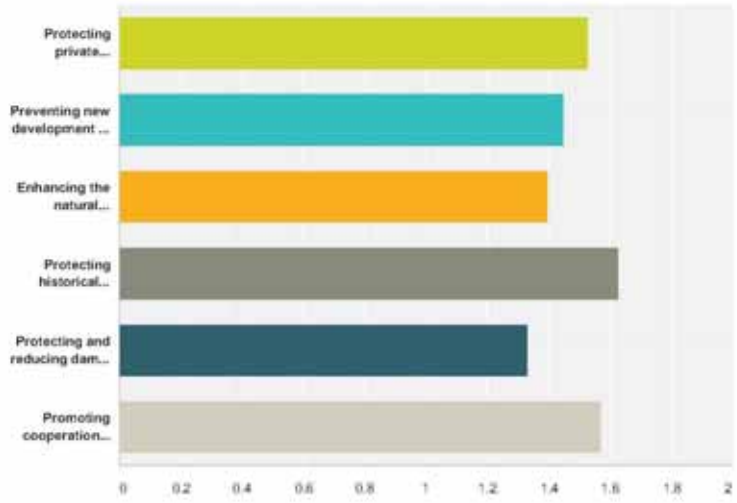
	Very Important	Neutral	Not Important	Total	Weighted Average
Town Hall	81.82% 27	12.12% 4	6.06% 2	33	1.24
Town Garage	72.73% 24	21.21% 7	6.06% 2	33	1.33
Roads	90.91% 30	6.06% 2	3.03% 1	33	1.12
South Kirby School House	25.81% 8	54.84% 17	19.35% 6	31	1.94

10 / 13

Kirby, VT Natural Hazards Preparedness Survey

Q10 Let us know your priorities regarding planning for natural hazards in your community.

Answered: 31 Skipped: 5

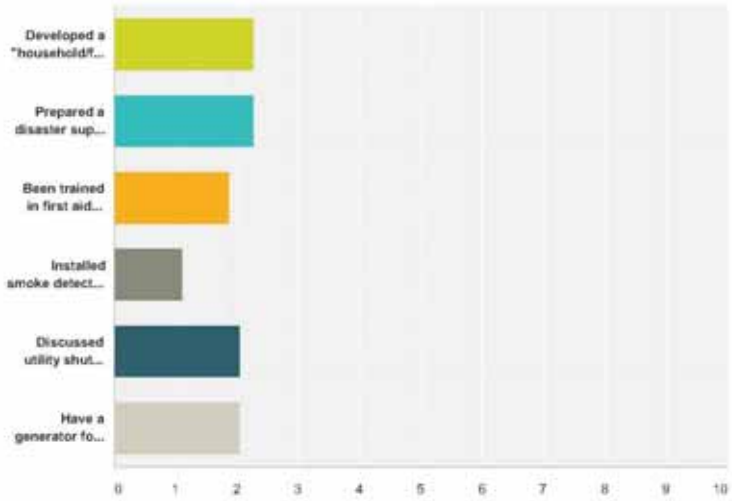


	Very Important	Neutral	Not Important	Total	Weighted Average
Protecting private property	60.00% 18	26.67% 8	13.33% 4	30	1.53
Preventing new development in high hazard areas	68.97% 20	17.24% 5	13.79% 4	29	1.45
Enhancing the natural environment	70.00% 21	20.00% 6	10.00% 3	30	1.40
Protecting historical properties	53.33% 16	30.00% 9	16.67% 5	30	1.63
Protecting and reducing damage to utilities	76.67% 23	13.33% 4	10.00% 3	30	1.33
Promoting cooperation among public and private agencies	60.00% 18	23.33% 7	16.67% 5	30	1.57

Kirby, VT Natural Hazards Preparedness Survey

Q11 What have you done to prepare for a disaster?

Answered: 32 Skipped: 4

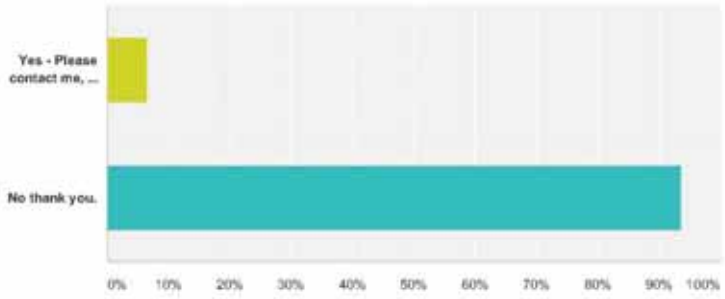


	Have done	Plan to	Not done	Total	Weighted Average
Developed a "household/family emergency plan?	19.23% 5	34.62% 9	46.15% 12	26	2.27
Prepared a disaster supply kit	23.08% 6	26.92% 7	50.00% 13	26	2.27
Been trained in first aid and CPR in the last year	50.00% 13	11.54% 3	38.46% 10	26	1.88
Installed smoke detectors and carbon monoxide detectors	93.55% 29	3.23% 1	3.23% 1	31	1.10
Discussed utility shutoff procedure in the event of a disaster	37.04% 10	22.22% 6	40.74% 11	27	2.04
Have a generator for temporary power	42.86% 12	10.71% 3	46.43% 13	28	2.04

Kirby, VT Natural Hazards Preparedness Survey

Q12 Would you like information regarding flood insurance or flood mitigation?

