2022 HAZARD MITIGATION PLAN

Town of Ryegate-- DRAFT

Adopted

Date to be determined

CERTIFICATE OF LOCAL ADOPTION

Town of Ryegate, Vermont

(Note: This resolution does NOT get signed until the plan is approved.)

A Resolution Adopting the Local Hazard Mitigation Plan Update

WHEREAS, the Town of Ryegate has worked with its residents and stakeholders to identify its hazards and vulnerabilities, analyze past and potential future losses due to natural and human-caused hazards, and identify strategies for mitigating future losses; and …

WHEREAS, the Town of Ryegate Local Hazard Mitigation Plan contains recommendations, potential actions and future projects to mitigate damage from disasters in Ryegate; and

WHEREAS, the Town of Ryegate and the respective officials will pursue implementation of the strategy and follow the maintenance process described in this plan to assure that the plan stays up to date and compliant; and…

WHEREAS, a meeting was held by the Town of Ryegate Selectboard to formally approve and adopt the Ryegate Local Hazard Mitigation Plan.

NOW, THEREFORE BE IT RESOLVED that the Town of Ryegate adopts this Local Hazard Mitigation Plan for the town.

_____ _____

Date Selectboard Chair

_____

Selectman

_____

Selectman

_____

Selectman

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1. INTRODUCTION

Purpose

The purpose of this plan is to assist Ryegate in identifying all the hazards facing the town and to identify mitigation strategies to begin reducing risks from the identified hazards.

The Vermont State Hazard Mitigation Plan of 2018 defines *hazard mitigation* as

> "...any sustained action that reduces or eliminates long-term risk to people and property from natural hazards and their effects."

It is less costly to reduce vulnerability to disasters than to repeatedly repair damage. This plan recognizes that communities have opportunities to identify mitigation strategies and measures during all the other phases of Emergency Management – Preparedness, Response and Recovery.

Hazard mitigation strategies and measures alter the hazard by eliminating or reducing the frequency of occurrence, avert the hazard by redirecting the impact by means of a structure or land treatment, adapt to the hazard by modifying structures or standards, or avoid the hazard by stopping or limiting development. Specific hazard mitigation projects include:

- Flood-proofing structures
- Securing propane/fuel tanks in flood-prone areas
- Elevating furnaces and water heaters in flood-prone areas
- Identifying and modifying high traffic incident locations and routes
- Ensuring adequate water supply
- Elevating structures or utilities above flood levels
- Identifying and upgrading undersized culverts
- Proactive land use planning for floodplains and other flood-prone areas
- Proper road maintenance and construction
- Ensuring critical facilities are safely located
- Providing public information

With enhanced emphasis on community resilience, many state agencies and local organizations have an increased awareness of the importance of mitigation planning and have produced plans and resources that towns can use to support their planning efforts. This plan will reference, when relevant, pertinent tools and resources that can be used to enhance mitigation strategies.

The Code of Federal Regulations (44 CFR Part 201), establishes criteria for State and local hazard mitigation planning authorized by Section 322 of the Stafford Act as amended by Section 104 of the *Disaster Mitigation Act of 2000*. Effective November 1, 2003, local governments must have an approved local hazard mitigation plan prior to the approval of a local mitigation project funded through federal Pre-Disaster Mitigation funds. Furthermore, the State of Vermont is required to adopt a State Pre-Disaster Mitigation Plan

for Pre-Disaster Mitigation funds or grants to be released for either a state or local mitigation project after November 1, 2004.

There are several implications if the plan is not adopted and approved by FEMA:

- After November 1, 2004, Flood Mitigation Assistance Grant Program (FMAGP) funds will be available only to communities that have adopted a local plan;
- Communities without a plan are not eligible to receive funding from FEMA's Hazard Mitigation Grant Program (HMGP) to pay for hazard mitigation projects. (Communities, however, may apply for planning grants under the 7% of HMGP available for planning;
- Communities with a local plan are not eligible to funding from FEMA's Pre-Disaster Mitigation (PDM) program, and
- For disasters declared after October 14th, 2014, a community without a plan will be required to meet a greater state match when public assistance is awarded under the Emergency Relief Assistance Fund (ERAF) requirements.

Adoption and maintenance of this Hazard Mitigation Plan will:

- Make certain funding sources available to complete the identified mitigation initiatives that would not otherwise be available if the plan was not in place;
- Lessen the receipt of post-disaster state and federal funding because the list of mitigation initiatives is already identified;
- Support effective pre- and post-disaster decision making efforts;
- Lessen each local government's vulnerability to disasters by focusing limited financial resources to specifically identified initiatives whose importance have been ranked; and
- Connect hazard mitigation planning to community planning where possible.

Planning Process

The Town of Ryegate did not have a Local Hazard Mitigation plan until 2014. In 2011, the town was affected by two storm events that heightened the need for comprehensive, holistic emergency planning at the local level. The Northeast Kingdom was hit hard by a sudden rainstorm in May of 2011, and again later that year in Tropical Storm Irene. Local damages included personal property, roads and bridges, and single-family residences in South Ryegate village. One of those structures was considered a "repetitive loss structure" in the National Flood Insurance Program and was eventually purchased with FEMA hazard mitigation funds. The Town needed a FEMA approved Local Hazard Mitigation Plan to complete the buyout. The Town of Ryegate's Local Hazard Mitigation Plan (single jurisdiction) was approved by FEMA on March 27, 2014 and was adopted by the Town on April 4, 2014. The plan expired March 26, 2019.

This 2020 Local Hazard Mitigation Plan for the Town of Ryegate builds upon and augments previous regional mitigation and planning efforts. The development of this plan has followed a similar process to most community planning efforts, in addition to the Hazard Mitigation protocol established by FEMA. In addition to updated hazard and risk data assessment and mitigation strategies, this plan has been reorganized for clarity.

Steering committee

The committee responsible for overseeing the plan update process represents a cross section of local stakeholders whose expertise was essential to the development of the mitigation plan. Collectively, this group possesses a first-hand knowledge of natural hazards and how they affect the community. Committee members are also able to develop, evaluate, and prioritize mitigation actions that will counteract the effects of these hazards.

- Elizabeth Page, *Town Clerk*
- Marsha Nelson, *Assistant Town Clerk and Liaison to the Selectboard*
- Gene Perkins, *Fire Chief and Town Emergency Management Director*
- Nelson Elder, *Department of Public Works and Road Foreman*
- Khristine Elder, *public at large*
- Regina Hazel, *Ryegate Planning Commission and Town Lister*
- Stephen Genereaux, *Ryegate Planning Commission and Town Health Officer*

Steering committee members attended planning meetings but also made themselves available to provide information on request by the regional planning commission. They reviewed progressive drafts of plans and data.

Regional Planning Commission

Multiple individuals from this organization were involved. A Senior Planner from Northeastern Vermont Development Association (NVDA) worked directly with the Steering Committee, facilitated meetings, oversaw public outreach efforts, and was responsible for plan updates and research. She was assisted by NVDA's Emergency Management Planner, who was the chief liaison with Local Emergency Planning Committee #9 (and after 2021, the statewide local emergency management committee) and who regularly attends planning and emergency response training exercises. Additionally, NVDA's GIS Specialist compiled and mapped hazard data, and NVDA's Senior Transportation Planner advised on road and public infrastructure.

Public Involvement

Prior to development of the updated plan, the steering committee developed a public survey to be distributed via Front Porch Forum. Paper copies of the survey were made available from the Town Offices during election day. Relevant findings are cited throughout the plan, and a survey summary is appended to this plan.

The public also had opportunities to participate in the planning process in duly warned public presentations held in conjunction with regularly scheduled selectboard hearings on November 9, 2020 and March 28, 2022. Comments received in those meetings are summarized in Table 1.1.N

Draft plans were made available from the Town's Web site and NVDA's Web site. Hyperlinks were publicized in Front Porch Forum and other places.

Neighboring communities & Relevant Agencies

Prior to development of the updated plan, a public notice was emailed to the town clerks of following communities, notifying them of the first public hearing (and Zoom link):

- In Vermont, Groton, Peacham, Barnet, Topsham, and Newbury
- In New Hampshire, across the Connecticut River, the Town of Bath and Monroe. A notice was also sent to Haverhill, which is not directly adjoining, but houses the first responder dispatch services.

We received no comments from neighboring communities.

On xx, draft copies of the plan update were emailed to the Town Manager or Selectboard Chair of each of the neighboring communities, each with a request to send comments to the NVDA Senior Planner. Xxx comments were received.

Additionally, contacts at the Agency of Natural Resources, River Management Program, were notified prior to the first public hearing for the plan update process. This is where we will describe any participation or comments. On xx, draft plans were emailed to xxx, and this is where we will describe any comments received.

Table 1.1: Planning Process

Date	*Summary*
10.20.2020	*The Steering Committee met via Zoom to confirm the benefits of hazard mitigation planning, review the proposed planning process and timelines, review the required sections of the hazard mitigation plan, and approve a draft public survey. The committee also confirmed the means of distribution of the survey. Finally, the group started the community hazard assessment process by using a qualitative process to rank hazards. Beaver dam failures were identified as a specific event that contributes to flooding.*
11.09.2020	*Alison Low presented (via Zoom) the initial results of the survey (17 responses at that point) and reviewed the initial hazard assessment results from the steering committee. There was a comment from the general public that climate change should be mentioned as this provides context to the changing nature of Ryegate's risks (e.g. ice in the winter has recently become more of a hazard than heavy snowfall in recent months.) There was also a question regarding the risks of extreme cold temperatures. One of the risks identified was to vulnerable populations, such as the elderly or those with substandard housing. There was a suggestion to rank heat higher in recognition of the increasing occurrence of heat waves, but this suggestion was rejected by the majority, and it was agreed that drought was a greater concern. Finally, there was an agreement to add microbursts to the list of ranked hazards, as an unnamed event in 2011 cause significant damage to Ryegate infrastructure and private residences.*
January 13, 2002	*Steering committee meeting. The team received updated drafts and reviewed and updated mitigation actions identified from the 2014 plan. The team also reviewed new proposed mitigation actions, as well as the methodology for evaluating their feasibility.*
March 28, 2022	*Based on the input from the steering committee, NVDA facilitated a second public hearing which included a presentation of the vulnerability assessment, mitigation strategies, and proposed strategy for keeping the plan up-to-date.*
TBD	*The final full draft plan, which incorporated input from the public hearing and any other input was sent to the Vermont Emergency Management, along with a Local Hazard Mitigation Plan Review Tool.*
TBD	*Final Plan Submitted*

Information Sources Reviewed

The following documents and information sources were used to update the Ryegate Hazard Mitigation Plan:

- Centers for Disease Control
- Efficiency Vermont
- Federal Emergency Management Agency, Open FEMA Datasets https://www.fema.gov/about/openfema/data-sets#public
- Feeding America
- Great River Hydro, LLC
- National Weather Service, National Oceanic and Atmospheric Administration https://www.noaa.gov/
- New Hampshire Department of Environmental Services, Water Division – Dam Bureau
- NOAA National Centers for Environmental information, Climate at a Glance: County Time Series, published December 2021, retrieved on January 5, 2022 from https://www.ncdc.noaa.gov/cag/
- Ryegate Town Plan, adopted October 8, 2018
- Ryegate Zoning Bylaw (included Flood Hazard Regulations), last amended January 9, 2017
- Town of Ryegate 2014 Local Hazard Mitigation Plan
- Town of Ryegate Lister data
- Town of Ryegate, Annual Reports, 2019, 2020, and 2021
- U.S. Drought Monitor, National Drought Mitigation Center, University of Nebraska-Lincoln
- University of Vermont
- University of Vermont Vermont State Indicators Online https://www.uvm.edu/crs/vermont-indicators-online
- US Census Bureau: 2020 Decennial Census and 2020 American Community Survey 5-Year Estimates
- Vermont 10 Year Telecommunications Plan
- Vermont Agency of Natural Resources
- Vermont Agency of Transportation, VTrans Town Highway Maps https://vtrans.vermont.gov/content/planning/maps/town-maps/highway-maps
- Vermont Center for Geographic Information https://vcgi.vermont.gov/
- Vermont Climate Action Plan https://climatechange.vermont.gov/about
- Vermont Department of Health
- Vermont Online Bridge and Culvert inventory (VOBCIT) https://vtculverts.org/
- Vermont State Hazard Mitigation Plan 2018 https://vem.vermont.gov/plans/SHMP

Integration with Future Planning Endeavors and Local Decisions

The existing Ryegate Town Plan, Zoning Bylaw and Flood Hazard Regulations, and local Emergency Operations Plan informed the development of this Local Hazard Management Plan. Once adopted, there are significant opportunities to make this document a relevant and dynamic force in local decision making. State statute, for example, requires town plans adopted after July 1, 2014 to contain a flood resilience element. This element can and should incorporate a locally adopted and FEMA-approved hazard mitigation plan. Ryegate's Town Plan, which was adopted in 2018, already contains a flood resilience element that reflects the recommendations of the 2014 Hazard Mitigation Plan. Subsequent updates to the Town Plan, which expires in 2026, will incorporate recommendations from this updated plan.

Additionally, Ryegate's flood hazard regulations were updated following the adoption of the 2014 Hazard Mitigation Plan. These changes were deemed necessary to bring the local flood hazard regulation into minimum compliance with 44 CFR, the federal code of regulations that governs participation in the National Flood Insurance Program. While the State's Emergency Relief Assistance Fund offers financial incentives to establish regulations that exceed the minimum standards of 44 CFR and effectively prohibit new development in the floodplain and encroachments into river corridors, this plan cannot guarantee adoption. In fact, following the adoption of the 2014 Hazard Mitigation Plan, the Ryegate Planning Commission proposed such regulations, and they were not supported by the general public. Nevertheless, an ongoing public dialog regarding the assessment, management, and mitigation of risks has already been initiated and is certain to continue. Local officials, members of the Hazard Mitigation Planning Committee, and the Ryegate Planning Commission will continue to work with NVDA, State and Federal officials to implement this Local Hazard Mitigation Plan.

Implementation and Monitoring of Mitigation Strategies

Public Involvement Following Plan Approval

After adoption, the Town of Ryegate will make its Local Hazard Mitigation Plan available to the general public, providing the community an opportunity to provide ongoing input. (The Ryegate Local Hazard Mitigation will also be available from the regional planning commission's web site, www.nvda.net. Additionally, the town will hold an annual public meeting after performing the annual progress report for the mitigation plan to discuss achievements and the following year's implementation plan. At town meeting, the town will present mitigation information and provide the public an opportunity to increase understanding and involvement with planning efforts. The LEPC will also host an annual mitigation plan presentation where response/state agencies, neighboring communities and other stakeholders can provide input. The Town will also notify its neighboring municipalities of the availability of information for review and any significant risks and/or mitigation actions that have an impact on surrounding towns.

Project Lead and Monitoring Process

The town's Selectboard chair is the project lead and will work in conjunction with the Selectboard, town clerk and NVDA to complete the yearly progress report included in the plan. The town will create a mitigation action collection system that will be used as the source of future updates following the annual evaluation that will occur in conjunction with the progress report using the Plan Implementation Matrix provided below. While mitigation actions are, by default, often addressed at monthly Selectboard meetings, the town will schedule one meeting annually to formally assess the plan and adopt updates following the annual progress report and community meeting regarding the LHMP. Once the plan is approved by FEMA, the calendar will begin for annual review. The town will take the implementation matrix (identified below) and add actions to it each year, modifying tasks and/or needs as required so that the next LHMP update will be populated with the specific actions related to each mitigation strategy by year.

Plan Evaluation and Update Process

The town's Selectboard chair will lead the plan evaluation process as part of the annual progress report. Prior to town meeting and in preparation for the annual town report, a mitigation section will be included that provides an executive summary for the public that addresses the following topics:

- Status of recommended mitigation actions for the five-year planning period;
- Identification of barriers or obstacles to successful implementation or completion of mitigation actions, along with possible solutions for overcoming risk;
- Identification of a lead person to take ownership of, and champion the Plan, if different from Selectboard Chair;
- An approach to evaluating future conditions (i.e. socio-economic, environmental, demographic, change in built environment etc.);
- Discussion of how changing conditions and opportunities could impact community resilience in the long term; and
- Discussion of how the mitigation goals and actions support the long-term community vision for increased resilience.

By engaging in the annual evaluation, the town will have a viable method for keeping the plan relevant. The town is committed to "institutionalizing" mitigation into its normal operating procedures and with approval of this plan, embarks on the formal incorporation of mitigation actions and discussion, maintaining an awareness that involves not only the Selectboard, Town Clerk, and Road Foreman but also the community at large, including the organizations and entities represented by the current planning team. Along these lines, the town will maintain a contact list of the current planning team and make revisions as required, including the team on the evaluation process each year. Through this consistent attention resulting from the evaluation process, progress reports and communication in the annual town report, the town will achieve the consistency required to enhance resilience through planning, assessment and actions devoted to mitigation.

The Plan update will be led by the Selectboard Chair and Town Clerk. Depending on funding availability, the town may elect to acquire the assistance of NVDA and/or a consultant to update the plan following a declared disaster and/or the next five-year planning cycle. To assure that the Plan does not expire, the town will begin the update process within no less than six months of the current Plan's expiration date. Following a disaster and during the recovery phase, the town will use the experience to assess the current Plan's ability to address the impact of the most recent disaster and edit the plan accordingly. Using the annual progress reports and evaluation narratives as a guide, along with perceived changes in risk or vulnerabilities supported by data and/or observation, strategies will be captured in accordance with FEMA guidelines, which includes reconvening the planning team during the update process. The town will establish a "Mitigation File" that documents all evaluations and progress reports, along with actions, especially related to infrastructure improvement projects. While the progress reports are designed to capture the specific actions the town has accomplished related to implementation, keeping a narrative list with dates on all actions relatable to mitigation will provide the town the bulk of information required in the update process.

Implementation Matrix for Annual Review of Progress

The following table is intended to aid municipal officials in implementing the mitigation actions for The Town of Ryegate and to facilitate the annual monitoring and progress reporting. Progress has been included as a guide to future updates. Each year, the town will reserve a Selectboard meeting to review and update the Implementation Matrix as means to establishing an accurate evaluation of the plan's efficacy and the information required for the succeeding update to the plan.

Note: The Implementation Matrix will be added when we decide on the mitigation actions.

2. COMMUNITY PROFILE

Town Background

Ryegate is a small, rural community located in Northeastern Vermont (Chartered: September 8, 1763). It is one of the most southern communities in Caledonia County (See Exhibit 1: Ryegate Base Map). The Connecticut River is on the eastern border along with Interstate 91, which heads north to Canada and south towards White River Junction. Ryegate is bordered by the Vermont towns of Barnet (north), Groton (west), and Newbury (south). The New Hampshire towns of Bath and Monroe are located across the Connecticut River from Ryegate. Vermont Route 302 traverses along the southern end of town and provides a bridge crossing over the Connecticut River (located just east of Ryegate in the Village of Wells River).

The Town of Ryegate has two small unincorporated villages, East Ryegate and Ryegate Corner. These two centers of development are mostly residential hamlets interdispersed with civic uses. Neither are Census Designated Places. There are also several small residential hamlets located along Route 5, such as "Little Ryegate" and near the northern tip of Ticklenaked Pond. Ryegate town records are kept at the Town Office, located in Ryegate Corner. The building also houses a U.S. Post Office. The Town Garage, Town House, and a fire station are also located in Ryegate Corner. The Town House is an old building with wood heat used for town meetings. In the past decade, the town Ryegate received a grant to improve the parking facilities and ADA accessibility at the Town House.