Answered: 31 Skipped: 5



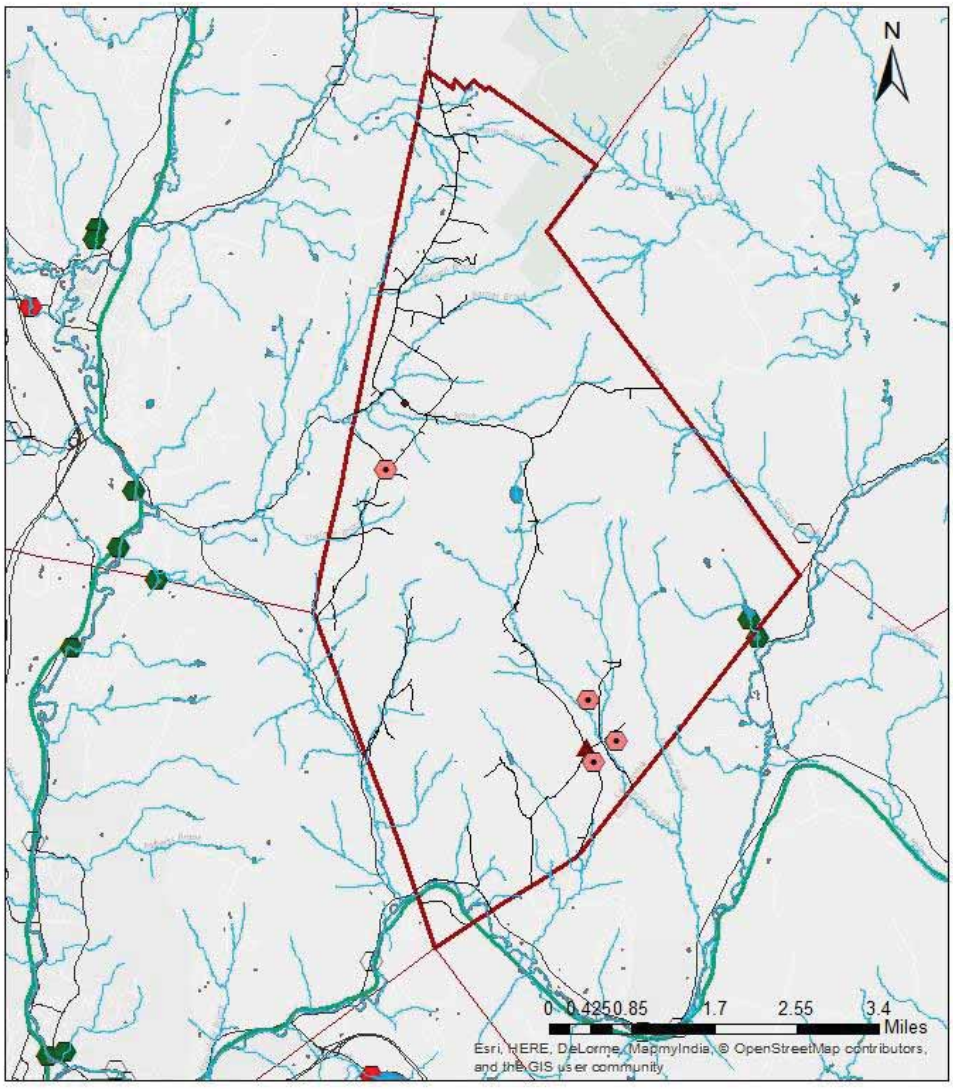
Answer Choices	Responses	
Yes - Please contact me, my information is below.	6.45%	2
No thank you.	93.55%	29
Total		31

13 / 13

APPENDIX B: RISK ASSESSMENT SUPPORT MATERIALS

DAMS NEAR KIRBY

Dams in the vicinity of the Town of Kirby, VT



Legend

- Local Road (VT Census)
- Stream
- Rail Road Line
- Pond
- Town Boundary

Critical Facilities

- Dairy Farm
- Town Hall / Garage
- South Kirby Schoolhouse (Gathering Place)

Dams

- High Hazard Potential
- Significant Hazard Potential
- Low Hazard Potential
- Hazard Potential Unknown

Source: Vermont Center for Geographical Information

Storm Events in Caledonia County

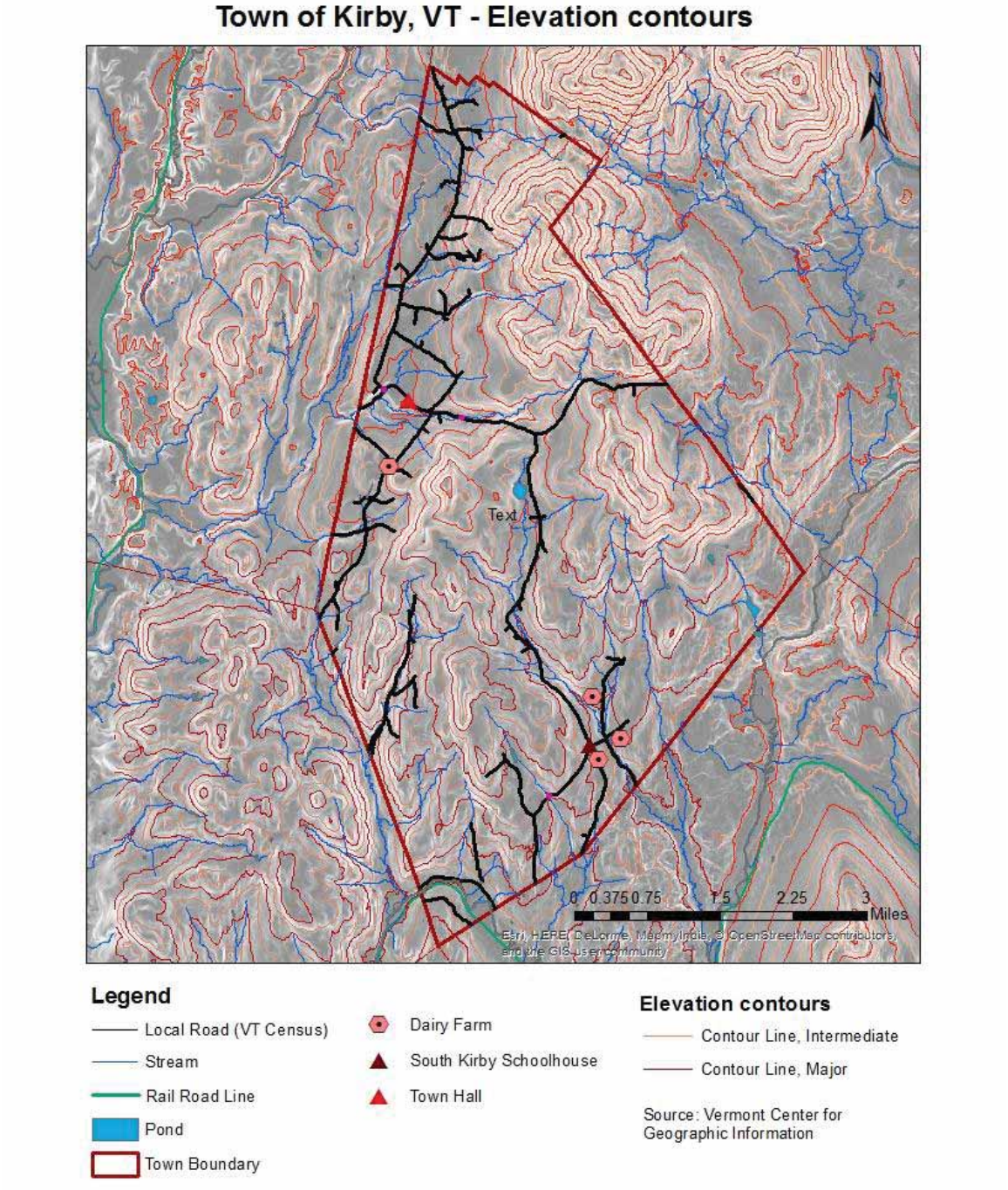
Storm Events in Caledonia County (1950-2016)[207]

Begin Location	End Location	Begin Date	Event Type	Property Damage	Flooding Cause
St. Johnsbury	Lyndonville	02/25/2016	Flood	$40,000	Ice Jam
Hardwick	Hardwick	02/25/2016	Flood	$75,000	Ice Jam
South Peacham	Wheelock	4/15/2014	Flood	$350,000	Heavy Rain / Snow Melt
Lyndonville	Brown Arpt	1/12/2014	Flood	$2,000	Ice Jam
East Hardwick	East Hardwick	1/11/2014	Flood	$1,000	Ice Jam
Lyndonville Arpt	Lyndon	12/22/2013	Flash Flood	$15,000	Ice Jam
East Burke	East Ryegate	8/28/2011	Flood	$4,000,000	Heavy Rain
Danville	East Peacham	5/30/2011	Flash Flood	$75,000	Heavy Rain
Ricker Mills	East Ryegate	5/26/2011	Flash Flood	$2,500,000	Heavy Rain
Sheffield	Passumpsic	4/27/2011	Flood	$750,000	Heavy Rain / Snow Melt
Egypt	East Lyndon	4/11/2011	Flood	$5,000	Heavy Rain / Snow Melt
St Johnsbury	St Johnsbury	3/13/2011	Flood	$10,000	Ice Jam
South Wheelock	St Johnsbury Ctr.	3/6/2011	Flood	$0	Ice Jam
Lyndon Center	Lyndon	10/1/2010	Flood	$100,000	Heavy Rain
Lyndon Center	Lyndonville	3/23/2010	Flood	$2,000	Heavy Rain / Snow Melt
Barnet Center	St Johnsbury	8/6/2008	Flash Flood	$50,000	Heavy Rain
Lyndon Center	Lyndon Center	7/24/2008	Flood	$10,000	Heavy Rain
Lyndon Center	Lyndonville	4/29/2008	Flood	$25,000	Heavy Rain / Snow Melt
East Burke	East Burke	3/8/2008	Flash Flood	$200,000	Ice Jam
Hardwick	Hardwick	7/11/2007	Flash Flood	$250,000	Heavy Rain
Stannard	Stannard	5/16/2007	Flood	$20,000	Heavy Rain
Countywide	Countywide	1/18/2006	Flood	$25,000	
Countywide	Countywide	4/3/2005	Flood	$5,000	
Countywide	Countywide	10/27/2003	Flood	$5,000	
Countywide	Countywide	3/29/2003	Flood	$0	
Countywide	Countywide	6/12/2002	Flood	$50,000	Heavy Rain
Countywide	Countywide	4/13/2002	Flood	$20,000	
Countywide	Countywide	4/24/2001	Flood	$1,000	
Countywide	Countywide	12/18/2000	Flood	$5,000	
Countywide	Countywide	12/17/2000	Flash Flood	$100,000	
Lyndonville	Lyndonville	5/11/2000	Flash Flood	$5,000	
South Portion	South Portion	4/4/2000	Flash Flood	$1,000	
South Portion	South Portion	8/11/1998	Flash Flood	$1,000,000	
Ricker Mills	Ricker Mills	6/29/1998	Flash Flood	$5,000	