Though not a Census Designated Plan, the Village of South Ryegate has a more diverse mixture of development. South Ryegate Village includes a church, fire station, baseball diamond, US Post Office, general store, ice cream stand, and Gandin Brothers Monument businesses in addition to general homesteads.

There have been no major changes to the development trends in Ryegate since the previous plan. Development is largely incremental and follows the traditional patterns of scattered large-lot rural residential development surrounding three traditional villages. The 2018 Town Plan calls for measures to support and promote the vitality of Ryegate's three village areas by allowing for a vibrant mix of uses in those areas: residential, civic, public and semi-public, and appropriately scaled commercial and industrial uses. One of these measures is to obtain Village Center Designation from the State of Vermont for all three villages – East Ryegate, Ryegate Corner, and South Ryegate. This designation, which was conferred in 2020 and expires in 2028, provides tax credits to incentivize improvements to income-producing properties, including multi-unit buildings built before 1983. The designation also gives priority consideration to some grant programs for improvements to public facilities and transportation improvements.

There are a few existing small businesses, home-based industries, and successful farming operations in Ryegate, most of which are scattered throughout town. Only a handful of industrial operations exist in town and include the McCullough Crushing (a stone quarry operation) on Stone Road; Ryegate Power Station in East Ryegate; and, Gandin Brothers Monument in South Ryegate. A pottery business in South Ryegate closed in the past few years, but another industrial use (controlled agriculture) is proposed for that site.

Ryegate is part of the Blue Mountain School District which provides K-12 public education in the Village of Wells River located in the Town of Newbury, Vermont. Enrollment normally hovers around 440 (in non-pandemic times). In recent years, the school has made renovations to convert open air classrooms into self-

contained classrooms and replace the original electric heating system with a wood-chip fueled heating system.

Table 2.1: Town of Ryegate Statistics

Datum		
Population	1,165	2020 Decennial Census
Total Land Acres	23,411	UVM, Vermont State Indicators Online
Total Square Miles	36.5	US Census Bureau
Population per square mile	31.9	
Median age	48.0	
Median home value	146,800	American Community Survey 2020 5-Year Estimates
Total Housing Units	614	2020 Decennial Census
Housing Units with a mortgage	220	American Community Survey 2020 5-Year Estimates
Homestead tax rate (per $100)	2.1407	Town of Ryegate Report 2021
Non-residential tax rate	2.2.2572	

Town Infrastructure

The Town of Ryegate is fortunate to have good highway and rail access. Route 302 connects with Interstate 91 (via exit 17), and continues east to New Hampshire (via bridge), and west to the Barre-Montpelier area. The major transportation routes in Ryegate are US Route 5 and Vermont Route 302, with East Road running from US 5 to Ryegate Corner, and portions of the Bayley-Hazen Road running from the Barnet Town line to Boltonville Road to VT 302. The Connecticut River Line of Washington County Railroad runs north-south along the river and provides a few sidings for industry to utilize rail for shipping. The Connecticut River Division of the Washington County Railroad Company owns and operates a total of 102.2 miles of the rail line between White River Junction, Vermont and Newport, Vermont. The WACR line to White River Junction is a class II freight line, which means that the maximum allowable speed for freight is 25 mph. The line serves shippers whose principal commodities are plywood, grain, furniture, grocery products, and paper products.

Ryegate has six bridges with spans of two feet or more: Pleasant Street, Terry Hill Road, Stone Road, Hillside Drive, Church Street, and Creamery Road. Two of these – Terry Hill and Creamery Road -- are classified as being in “poor condition”. In 2009, the Ryegate Selectboard hired an engineering firm to evaluate and perform a scoping study on the Creamery Road Bridge. A cost estimate was developed for this through-girder bridge back in 2014, and the minimum cost was $760,000. The 108 foot long structure was noted for having significant corrosion on fascia girders as well as laminated rust. During Tropical Storm Irene, the south end of the bridge was undermined and about 35 feet of road washed out.

According to the Vermont Online Bridge and Culvert inventory (VOBCIT), there are four bridges with spans of under 20 feet: Creamery Road, Stoneshed Road, Symes Pond Road, and Stone Road. Of these bridges, Symes Pond is classified to be in an overall "fair" condition.

The VOBCIT also shows that there are 81 culverts in "poor" condition (i.e. about 25% open with serious deficiencies.) Culverts in poor condition are found mostly around the Bayley Hazen Road, Hall Road, and Creamery Road. This is due to sediment load which is deposited during storm events. Undersized or "plugged" culverts often result in storm runoff flowing over the road or highway, rather than under it, and damaging or even washing out the roadway.

According to the most VTrans Town Highway Maps (2020) Ryegate has a total of 57.2 miles of town roads.

Table 2.2: Ryegate Road Mileage Summary

Class	Mileage
2	13.960
3	43.24
State (US 5)	7.386
State (US 302)	3.698
Interstate (91)	6.241

Ryegate currently hosts two cell towers in town that give communications access to certain parts of town. Unfortunately the hilly terrain blocks other areas of town from adequate cell service. The two cell towers are located along Interstate 91 at high elevations and provide service for the I-91 Corridor and Connecticut River Valley area. Cell service begins to become spotty in the western parts of town, including Ryegate Corner. South Ryegate Village has no cell service.

The town's electricity service is provided by Green Mountain Power and Washington Electric Cooperative. There are also several high-voltage transmission lines located in town. Ryegate also is home to Ryegate Associates (GDF Suez), a woodchip generating plant that provides power to the New England power grid. The plant has a 22 MW capacity and employs 20 people. There are also several high-voltage transmission lines located in town. Just north of Ryegate on the Connecticut River are three very large hydroelectric dams that provide approximately 638,000 MWh of electricity to the New England Grid. The Comerford Dam, McIndoe Falls Dam, and the Moore Dam collectively require a total drainage area of 3.4 MM acres to handle a breach.

The East Ryegate Fire District No. 2 owns a 174-foot deep gravel well located on the eastern side of the East Ryegate Village between Russell and Wallace Streets. A six-inch water main carries 150 gallons per minute to a 200,000 gallon reservoir situated about 1,000 feet west of U.S. Route 5, approximately 100 feet above the village. This water supply serves about 50 households. The Fire Department goes up the road about a half-mile to Ryegate Wood Energy to obtain water for fire service because of the aging infrastructure of the East Ryegate Village Water system. Ryegate's water resources include the Connecticut and Wells Rivers and their tributaries, Coburn, McLam, Symes and Ticklenaked Ponds; wellhead protection areas for community water supplies are located in East and South Ryegate, as well as a surface water area in the northern part of Ryegate. South Ryegate has a private water system that serves nine households. In 2013, the cooperative responsible for maintaining the system paid for one household to drill its own water system in order to be disconnected. The system dropped below the user threshold to be considered a public system.

East Ryegate Fire District provides sewage for East Ryegate village; South Ryegate Waste Water District provides sewage for 14 units in South Ryegate. The rest of the town relies on private septic systems.

Built in 1985, the East Ryegate system serves about 55 homes. Grey water is pumped from a gravity fed cistern to a covered sand filtration complex. Filtered water aerates in a weir and is then tested for coliform counts. If needed, minute amounts of chlorine are added prior to the water's return to the Connecticut River. The system is permitted by the State of Vermont for 10,000 gallons per day. Currently between 4,000-5,000 gallons are processed each day The East Ryegate water system was recently upgraded and revised. Piping was replaced, the stand-by chlorination system was upgraded and the cistern was repaired. Samples are tested frequently, and it is rare that any chlorine is required.

South Ryegate's community sewage facility serves 16 residences. It handles 4,000 gallons of sewage per day, below its capacity of 6,000 gallons per day. Built in 1982, it has outlived its expected lifespan. The leach field may require replacement in the near future. The South Ryegate sewer has a holding tank and leach field. It is permitted for 6,000 gallons/day, and about 4,000/day go through it. There is annual engineer testing.

Town Emergency Services

The emergency shelter is at the Blue Mountain School located in Wells River. The Blue Mountain School has a back-up generator.

Ryegate has a volunteer fire department with 22 volunteers and two stations, one in Ryegate Corner and one in South Ryegate. The Ryegate Corner Station was built in 1981. The South Ryegate Station was purchased by the town in November of 2000. The fire department has a mutual aid agreement with the surrounding towns of Groton, Barnet, Wells River, Monroe and Woodsville, New Hampshire. Fire fighters are dispatched by Twin State Mutual Aid in North Haverhill, New Hampshire. There are eleven dry hydrants located throughout the town. In the past few years, the fire department has received new radios for emergency communications, and cell service is slowly improving around town (although South Ryegate continues to lack coverage).

In 2020, the Fire Department had 12 responses, the majority of which were focused on providing a safe response zone for fire, police, emergency management services, and wreckers on I-91. Most incidents occurred northbound on I-91 between mile marker 114 and 116 and involved collisions with wildlife. The prior year saw 28 calls, 5 of which were cancelled en route. The largest number of responses were for multi-vehicle accidents (7), followed by downed power lines (6).

The Fire Department has 14 members, but only five of the volunteer staff are available for responses during the day, the Department is looking for additional members. The Town of Ryegate has two mutual aid systems for unlimited resources: Capital Fire Mutual Aid, which encompasses towns all the way to Warren, Vermont, Twin State Mutual Aid Fire Association, which encompasses Groton, Ryegate, and towns all the way to Twin Mountain in the East. On all responses one other department is toned to respond with Ryegate. The Ryegate Corner station has a 2005 International Tanker, and 1997 Ford Pumper, and a 1988 Ford Mini-Pumper. South Ryegate has a 1987 International Equipment Truck and a 1992 International Pumper.

The Town regularly provides an appropriation to the Vermont Rural Fire Task Force, which helps local fire departments identify appropriate sites for dry hydrants and other rural water supply systems, design installations and find financial support to cover the costs of construction.