[207] NCDC. NOAA Storm Events Database. Retrievable from https://www.ncdc.noaa.gov/stormevents/

Begin Location	End Location	Begin Date	Event Type	Property Damage	Flooding Cause
Countywide	Countywide	4/1/1998	Flash Flood	$5,000	
Countywide	Countywide	3/31/1998	Flash Flood	$10,000	
Countywide	Countywide	1/8/1998	Flash Flood	$5,000	
Countywide	Countywide	7/15/1997	Flash Flood	$500,000	
Countywide	Countywide	7/3/1996	Flood	$15,000	
Countywide	Countywide	4/27/1996	Flood	$5,000	
Countywide	Countywide	1/19/1996	Flood	$25,000	

Kirby Elevation Contours



APPENDIX C: CAPABILITY ASSESSMENT SUPPORT MATERIALS

State Reports

EXPANDED COMMUNITY REPORT

Expanded Community Report for Kirby

9/28/2016
3:25:04 PM

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	04/01/2013		Kirby	Yes
2. Local Emergency Operations Plan	05/02/2016		Kirby	Yes
3. National Flood Insurance Program	02/13/2013		Kirby	Yes
4. Local Hazard Mitigation Plan			Kirby	No
5. River Corridor Protection		Interim		Yes
ERAF Rate for Actions 1 - 4:12.5%,	Actions 1 - 5: 17.5%	**ERAF Rate for:**	**Kirby**	**7.5%**

?	Buildings in the Special Flood Hazard Area (SFHA) (estimated from e911 sites).
1	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.
02/13/2013	National Flood Insurance Program (NFIP) (Enrollment Date)
FIRM	Flood Insurance Rate Map Standard (Digital FIRM (DFIRM), Rough Digital, Paper)
Kirby	NFIP Status: Emergency Program
	Community Rating System (CRS)
Yes	Local Emergency Operations Plan (LEOP) ERAF Status valid for Kirby?
05/02/2016	LEOP - annual update after Town Meeting and before May 1.
No	Local Hazard Mitigation Plan (LHMP) ERAF Status valid for Kirby?
	LHMP - Valid for 5 years from FEMA final approval date
	LHMP - Status of review (Plans currently in review are valid for ERAF).
Yes	River Corridor Protection in Kirby?
Interim	River Corridor Interim Protection Status for ERAF valid for Kirby?
11/06/2012	Municipal Plan - Valid for 5 years from adoption date
11/06/2012	Zoning Adoption / Amendment Date
11/06/2012	Hazard Area Regulation Adoption / Amendment Date
Yes	2013 Road and Bridge Standards
31.420	Town Highway Mileage in Kirby
04/01/2013	Kirby Road and Bridge Standards and Adoption Date
3/21/2016	Kirby Certificate of Compliance with Road and Bridge Standards and Date
3/21/2016 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 7	Project Manager email for VTrans Maintenance District 7

Note: if you have updated information - please let us know:

1. Road Standards and Certificates - contact your VTrans District Project Manager: District 7
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

9/28/2016 Summary of Flood Hazard Mitigation Actions for:

County =
Region =
Community = Kirby
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
Kirby	7.5%	Yes	Yes	Yes	No	Yes	?	?	?	?

(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

9/28/2016 Summary of Flood Hazard Mitigations Actions for: County =
Region =
Community= Kirby
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
Kirby	7.5%	Yes	Yes	Yes	No	Yes	Interim	02/13/2013	04/01/2013	05/02/2016		

ERAF Criteria For State Post-Disaster Funding

12.5% Mitigation Actions 1 through 4;

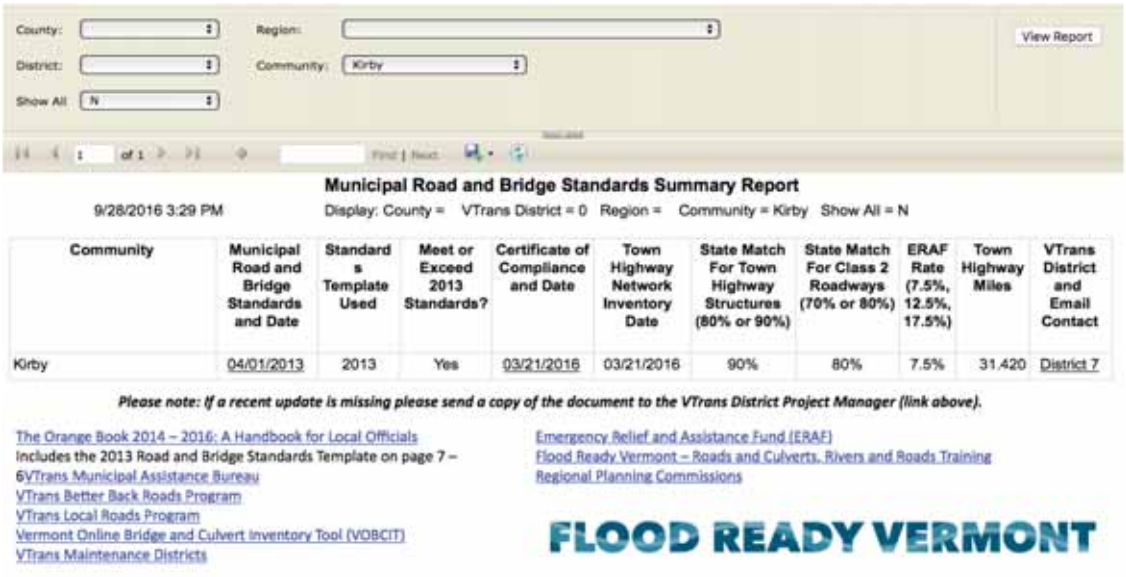
17.5% Mitigation Actions 1 through 5;

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

9/28/2016 3:29 PM — Display: County = VTrans District = 0 Region = Community = Kirby 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
Kirby	04/01/2013	2013	Yes	03/21/2016	03/21/2016	90%	80%	7.5%	31.420	District 7

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

MUNICIPAL RIVER CORRIDOR PROTECTIONS SUMMARY REPORT

Vermont Municipal River Corridor Protections

9/28/2016 3:30 PM — Display: County = Region = Community = Kirby Show All = N

Community	Municipal River Corridor Protection	Adoption Date	Status for ERAF ?	ERAF Rate (7.5%, 12.5%, 17.5%)
Kirby	No		Interim	7.5%
Total: 1	0		1	

- VT DEC - River Corridor and Floodplain Protection
- Flood Ready - Protect River Corridor and Floodplains
- River Corridor Frequently Asked Questions
- River Corridor Maps on Flood Ready Atlas

- Emergency Relief and Assistance Fund (ERAF)
- VT DEC Floodplain Managers
- 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	CALEDONIA COUNTY	06/28/74	06/15/84	07/17/02	06/15/84	No
	INCLUDES THE VILLAGE OF HARDWICK						
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
500178A	LANDGROVE, TOWN OF	BENNINGTON COUNTY	01/03/75	09/18/85	12/02/15(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
	INCLUDES THE VILLAGE OF LYNDONVILLE						
500015A	MANCHESTER, TOWN OF	BENNINGTON COUNTY	08/02/74	04/03/78	12/02/15	04/03/78	No
500179A	MANCHESTER, VILLAGE OF	BENNINGTON COUNTY	10/13/74	08/19/86	12/02/15	08/19/86	No
500283#	MARLBORO, TOWN OF	WINDHAM COUNTY	12/27/74	09/18/85	09/28/07(M)	09/18/85	No
500323#	MARSHFIELD, TOWN OF	WASHINGTON COUNTY	09/20/74	07/16/84	03/19/13	07/16/84	No
500113#	MARSHFIELD, VILLAGE OF	WASHINGTON COUNTY	09/20/74	07/16/84	03/19/13	07/16/84	No
500095#	MENDON, TOWN OF	RUTLAND COUNTY	08/16/74	09/18/85	08/28/08(M)	09/18/85	No
500008#	MIDDLEBURY, TOWN OF	ADDISON COUNTY		01/03/85	01/03/85	01/03/85	No
500114#	MIDDLESEX, TOWN OF	WASHINGTON COUNTY	06/28/74	05/03/82	03/19/13	05/03/82	No
500261#	MIDDLETOWN SPRINGS, TOWN OF	RUTLAND COUNTY	12/06/74	09/18/85	08/28/08(M)	09/18/85	No
500038#	MILTON, TOWN OF	CHITTENDEN COUNTY	07/26/74	01/06/82	07/18/11	01/06/82	No
	INCLUDES THE VILLAGE OF MILTON						
500167#	MONKTON, TOWN OF	ADDISON COUNTY	01/24/75	11/01/85	11/01/85(M)	11/01/85	No
500056#	MONTGOMERY, TOWN OF	FRANKLIN COUNTY	06/21/74	12/02/80	07/05/01	12/02/80	No
505518#	MONTPELIER, CITY OF	WASHINGTON COUNTY		06/22/73	03/19/13	06/22/73	No
500116#	MORETOWN, TOWN OF	WASHINGTON COUNTY	05/31/74	09/29/78	03/19/13	09/29/78	No
500064#	MORRISTOWN,TOWN OF	LAMOILLE COUNTY	05/31/74	01/03/79	07/02/87	01/03/79	No
500065#	MORRISVILLE, VILLAGE OF	LAMOILLE COUNTY	02/01/74	05/15/78	07/02/87	05/15/78	No
500096#	MT. HOLLY, TOWN OF	RUTLAND COUNTY	06/28/74	09/18/85	08/28/08(M)	09/18/85	No
500009#	NEW HAVEN, TOWN OF	ADDISON COUNTY	10/25/74	04/03/78	09/04/86	04/03/78	No
500237#	NEWBURY, TOWN OF	ORANGE COUNTY	10/25/74	05/17/90	07/21/99	05/17/90	No
	INCLUDE THE VILLAGES OF						