Ryegate and Groton have a FAST Squad of approximately 12 volunteers with training as Emergency Medical Technicians (EMT) and Emergency Care Attendants (ECA). A truck, stationed at the Groton Fire Station, is equipped to carry tools and supplies, but does not transport patients. The Fast Squad stabilizes patients and provides emergency first aid preceding the arrival of Woodsville Ambulance. DHART, the emergency helicopter from Dartmouth-Hitchcock in Lebanon, New Hampshire serves Ryegate with pre-arranged landing spots and fast emergency transportation. One landing spot in South Ryegate is located in the Special Flood Hazard Area. The town pays a yearly appropriation to Woodsville Ambulance, and users of the service are billed. The Fast Squad is currently dispatched by Twin State Mutual Aid in North Haverhill. Patients requiring hospitalization are transported to the Cottage Hospital in Woodsville, NH. There are no private doctors' offices or clinics in Ryegate.

The Town of Ryegate is dependent upon the Vermont State Police and the Caledonia County Sheriff's Department for law enforcement. The nearest Vermont State Police Barracks is St. Johnsbury.

Topography and Climate

According to GIS Land Use Land Cover data, Ryegate is more than 73% forested. Its next predominant use is open agricultural land (18%). Less than 8% of Ryegate is developed. According to the United States Census Bureau, the town has a total area of 36.87 square miles, of which 36.8 square miles is land and 0.31 square miles, or 0.80%, is water. Bounded on the east by the Connecticut River (the boundary between Vermont and New Hampshire), Ryegate is drained by the Wells River. Blue Mountain, the highest point in the town, has an elevation of 2,340 feet above sea level. Ryegate has about 300 acres of granite on the south and west sides of Blue Mountain. (See Exhibit 2: Ryegate Topography Maps.)

Ryegate is located in the Northeast Kingdom (on the eastern side of a mid-latitude continent, in the hills between the Green and White Mountains, in northern New England, and about 100 miles west of the Atlantic Ocean. Although the climate can be best characterized by long cold winters and short and relatively cool summers with adequate precipitation in all seasons, the region's mountainous terrains creates numerous microclimates that vary significantly. The location is susceptible to storm systems. Tornadoes are extremely rare in the area, but remnants of hurricanes and nor'easters can reach far enough inland to affect the weather. Summers are generally short, but pleasant. Nights are cool, and afternoon highs are generally free of extreme heat and humidity. Annual average precipitation in Ryegate ranges about 36" to 44". Normal highs in the summer months are in the low 80s, and normal lows in the single digits during the winter months, although temperatures in the area have historically been as low as -38F.

Climate Change and Severe Weather Patterns

It is commonly accepted that weather extremes are becoming more commonplace in Vermont. From 1964 to 1985 there were eight Major Disaster Declarations in Vermont. Subsequent decades have seen a steady increase: From 1996 through 1986, there were six, from 1997-2007 there were 11, and from 2008 to 2018, 19. In just the past two years, there have already been four. Since 2011, record-setting snow, rain and cold have been experienced in the state. Of these disaster declarations, 23 have occurred in Caledonia County. (See Table 2.3)

In recent years, it has become evident that human activities, mostly associated with the combustion of fossil fuel, have added to the natural concentration of greenhouse gases in the atmosphere and are contributing to rapid climate change on a global scale. An analysis of annual minimum and maximum temperatures in

Caledonia County shows that minimum temperatures are generally rising faster (.3°F per decade) than maximum temperatures, (.1°F per decade). (See Figure 2.1). Annual precipitation is rising at a rate of about .69" per decade (See Figure 2.2). While projections of the effects of climate change vary, it is generally predicted that the region can expect to have warmer temperatures year-round, with warmer, wetter winters, and increasingly erratic patterns of precipitation.

USDA's recent drought disaster declaration in Caledonia County (and all other counties in Vermont) is not an aberration from the warming trend: Vermont's precipitation patterns, according to a University of Vermont Climate Assessment due out next summer, are moving to extremes: either too much or not enough.[1]

An increase in the size and frequency of storms is also predicted. Thus, climate change in the next century will likely increase the chance of weather-related hazards. An increase in precipitation may also result in increased flooding and fluvial erosion. Drier summers may increase the chance of drought and wildfire. A warmer climate may also result in the influx of diseases and pests that cold winters previously prevented. The Intergovernmental Panel on Climate Change (IPCC) forecasts a temperature rise of 2.5°F to 10°F over the next century, which will affect different regions in various ways over time. Increasing temperatures are expected to significantly exacerbate the impacts of natural hazards and net economic damages will continue to rise[2].

These changes will continue in the future to a greater or lesser extent, depending on how quickly countries transition to a new low-carbon economy. The State of Vermont's Climate Action Plan organizes multiple strategies around five impact areas:

1. Cutting Climate Pollution: Reducing emissions from transportation, buildings, energy and products

2. Resilient and Working Natural Lands: Preparing farms, forests and ecosystems for climate change.

3. Vital Communities: Protecting people and infrastructure from climate impacts.

4. Capturing Carbon: Removing carbon from the air and storing it in soil or plants.

5. Cross Cutting Solutions: Investing in communities and workforce development.

More information is available at https://climatechange.vermont.gov/

Figure 2.1: Minimum and Maximum Annual Temperatures in Caledonia County, 1960-2012

1 Kevin McCallum and Ken Pickard: "Trickle to Torrent: The Climate Crisis Brings Both Deluges and Droughts to Vermont," Seven Days Vermont, October 21, 2020.

2 World Economic Forum: Climate Change is Making Disasters More Expensive. https://www.weforum.org/agenda/2018/10/climate-disasters-cause-global-economic-losses-un/

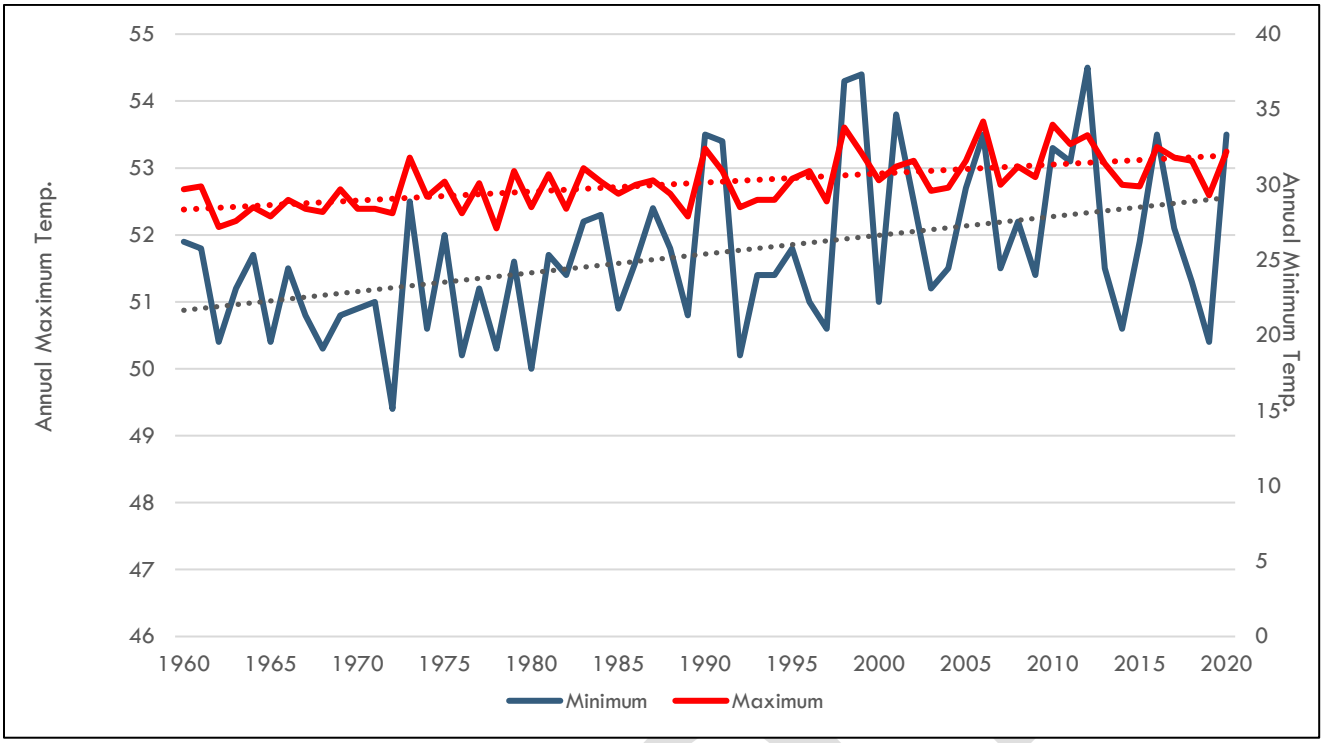
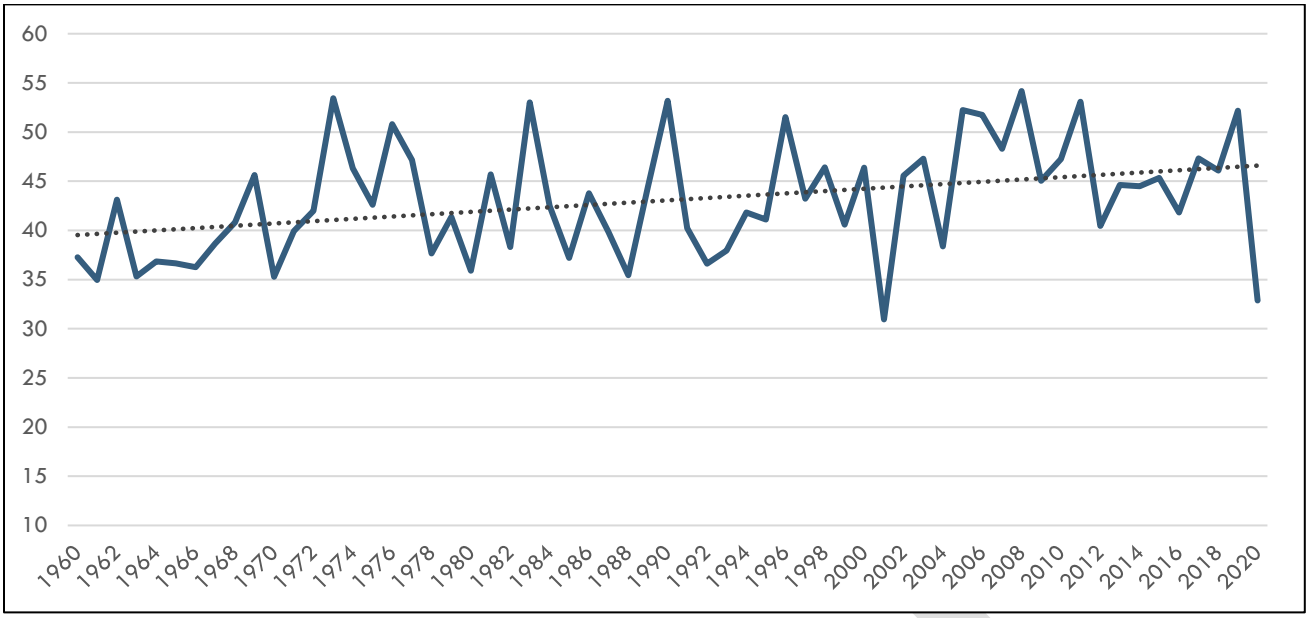