JEB SPAULDING, SECRETARY OF ADMINISTRATION LETTER

State of Vermont
Agency of Administration
Office of the Secretary
Pavilion Office Building
109 State Street
Montpelier, VT 05609-0201
www.aoa.vermont.gov

[phone] 802-828-3322
[fax] 802-828-3320

Jeb Spaulding, Secretary

January 29, 2014

Dear Vermont Municipal Official,

I am writing you to let you know of an important change regarding State promised assistance after a major flood or other natural disaster. This change is intended to encourage communities across Vermont to take action to improve their community's resilience to future flood impacts, which will save taxpayer money over time.

Following the recovery from Tropical Storm Irene, the State of Vermont modified its standard for managing the State's Emergency Relief and Assistance Fund (ERAF). The new standard, which will be effective for any disaster after October 23, 2014, is structured to encourage municipalities to take four basic steps to prepare their communities *before the next disaster:*

1. Have proactive flood hazard regulations;
2. Adopt up-to-date (2014-2016) local Transportation Codes and Standards;
3. Establish an up-to-date Local Emergency Operations Plan; and,
4. Develop and adopt a Local Hazard Mitigation Plan.

After a federally-declared disaster, federal public assistance funds from FEMA can reimburse 75% of eligible community losses associated with damage to public infrastructure. Typical community losses eligible for public assistance funds include costs to repair or replace transportation infrastructure, debris removal, and emergency protective measures. **Communities that have taken the four basic steps will receive an additional 12.5% state contribution to cover the damage.**

Communities that have not taken these steps will still receive state aid, but at a reduced amount. Those communities will receive a state contribution rate of 7.5%.

In addition, communities can secure state contribution of 17.5% by completing the four basic steps and by taking an additional step to protect themselves from flood damages. Please refer to the ***ERAF Frequently Asked Questions Enclosure*** for more information.

Please contact your regional planning commission or development agency, the Vermont Agency of Transportation District staff, or the Vermont League of Cities and Towns if you need additional assistance.

Thank you for attention to this important issue.

Sincerely,

Jeb Spaulding
Secretary of Administration

Enclosure: hand-out (with links) about the new ERAF criteria which will take effect on Oct. 23, 2014

VERMONT

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).

FEMA AND STATE FUNDING FOR KIRBY ROAD MITIGATION

Date	Project #	Location	Damage Description	Scope Of Work	Project Amount	Fema Amount	State amount	Mitigation Amount
12/2/04		Kirby Mountain Road	Severe rain flooded and eroded edge 300'x3'x2'x1/2767 cy at 0.4MI, and 300'x3'x3'x1/27= 67cy at 0.6 MI, and 200'x2'x1.5'x1/27=22cy at 0.9 MI.	Fill and grade //HMP	$3,057.99	$2,385.23	$382.25	The estimated cost is less than 15% of the total eligible cost. 15%x($3,058.00-work done- -$100.)= $444.00
12/2/04		Wood Lane	Severe rain flooded and eroded edge 150'x3'x1.5x1/27=25 cy at 0.1MI, and 150'x8'x2'x1/27= 89cy at 0.3 MI	Refunrbish an existing cutout	combined with above figures	combined with above figures	combined with above figures	
5/31/07		Town wide	High winds uprooted trees, and limbs of various size.	Approximateely 300cy of uprooted trees 12'' in diameter.	$8,916.65	$6687.49 plus Subgrantee Admin. of $267.50	$1,114.58	No hazard mitigation
9/12/08	00104(0)	Kirby Mountain Road Site 2	Heavy rain caused 1200'x4'x2' gravel road and ditchline washout. Ledge outcrop in ditchline	Replace 378cy of gravel. Clean/shape 1200' of ditchline. Seed and mulch 1000'x8'/9=889cy	$11,058.41	$8,293.81	$1,382.30	Proposal to add 50'x4'x1'=8cy rip rap to ditchline. Add 50'x18'' of HDPE culvert $2,202.00
9/12/08	00105(0)	Ridge Road Site 1	Heavy rain flooded and washed out rock embankment 80'x30'x15' to paved road. 80'x3'x2' of	Place 234cy rock fill, 36cy rip rap, 20cy gravel, re-set 90' guard rail	$5,834.82	$4,376.12	$729.35	No hazard mitigation