Annual Maximum Temp.
Annual Minimum Temp.
55
54
53
52
51
50
49
48
47
46
40
35
30
25
20
15
10
5
0
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Minimum
Maximum

Figure 2.2: Annual Precipitation in Caledonia County, 1960-2020



NOAA National Centers for Environmental information, Climate at a Glance: County Time Series, published December 2021, retrieved on January 5, 2022 from https://www.ncdc.noaa.gov/cag/

Table 2.3: Disaster Declarations in Caledonia County, 1964-2022

Declaration Number	Date (FY)	Incident Description
DR-160-VT	1964	Drought and impending freeze (this was a statewide declaration)
DR-164-VT	1964	Flooding (this was a statewide declaration)
DR-397-VT	1973	Severe storms, flooding and landslides
DR-518-VT	1976	Severe storms, high wind, and flooding
DR-712-VT	1984	Severe storms and flooding
DR-840-VT	1989	Severe storms and flooding
DR-875-VT	1990	Severe storms and flooding
DR-938-VT	1992	Heavy rains, ice jams and flooding
DR-1063-VT	1995	Excessive rainfall, flooding
DR-1184-VT	1997	Excessive rainfall, high winds, and flooding
DR-1228-VT	1998	Severe storms and flooding
DR-1307-VT	1999	Tropical Storm Floyd
DR-1428-VT	2002	Severe storms and flooding
DR-1559-VT	2004	Severe storms and flooding
DR-1698-VT	2007	Severe storms and flooding
DR-1715-VT	2007	Severe storms and flooding
DR-1784-VT	2008	Severe storms, a tornado, and flooding
DR-1790-VT	2008	Severe storms and flooding
DR-4001-VT	**2011**	**Severe storms and flooding**
DR-4022-VT	**2011**	**Tropical Storm Irene**
DR-4140-VT	2013	Severe storms and flooding

DR-4163-VT	2014	Severe ice storm/Severe winter weather
DR-4178-VT	2014	Severe storms and flooding
DR-4330-VT	**2017**	**Severe storms and flooding**
DR-4532-VT	**2020**	**Biological – Pandemic**
S-4869	2020	Preliminary declaration – Drought
EM-3567-VT	2021	Hurricane – Tropical Storm Henri

Source: FEMA, with the exception of S-4869, records were accessed from Open FEMA Data Sets, accessed December 1, 2020 and again on March 21, 2022. Bolded entries denote known impacts in Ryegate, generally in the form of public assistance.
https://www.fema.gov/about/openfema/data-sets#public

3. RISK ASSESSMENT

Hazard Identification Process

Effective mitigation efforts must be based on a rational evaluation method that answers three basic questions:

1. *What bad things can happen, given the town's vulnerabilities and loss history?*
2. *How likely are these hazards to occur?*
3. *How bad could they be?*

To answer those questions, we assembled as much data and insight on past events. Disasters that have occurred within the Town of Ryegate, the larger region, and the State of Vermont can give us good information about what types of disasters we can expect in the future and what kinds of damage they might cause. However, while this historical data shapes our perspective, the past losses are by no means a crystal ball for predicting future events. Climate change is already changing our weather patterns, which means that we can expect a proliferation in storm events with severe impacts as well as new challenges, like drought in summer and long winters characterized by heavy ice accumulation. Armed with historical data and a healthy respect for climate change and the unknown, the plan represents the town's best attempt to identify hazards and prepare for the future.

Ryegate's 2014 Local Hazard Mitigation Plan identified the following risks as the highest risks to the community:

- Flooding
- Hazardous Materials
- Severe Weather (including high winds, hurricanes, tornadoes, and winter/ice storm)
- Structure Fires
- Water Supply Contamination
- Dam Failures
- Highway Incidents

For this update, the Ryegate Hazard Mitigation Steering Committee considered the hazards profiled in the 2018 Vermont Hazard Mitigation Plan, as well as all the hazards originally assessed in the 2014 Ryegate Hazard Mitigation Plan. To be consistent with the methodology used in the State Hazard Mitigation Plan, the Steering Committee assessed specific *impacts* of hazards (e.g. fluvial erosion, wind, ice) rather than events (such as hurricanes), since the *impacts* of hazards can be mitigated, not events.

Table 3.1: Ryegate Hazards Assessed in 2014, 2022

2014 Plan	2022 Plan	Note
Tornado	Wind	Made consistent with state mitigation plan methodology
Floods (inundation in the floodplain)	Fluvial Erosion Inundation Flooding	Microbursts and beaver dam failures are evaluated as specific events contributing to flooding in Ryegate
Flash Flood		
Hazardous Materials	Combined into a Highway Incident/Hazardous Materials	Both events are related to fixed site and transportation accidents
Radiological Incident		
Structure Fire	Structure Fire	Not profiled as a risk in the 2022 plan. Now considered a vulnerability of extreme cold.
Power Failure		Evaluated as a secondary impact of severe weather and wind
Winter storm/ice	Snow Cold Ice	Made consistent with state mitigation plan methodology
High wind	Wind	Made consistent with state mitigation plan methodology
Air crash	Air crash	
Water supply contamination		Evaluated as a secondary impact of drought
Hurricane	Wind Fluvial Erosion Inundation Flooding	Made consistent with state mitigation plan methodology
Earthquake	Earthquake	
Dam Failure	Dam Failure	
Highway Incidents	Combined into a Highway Incident/Hazardous Materials	
Wildfire/Forest Fire	Wildfire	
Landslide	Landslide	

The steering committee applied the same methodology used in the 2018 State Hazard Mitigation Plan to determine highest-priority hazards:

> Probability * Average Impact Score = Overall Score

Table 3.2: Probability and Impact Scoring

#	Probability	Impact
1	**Unlikely:** <1% probability in any year	**Negligible**: isolated occurrences of minor property and environmental damage, potential for minor injuries, no to minimal economic disruption
2	**Occasionally:**, 1-10% of occurrence in any year; at least 1 chance in 100 years	**Minor**: isolated occurrences of moderate to severe property and environmental damage, potential for injuries, minor economic disruption

3	**Likely**: >10% but < 75% in any year; at least one chance in next 10 years	**Moderate**: severe property and environmental damage on a community scale, injuries or fatalities, short-term economic impact
4	**Highly likely**: >75% in any given year	**Major**: severe property and environmental damage on a community or regional scale, multiple injuries or fatalities, significant economic impact

Table 3.3 All Hazards Assessed

Hazard	Probability	Impact				Overall Score
		Infrastructure	Life	Economy	Environment	
Fluvial erosion	4	4	3	4	4	**15**
Inundation flooding	4	4	3	4	2	**13**
Ice	4	3	3	3	2	**11**
Microburst	4	3	2	3	2	**10**
Beaver dam failure	3	4	2	2	4	**9**
Infectious disease/outbreak	3	3	3	4	1	**8.25**
Invasive species	4	1	1	3	3	**8**
Highway Incidents & Hazard Materials (including radiological incident)	3	2	3	2	3	**7.5**
Dam Failure	2	4	4	3	3	**7**
Snow	4	1	3	2	1	**7**
Wind	4	2	2	1	1	**6**
Cold	3	1	3	2	2	**6**
Drought	3	1	2	2	3	**6**
Water supply contamination	3	2	2	2	2	**6**
Heat	3	1	2	2	2	**5.25**
Structure fire	2	1	3	3	3	**5**
Wildfire	2	2	2	2	2	**4**
Landslide	2	2	2	1	2	**3.5**
Earthquake	1	3	3	3	2	**2.75**
Hail	2	1	1	1	1	**2**
Air crash	1	2	3	1	1	**1.75**

The highest risks to the town (risks to be profiled) were identified and grouped accordingly:

- Flooding: characterized by fluvial erosion, inundation flooding, beaver dam failure, and dam failure.
- Severe winter weather: characterized by ice, snow, and cold
- Severe summer weather: characterized by microbursts, wind, and heat
- Infectious disease/outbreak

- Invasive species
- Drought

The risks not profiled are identified in Table 3.4 below.

Table 3.4 Ryegate Hazards Not Profiled

Risk	Rationale
Highway Incidents & Hazard Materials (including radiological incident)	Concerns over this risk relate primarily to transportation along Route 91 and along an active rail line. Nevertheless, the Town determined that it was inappropriate to profile man-made risks, since the Hazard Mitigation Plan's focus is natural hazards, and FEMA mitigation funds are not used to mitigate man-made risks. This hazard is best addressed through ongoing planning exercises coordinated by first responders and the regional emergency management committee.
Water supply contamination	Though sometimes man-made (through hazard spills), contamination to private water supplies is generally a vulnerability from other natural hazards such as drought and structure fires. This risk is best addressed through implementation of Ryegate's Town Plan (2018), which includes the following strategies to be headed up by the Planning Commission: 1) Develop source protection plans for community water supplies, which identify all potential sources of contamination and suggest strategies for minimizing the risks coming from these sources. 2) Add overlay zone to zoning bylaw for wellhead protection areas to the zoning bylaw. 3) Enlist cooperation of land and home-owners within wellhead protection areas to help minimize risks of contamination from existing land uses. 4) Determine capacity of existing wells and plan for future supply-replacement in case of contamination, and additional supply to accommodate future population growth.
Structure fire/wildfire	Both risks received extremely low overall scores. The bulk of Ryegate's Fire Department responses are for motor vehicle accidents and crashes on Interstate-91. Diligent chimney cleaning initiatives have significantly reduced the number of structure fires. Nevertheless, structure fires are considered a vulnerability of cold winter weather.
Landslide	Low probability and limited potential impact.
Earthquake	Low probability and limited potential impact.
Hail	Low probability and limited potential impact.
Air crash	This is a man-made risk with extremely low probability. This risk was originally identified in the 2014 Hazard Mitigation Plan because of a single incident that occurred in the early 1970s. No data is available.

Profiled Risks

Each of the profiled hazards will be discussed in the following sections. Within each section, previous occurrences of each hazard will be listed, including the County-wide FEMA Disaster Declarations (DR-#), where applicable. Hazards information was gathered from local sources, the National Centers for Environmental Information, and Special Reports produced by the National Weather Service in Burlington, Vermont. This section also includes a description of each "top hazard" and a hazard matrix that will also include the following information:

Location	General areas in community that may be vulnerable to the hazard.

Vulnerability	Community structures, systems, populations, or other assets as defined by the community that are susceptible to damage and loss from hazard events.
Extent	The strength or magnitude and details of the most notable event(s).
Observed impact	Financial impact from an event, and/or the number of structures that are impacted.
Likelihood/Probability	Occasionally:, 1-10% of occurrence in any year; at least 1 chance in 100 years; Likely: >10% but < 75% in any year; at least one chance in next 10 years; Highly likely: >75% in any given year

Flooding

Floods can damage or destroy public and private property, disable utilities, make roads and bridges impassable, destroy crops and agricultural lands, cause disruption to emergency services, and result in fatalities. People may be stranded in their homes for a time without power or heat, or they may be unable to reach their homes. Long-term collateral dangers include the outbreak of disease, loss of livestock, broken sewer lines or wash out of septic systems causing water supply pollution, downed power lines, loss of fuel storage tanks, fires and release of hazardous materials. The National Weather Service issues flood watches and warnings when conditions are right for flooding. A flood watch indicates that meteorological conditions are conducive to flooding. People in the watch area are instructed to stay tuned to local radio or television stations for updates on flooding and weather conditions. When flooding is imminent, a flood warning is issued. The warning will identify the anticipated time, level and duration of flooding. Persons in areas that will be flooded are instructed to take appropriate protective actions, including evacuation of family members and removal or elevation of valuable personal property.

Ryegate has two major rivers flowing through town, the Connecticut and Wells Rivers, and several small ponds, including Ticklenaked Pond, Lower Symes Pond, McLam Pond, and Coburn Pond (See Exhibit 1: Ryegate Base Map). Typically, the type of development that exists within the floodplain will determine the extent of damage that flooding will cause. In Ryegate, development within the Special Flood Hazard Area includes mostly residential uses in and east of South Ryegate Village along the Wells River.

The one major flood event in recent history where all other events are judged against is the Flood of 1927. Severe loss of life and property was experienced. Statewide, more than 50% of bridges and roads were damaged in the flood that occurred on November 27th of that year. Flooding was statewide. Most bridges over roads were installed after that flood and are now being methodically replaced by the Vermont Transportation Agency on state roads and highways. The Federal Emergency Management Agency (FEMA) and the State of Vermont report that since 1973, Caledonia County has been involved in 24 Presidentially Declared Disasters. All but two involved some form of flooding, and of these, flooding incidents, all but one occurred in the spring or summer months.

The Town of Ryegate has a history of flooding that predates FEMA's reporting of disaster declarations. Damage has been primarily related to road and bridge damage along Routes 5 and 302. These sections of road were considered state highways and were repaired through the Vermont Agency of Transportation. There have been ice jams at the southern end of Ryegate along the Wells River, where one house near the flood zone is affected. All surrounding towns' water drains into South Ryegate before heading to Wells River where regular flooding takes place.

Records of major floods in Ryegate go far back as March 1913. Of these floods, the July 1973 flood was found to be the most severe. Long-term stream records (1949 to present) at the USGS gauging station just

before the confluence of the Connecticut River and the Wells River indicate that the July 1973 flood had a recurrence level of less than one hundred years. The areas around South Ryegate (Routes 302 along the Wells River), the Creamery Road, and Brown Drive, are most vulnerable to flooding. Properties in this area can become isolated when low lying portions of roadways become flooded. The most definitive flooding data comes from the USGS gaging station at the Wells River, where the flood stage is set at six feet. Data going back to the early 1940s indicates that water levels have exceeded the flood stage 29 times, with 9 of those flooding events occurring in the year 2000 or later. Data shows that the 1973 flood remains the highest flood on record – but Tropical Storm Irene is not far behind. Rainfall for Irene was about 6 to 8 inches in southern Caledonia County, with highest rainfalls recorded in the vicinity of South Ryegate. (An observer WSW of neighboring Groton recorded 7.75 inches.)

Table 3.5: Historic Crests on the Wells River Gage

Date	Event	Location	Extent
6/30/1973	Severe storms and flooding (DR 397)	County Wide, Ryegate	Crest at 9.82 ft. and 5,970 cfs.
8/29/2011	Tropical Storm Irene (DR 4022)	Statewide, Ryegate	Crest at 9.0 ft., and 5,170 cfs. $110,064 in flood insurance claims in Ryegate
6/7/1984	Severe Storms (DR 712)	County Wide	Crest at 8.68 ft.
7/15/1997	Excessive rains, flooding (DR 1184)	County Wide	Crest at 8.54 ft.
6/2/1952	Flooding	County-Wide, Ryegate	Crest at 8.12 ft.
7/02/2017	Severe Storms and Flooding (DR 4330)	County-Wide, Ryegate	Crest at 7.61 ft.
4/16/2014	Severe Storms and Flooding (DR 4178)	County-Wide	Crest at 7.54 ft.
1/20/1996	Flooding	Caledonia, Ryegate	Crest at 7.52 ft.
5/26/2011	Severe storms and flooding (DR 4001)	Caledonia, Essex, Washington Counties, Ryegate	Crest at 7.39 ft.

Source: National Weather Service, NOAA

Two residential properties in South Ryegate were damaged in the 2011 flooding. One structure was the FEMA buyout. Another property was damaged when an unnamed tributary to the Wells jumped course and ran under a portion of the property. The damaged portion of the structure was removed by the owner. Apart from those losses, it is difficult to put a price tag on private property losses. However, in the recent community-wide survey, eight respondents indicated that they had been personally impacted by flooding or streambank erosion.

Inundation Flooding

Inundation flooding, which is characterized as the rise of riverine and lake water levels, occurs during significant levels of precipitation from rainstorms, thunderstorms, or hurricanes or tropical storms. Inundation can also occur due to rapid snow and ice melt during rapidly temperatures in the late winter or spring. Inundation flood risk information is presented on Flood Insurance Rate Maps (FIRMs), which are based on historic, meteorological, hydrologic, and hydraulic data, as well as open-space conditions, flood control works, and development. To prepare FIRMs that illustrate the extent of flood hazard in a flood prone community, FEMA conducts engineering studies referred to as Flood Insurance Studies (FISs). Using

information gathered in these studies, FEMA engineers and cartographers delineate Special Flood Hazard Areas (SFHAs) on FIRMs. SFHAs are those areas subject to inundation by a flood that has a 1-percent or greater chance of being equaled or exceeded during any given year. This type of flood is referred to as a base flood. A base flood has a 26-percent chance of occurring during a 30-year period, the length of many mortgages. The base flood is a regulatory standard used by Federal agencies, and most states, to administer floodplain management programs, and is also used by the National Flood Insurance Program as the basis for insurance requirements nationwide. (See Exhibit 4: FIRM Overlay Maps.)

Since Ryegate does not have digitized FEMA Flood Insurance Rate Maps (FIRM), NVDA has estimated the number of structures within the Special Flood Hazard Area by overlaying the FIRM with other Geographic Information System (GIS) mapping data available for the town. According to the mapping analysis, Ryegate has 29 properties that appear to be located in the Special Flood Hazard Area, mostly concentrated in the vicinity of South Ryegate. The majority of properties are residential, as well as two commercial structures, and the Library, South Ryegate Church, and the South Ryegate Post Office, and a DHART helipad site. If all these properties were to be destroyed the resulting damage would equal approximately $3,473,800 according to latest lister data.

While FEMA maps and accompanying information are typically sparse in Vermont's Northeast Kingdom, Ryegate is fortunate to have a flood insurance study and base flood elevations for the Wells River and the Connecticut River. All other areas on Ryegate's FIRMS are identified as "approximate A zones" without accompanying data.