Date	Project #	Location	Damage Description	Scope Of Work	Project Amount	Fema Amount	State amount	Mitigation Amount
			shoulder exposing 80' beam of guard rail.					
9/12/08	00106(0)	Barnes Brook Road	Heavy rain washout 900'x3'x6' over a 2800' length of gravel road.	Replace 140cy of gravel. Clean and shape ditchline of 2800' gravel road.	$2,971.08	$2,228.31	$371.39	No hazard mitigation
9/12/08	00107(0)	Brook Road	Heavy rain washed out 500'x4'x1' of roadway edge, ditchline, destroyed 30'x12'' culvert	Replace 30'x12'' culvert with 30'x18''. Clean and shape 400' ditchline, add 75'x4'x1' rip rap to ditchline.	$3,504.36	$2,628.27	$438.05	No hazard mitigation
9/12/08	00108(0)	Brookside Road	Heavy rain washed out 800'x5'x1.5' of roadway and ditchline.	Replace 228cy of gravel.	$3,885.42	$2,914.07	$485.68	No hazard mitigation
9/12/08	00110(0)	Mountain Road Site 1	Heavy rain washed out 415'x3'x2' of gravel roadway and ditchline. Washout 8'x8'x4' area around 36'' culvert	Replace 160cy of gravel. Clean/shape 200' ditchline. Replace 8'x8'x2'=5cy gravel around outlet of 36'' culvert.	$3,197.21	$2,397.91	$399.65	Was identified by placing 8'x8'x2'=5cy rip rap at outlet of 36'' culvert. $225.00
9/12/08	00111(0)	Mountain Road Site 3	Heavy rain washed out 400'x4'x2' of gavel road and ditchline.	Replace 116cy of gravel. Clean/shape 400' ditchline.	$1,513.37	$1,135.03	$189.17	No hazard mitigation
9/12/08	00113(0)	Ridge Road Site 2	Heavy rain washed out 700'x4'x6'' of gravel road and ditchline.	Replace 84cy of gravel. Clean/shape 350' ditchline.	$3,229.81	$2,422.36	$403.73	No hazard mitigation
9/25/08	00114(00	Wood Lane	Heavy rain washed out 500'x2'x1' of gravel shoulder,and around 24'x 36'' CMP (culvert), and washed away rock headers at inlet and outlet 2(5'x6'x2').	Replaced 24cy of gravel. Fill around 24'x36'' culvert to open road. Work to be completed: relay 24'x36'' culvert, construct (2) rip rap headwalls 5'x6'x2'=5cy. Clean/shape 100' ditchline.	$2,493.01	$1,869.76	$311.63	No hazard mitigation

Date	Project #	Location	Damage Description	Scope Of Work	Project Amount	Fema Amount	State amount	Mitigation Amount
5/26/2011 5/27/2011	091(0)	Kinship Ln - TH27	Severe storm flooding washed out shoulder, ditch and road surface	Labor & equipent graded 449" of road. Purchased delivered and dumped 108cy of crusher run. Clean & shape 449' of ditch cc3070. Restore road surface 449'x14'x.125'=29.1cy surface aggregate with cc33011	$4,290.94	$3,218.21	$536.37	
5/26/2011 5/27/2011	104(0)	Barnes Brook Road - TH6	Severe storm flooding washed out shoulder, ditch and road surface	Labor 52 Hrs. Equipment 27 Hrs. 4"x8" crushed/screened stone line ditches. 927cy of 3/4" crusher run gravel. Hauling & ditching done by contractors.	$40,190.79	$30,143.09	$5,023.85	
5/26/2011 5/27/2011	105(0)	Appletree Ln - TH18	Severe storm flooding washed out shoulder, ditch and road surface	Labor 2.15 Hrs. Equipment 1.63 Hrs. 40' of 18" culvert. 18" culvert band. Contract work and purchase of gravel. Labor, equipment & materials , clean & shape 264lf of ditch cc3070. Stone line 132'x4lfx1'+20cy,cc3253. Rebuild headers for culvert 4'x3'=12sf,cc5230	$6,629.86	$4,972.40	$828.73	
5/26/2011 5/27/2011	106(0)	Burroughs Rd - TH24 & TH23	Sever storm flooding washed out shoulder, ditch and road surface	Labor 46.5 Hrs. Equipment 43.5 Hrs. 64cy bank run gravel. 50cy Dense grade. 872 cy crusher run. Contract work to deliver & dump material. Clen and shape 2311lf of ditch cc3070	$42,734.19	$32,050.64	$5,341.77	

Date	Project #	Location	Damage Description	Scope Of Work	Project Amount	Fema Amount	State amount	Mitigation Amount
5/26/2011 5/27/2011	110(0)	Cross Rd - TH24	severe storm washout/erosion of road surface, ditches, culvert & shoulder	Labor 7.5 Hrs. Equipment 7.5 hrs. Base material 25'x25'x6'=138.9cy ; 881'x6'x2'=391.6cy ; 638'x3'x1.5'=106.3cy ; 794'x4'x1.5'=176.4cy ; 61'x6'x3'=40.7cy pit run gravel total 854cy. Agregate surface cc3011. restore ditches 1,519 lf cc3070. Stone line 47.3cy of ditch cc3253. 100sf of culvert masonry header c5230	$26,669.45	$20,002.09	$3,333.68	
5/26/2011 5/27/2011	111(0)	Ranney Hill Rd - TH21	Severe storm flooding washouted road. Damage wing wall on box culvert	Labor 7.5 Hrs. Equipment 7.5 Hrs. Clean & shape 1141lf of ditch cc3070. Stone line 890x4'x1'=131.9cy cc3253. Contract labor & equipment repair bridge #21 wing wall +/-6'x6'x2'=2.7cy stone repair	$20,930.74	$15,698.06	$2,616.34	