River Corridors

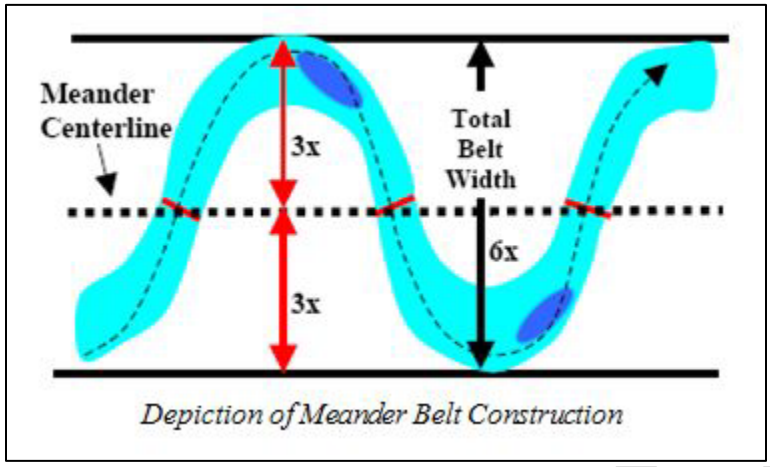
While inundation-related flood loss is a significant component of flood disasters; ANR estimates that inundation areas have only been mapped for about 20% of Vermont's stream miles. The more common mode of damage is associated with the dynamic, and often catastrophic, physical adjustment of stream channel dimensions and location during storm events. These adjustments are often due to bed and bank erosion, debris and ice jams, or structural failure of or flow diversion by man-made structures. This explains why Vermont's flood-related losses often occur outside of the Special Flood Hazard Areas on the FEMA FIRMS.

The Vermont Rivers Program of the Agency of Natural Resources has released statewide data on areas subject to fluvial erosion for all streams and rivers. These risk areas are defined by Vermont Statute as "River Corridors":

> "the land area adjacent to a river that is required to accommodate the dimensions, slope, planform, and buffer of the naturally stable channel and that is necessary for the natural maintenance or natural restoration of a dynamic equilibrium condition, as that term is defined in section 1422 of this title, and for minimization of fluvial erosion hazards, as delineated by the Agency of Natural Resources in accordance with river corridor protection procedures." (10 V.S.A. Chapter 32 § 752. Definitions)

Mapped river corridors along streams with a drainage area of two miles or more consist of two components: a *meander belt* and a *riparian buffer*. The meander belt is an area calculated to accommodate the amplitude of stream meanders that have or will form in response to the laws of physics which dictate that channel depth and slope evolve toward a state of minimal work (i.e., equilibrium or least erosive form). The width of the meander belt will vary depending on the amount of land draining to a given point on a stream, so the River Corridor width varies in part based on stream size. (See Figure 3.1)

Figure 3.1: River Corridor Meander Belt



Source: Vermont Agency of Natural Resources, https://floodready.vermont.gov/

The riparian buffer is an extension of the meander belt to provide additional protection. A naturally vegetated buffer helps to protect streambank stability if the meander moves to the edge of the meander belt. If this extension were not included and structures were planned at the very edge of the meander belt, a prospective home or business owner would need to armor the riverbank to protect the structure.

For streams with a drainage of less than two square miles, a riparian buffer of 50 feet on either side of the top of the streambank is deemed sufficient to accommodate lateral movement of the stream channel.

ANR's River Corridor Maps do not indicate any required action on the part of municipalities. They are developed to facilitate ANR's responsibilities in Act 250 to protect public safety from fluvial erosion hazards and to regulate activities exempt from zoning and local land use regulations under the Flood Hazard Area and River Corridor Rules. The Legislature has directed the ANR to promote municipal river corridor protection. Municipalities can – but are not required – to regulate development in the river corridor as part of their flood hazard regulation. The state does not require municipalities to use these maps, but they are strongly recommended.

Analysis of ANR River Corridor Maps indicates that there are 49 properties in the river corridor. Thirty-one of these properties are NOT located in the Special Flood Hazard Area. If all of these 31 properties values were destroyed, the resulting damage would equal approximately $3,807,300 according to latest lister data. The majority of these structures are residential, and there is a handful of camps and commercial structures. There is one leach field in the river corridor that serves three businesses.

Flash Flooding

Flash floods occur when severe storms drop high amounts of rainfall in short periods of time. Precipitation falls so quickly that the soil is unable to absorb the water, which results in surface runoff that collects in small, upstream tributaries, that then moves quickly downstream at a high velocity. Stream alterations due to fluvial erosion can exacerbate the effects of flash flooding. Because the accumulation originates in small, upstream tributaries, flash flooding is more frequent in areas with steep slopes and narrow stream valleys. Of all types of natural hazards experienced in Vermont, flash flooding has historically resulted in the greatest magnitude of damage suffered by private property and public infrastructure. Most communities have undertaken significant mitigation measures in recent years, although flash floods can strike at any time in areas that are not identified as typical flood hazard areas, continuing to cause public and private damage. Flash flooding has been more frequent in Ryegate, with three different events during 2011, one in 2012, and one in 2017. The events of 2011 resulted in damage to personal property and roads, and the event of 2017 resulted in town-wide damage to roads. Public assistance received covered of repairs of a road washouts from an unnamed tributary to Wells River by the bridge on old Vt. 302 (Town Highway 5, the Creamery Bridge Road) in South Ryegate village, and washouts at the junction of Witherspoon and Stone Roads (just north of the South Ryegate village near the quarry). Another road washout on the North Bayley Hazen Road (just north of Ryegate Corners) was caused by the Wormwood Brook. In 2017, the Town of Ryegate received nearly $59,000 in FEMA public assistance to make town-wide repairs to shoulders, swales, surfacing, and culverts along the following roads: Brock, Chamberlin, Hall, Mosquitoville, North Bayley Hazen, Stone, Whitehill, and Witherspoon.

Table 3.6: Public Assistance Received for Flood Damage

Declaration	Total Damage Amount	FEMA Share
4022	$1,085	$976
4022	$12,309	$11,078
4022	$51,237	$46,113
4330	$78,621	$58,966
Total	$143,252	$116,157.00

Source: Open FEMA

Major roads and highways, Classes One and Two, are governed and maintained by the Vermont Agency of Transportation, or VTrans. Many of these Class Two roads experience flooding during flash floods. Maintenance and repair of infrastructure has been ongoing. VTrans highway districts #7 covers the Town of Ryegate. VTrans staff has worked with the Town of Ryegate to adopt Local Codes and Standards as a best practice. The standards require upgrades on new roads, culverts and bridges to help withstand local flood-related damages.

Dam Failure

There are three large hydro-electric dams on the Connecticut River that are upstream of the Town of Ryegate and under federal regulation and New Hampshire's Department of Environmental Conservation oversight. They include the Comerford Dam, McIndoe Falls Dam, and the Moore Dam and are all listed as High Hazard dams because of the drainage area needed to absorb the reservoir, plus the potential loss of life and economic losses should a breach occur. The classification is independent of the dam's overall condition and is not indicative of the structural integrity of the dam, but rather the effects if a failure should occur. The hazard potential assigned to a dam is based on worst-case scenario consideration of the effects of a failure during both normal and flood flow conditions. High hazard dams are located where failure or mis-operation will probably cause loss of human life.

Table 3.7: Dams in Ryegate

Dam Name	Year Built	NH DEC HAZUS Class	Owner	Drainage Area (Acres)
Comerford Dam	1931	High Hazard	Great River Hydro	1,046,400
MacIndoe Falls Dam	1931	High Hazard	TransCanada	1,414,400
Moore Dam	1956	High Hazard	TransCanada	1,024,000

These three dams provide a significant amount of hydro-electric power to the New England Grid and the operating utilities are required to maintain safety checks, inform the public of inundation plans, and have an early warning system in place. Regular maintenance is ongoing to assure safety measures. If a large flood event beyond the historical magnitude of the region did occur, the possibility exists for a major breach of a large dam and severe inundation throughout the Connecticut River Valley. The Village of East Ryegate is located within the inundation areas for a dam breach. Large storms and heavy rainfall can contribute to a dam failure, as can a well-situated, higher magnitude earthquake. However, as Vermont's State Hazard Mitigation Plan (2018) also notes, dam failure can occur during a perfectly normal sunny day. This latter scenario, which provides no warning, is particularly dangerous.

According to dam inundation mapping, there are 15 properties in the dam inundation area, including 11 residential structures, three commercial structures, and a utility substation. If all these properties were to be destroyed, their collective listed value would be $2,527,200.

All three dams are inspected annually. The New Hampshire Dam Safety Program normally accompanies the federal inspectors, along with owner representatives, on the annual inspections. The NH Dam Safety officials consider the dams to all are in good condition and current with FERC requirements.

Great River Hydro, the dams' operator, has developed an Emergency Action Plan (EAP) website for communities that is username and password protected, so they can access EAPs for use in their local planning efforts. The EAP website includes PDF copies of our emergency action plans, GIS shapefiles, and has an interactive GIS mapping platform that shows the extents, timing, and depth of flooding for both sunny day and wet weather scenarios.

Beaver Dam Failure

Although Vermont statute allows for the lethal removal of nuisance beavers (live removal is prohibited) and the removal of beaver dams, other statutes require that water quality and wetlands be protected. The State of Vermont has developed Best Management Practices (BMPs) that attempt to achieve a balancing act between minimizing risk of damage and, to the greatest extent possible, protect water quality and wetland values.[3]

The Town of Ryegate encounters conflicts with beavers every year. Dams tend to some wash up and over roads, where they plug culverts. A particular problem spot is on Miller Drive, where beavers build annually, with mostly mud and not sticks. Every few years, this dam lets go and washes up and over at least two roads, sending the mud and sediment a mile downstream into Ticklenaked pond. About 15 years ago, a beaver

[3] VT Department of Fish and Wildlife: Best Management Practices for Handling Human-Beaver Conflict https://vtfishandwildlife.com/sites/fishandwildlife/files/documents/Learn%20More/Library/FACTSHEETS/FURBEARER%20AND%20TRAPPING/BMP%20BEAVER%20CONFLICTS%20BROCHURE.pdf

dam failed below a pond south of Hooper Road. The pond, which was at least two to three acres in size, blew downstream and took out the culvert under Witherspoon Rd.

Estimated losses of damage stemming from beaver dam failures over the past four years is about $5,000, when accounting for equipment, staff time, and materials.