Date	Project #	Location	Damage Description	Scope Of Work	Project Amount	Fema Amount	State amount	Mitigation Amount
5/26/2011 5/27/2011	112(0)	Ridge Rd - TH1	Severe storm flooding washed out road, shoulder, ditches & exposed culvert & guardrail post	Labor 22.5 Hrs. Equipment 20.5 Hrs. Applied bank run gravel 30cy. 3/4 crusher run 654cy. Dense grade 280cy. Oversize ledge 36cy. 12" minus 60T. Blasted ledge 88T. RipRap 108T. Clean & shape ditch 2765lfcc3070. Stone line 1950'x4'x1'=288.9cy. Squaring pavement edge 177'x3'avg.=59sycc3150. Pave edge 177'x3'avg.x2.5=8.1T. Bituminous base cc3120. Pave edge 177'x3'avg.x1.5"=4.9T. Bituminous surface cc3130	$57,428.42	$43,071.32	$7,178.55	
5/26/2011 5/27/2011	113(0)	Lynnhill Rd	Severe storm flooding washed out road surface and shoulder. Plugged culvert & needs header	Labor 12.6 Hrs. Equipment 11.2 hours. Contract work to deliver and dup materials. Bank run gravel 102.2cy. 3/4" crusher run 148.4cy=250.6cy. One culvert 18sf. Header both sides=36ftcc5230	$3,249.38	$2,437.04	$406.17	
5/26/2011 5/27/2011	116(0)	Wood Lane - TH19,20,29	Severe storm flooding washed out road & shoulder. Filled ditches need to replace header.	Labor 39.5 Hrs. Equipment 36 Hrs. Contract work to delivery & dump material. Bank run grave 189cy. Dense grade 265cy. 3/4" crusher run 509cy=963cy. Clean & shape 1761lf of ditch cc3070. Header of two 36" culverts=54sfcc5230	$23,195.46	$17,396.60	$2,899.43	

Date	Project #	Location	Damage Description	Scope Of Work	Project Amount	Fema Amount	State amount	Mitigation Amount
5/26/2011 5/27/2011	119(0)	Mud Hollow Rd - TH15	Severe storm flooding washed out road, ditches & culverts.	Labor 102. Equipment 89 Hrs. Contract work to deliver & dump material. 1459cy bank run gravel; 929cy 3/4" crusher run ; 562cy dense grade ; 20cy oversize stone ; 136cy ledge ; 59cy top soil=3489cy. Ditches 839cy pit ru gravel ; 94cy (3") aggregate surface. clean 7 shape 1519lf ; stone line 47cy. Repair 100sf culvert header. Clean out two 15"x3' culvert.	$77,894.00	$58,420.50	$9,736.75	
5/26/2011 5/27/2011	120(0)	Willey Farm Rd - TH10	Severe storm washed out road & shoulder leaving debris in ditches.	Labor 13.5. Equipment 13.5. Contract work to deliver & dump material. Clean & shape 852lf of ditch cc3070. Stone line 852'x4'x1'=126.2cy	$12,700.18	$9,525.14	$1,587.52	
5/26/2011 5/27/2011	121(0)	Brookside Road	Severe storm washed out road, shoulder & ditches.	Labor 47.5 Hrs. equipment 30.5 Hrs. Contract work to deliver & dump material. 388cy bankrun gravel. 178cy dense grade. 345cy 3/4" crusher run. 124cy 6"minus stone. =1035cy. Clean & shape 2472lf of ditch cc3070. Stone line 2472'x4'x1'=cc3253.	$42,268.07	$31,701.05	$5,283.51	
5/26/2011 5/27/2011	122(0)	Victory Rd - TH9	Severe storm washed out road & edge, and two culverts.	Labor 4 Hrs. Equipment 2 Hrs. Replace two culverts 30'x18"CMPcc3353.	$2,164.56	$1,623.42	$270.57	

Date	Project #	Location	Damage Description	Scope Of Work	Project Amount	Fema Amount	State amount	Mitigation Amount
5/26/2011 5/27/2011	123(0)	Kirby Mtn. Rd - - TH25&29	Severe storm washed out roads, ditches & culverts.	Labor 139.5 Hrs. Equipment 123.5 Hrs. Contact work to deliver & dump material. 956cy bank run gravel ; 879cy 3/4" crusher run ; 387cy dense grade =2,222cy. Clean & shape ditches ; stone line 1036cy(2,202lf) of ditch cc3253. Re-set two culverts ; one 30'x15" & one 30'x3"=60lfcc3340. Replace one 60'x30"cc3355	$117,287.00	$87,965.25	$14,660.88	

APPENDIX D: 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 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 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?	