Table 3.8: Flooding Risk Summary Table

Type	Vulnerability	Extent	Observed Impact	Likelihood/Probability
Inundation flooding/flash flooding/fluvial erosion	29 properties, including South Ryegate Church, library, South Ryegate Post Office, and DHART helipad, in Special Flood Hazard Area, with a collective listed value of $3,473,800; additional properties in the river corridor, with the collective listed value of $3,807,300. 81 culverts in poor condition; Creamery Road Bridge compromised.	Wells River Gage Crest at 9.82 ft. and 5,970 cfs. (1973) highest on record since early 1940s.	$143,252 total damage to roads and culverts (DR 4022 and 4330); loss of one residential structure and partial loss of another structure (DR 4022).	75% chance in any given year.
Dam failure	15 structures, including an electrical substation, with a collective listed value of $2,527,200.	No historical data on dam failures	No historical data on dam failures.	1-10% of occurrence in any year; at least 1 chance in 100 years.
Beaver dam failure	Plugged culverts; areas along Miller Drive.	Collapse of beaver dam south of a two-to-three acre pond.	$5,000 in damages over the past four years.	>10% chance but < 75% in any year; at least one chance in next 10 years

Severe Winter Weather

In the Ryegate Hazard Mitigation Survey, 94% of respondents indicated that they had been affected by severe winter storms, and more than half were “very concerned” about severe winter storms. About 60% indicated that they had gone without power for at least one day (although they did not attribute the power loss directly to winter storms). A third indicated that they went without heat for a day or longer. “When the power is out, I have no heat or water or anything,” wrote one respondent. One respondent indicated that impassable roads (from snow) hindered their ability to get to work.

Winter weather often results in temporary road closures, school and business delays, and even power outages. Given the high amount of snowfall this region experiences, the town and residents are generally well prepared to deal with normal winter weather conditions. Severe winter storms, however, have been shown to affect the entire region resulting in:

- Extensive damage to above-ground power and utility lines and extended power outages (as what happened in the ice storm of 1998);
- Road and rail shutdowns, making general travel, transport, and emergency vehicle access difficult;
- Shutdown of schools, businesses, and local government services, limiting access to goods and services;
- Structural failure from excessive snow loading, especially barns (as in the storm of 2007);
- Injuries and fatalities from poor driving conditions, frostbite, hypothermia, heart attacks from overexertion, and carbon monoxide poisoning from blocked vents.

Severe winter weather affects the entire planning area. According to the *2018 Vermont State All-Hazards Mitigation Plan*: "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. Significant accumulations of ice can cause hazardous conditions for travel, weigh down trees and power lines, and cause power outages. Freezing rain can also be combined with snowfall, hiding ice accumulation and further hindering travel, or with mixed precipitation and potentially ice jams or flooding."

The National Weather Service (NWS) has a new prediction tool (still in prototype) called the Winter Storm Severity Index. The purpose of this tool is to provide National Weather Service (NWS) partners and the public with an indication of the level of winter precipitation (snow and ice) severity and its potential related societal impacts. The WSSI does not depict official warnings, and should always be used in context with official NWS forecasts and warnings.

Table 3.9 NWS Winter Storm Severity Index (Prototype)

WSSI Descriptor	General Description of Expected Storm Severity Impacts
None	No snow or ice forecast. No potential for ground blizzard conditions.
Limited	Small accumulations of snow or ice forecast. Minimal impacts, if any, expected. In general, society goes about their normal routine.
Minor	Roughly equates to NWS Advisory Level criteria. Minor disruptions, primarily to those who were not prepared. None to minimal recovery time needed.
Moderate	Roughly equates to NWS Warning Level criteria. Definite impacts to those with little preparation. Perhaps a day or two of recovery time for snow and/or ice accumulation events.
Major	Significant impacts, even with preparation. Typically several days recovery time for snow and/or ice accumulation events.
Extreme Historic	Widespread severe impacts. Many days to at least a week of recovery needed for snow and/or ice accumulation events.

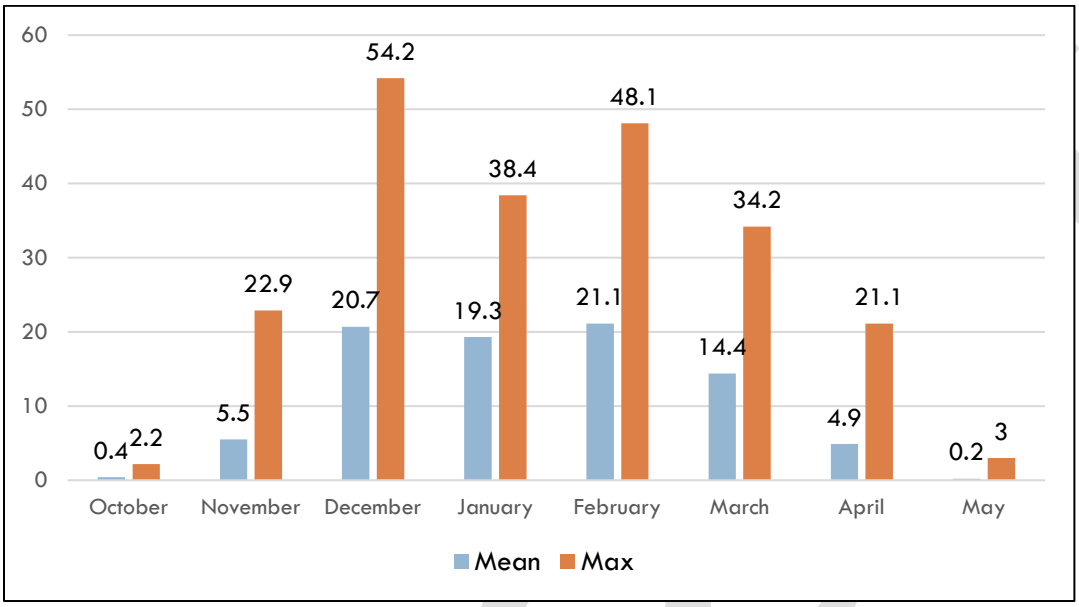
Any given storm will have different levels of impact from these individual components.

- Snow Amount
- Snow Load
- Ice Accumulation
- Blowing Snow Index
- Ground Blizzard
- Flash Freeze

Snow

According to the NOAA database, the record snowfall extreme for Caledonia County occurred on February 25, 1969, with 1-day, 2-day, and 3-day totals of 33", 34.5" and 35.5" respectively. Caledonia county's snow season can extend from October through May, with the heaviest accumulations occurring December and February. The mean average snowfall for the season (from 2000 through 2020) is 88.1. (Figure 3.2)

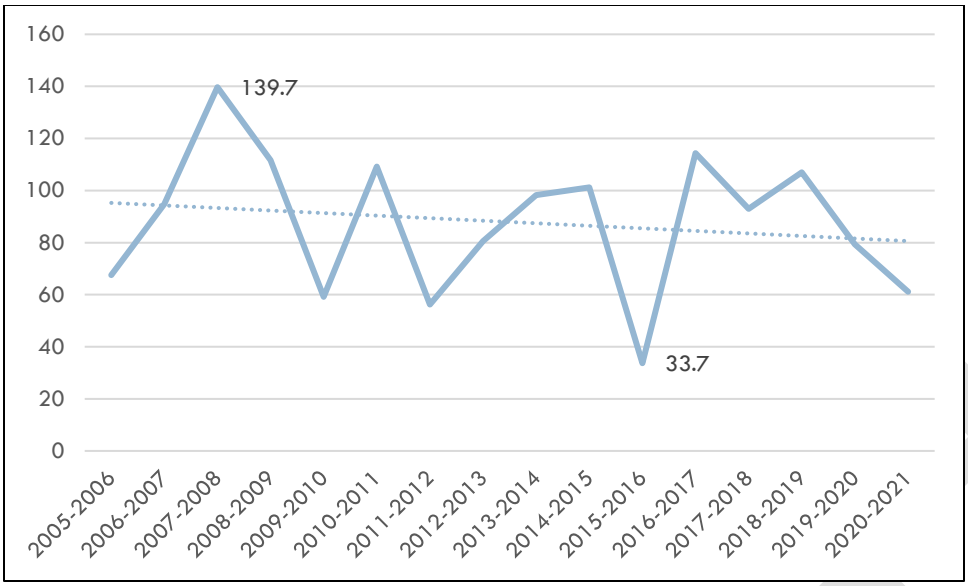
Figure 3.2: Mean and Maximum Snowfalls in Caledonia's Winter Season, 2000-2020



Source, National Weather Service, NOAA

Caledonia's snowiest season since 2005 was the winter of 2007-2008 with total snowfall of 138.7". The lightest snowfall occurred in the winter of 2016-2017 with only 33.7". Despite the highly erratic totals from year to year, data from the past 15 years indicate that total snowfall is decreasing. (Figure 3.3). Reductions in snow fall may leave exposed ground more vulnerable to freezing during extreme cold events, which can cause significant impacts to building infrastructure.

Figure 3.3: Total Snowfall in Caledonia County, 2005-2020



Source: National Weather Service, NOAA

"Heavy Snow" according to the National Weather Service snowfall accumulating to 4" or more in depth in 12 hours or less; or snowfall accumulating to 6" or more in depth in 24 hours or less. The NOAA database records four heavy snow events in Caledonia County since 2000:

- February 27, 2002 ($1,000 property damage)
- February 14, 2007 ($200,000 property damage)
- February 5, 2014 ($10,000 property damage)
- February 13, 2014 ($15,000 property damage

The Valentine's Day storm in 2007 had the greatest impact in the region. Snow fell heavy at times from late morning through early afternoon in southern Vermont and early afternoon through early evening elsewhere, before dissipating during the night. 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. Further, temperatures in the single numbers above zero combined with these brisk winds created wind chill values of 10 degrees below zero or colder. Snowfall totals ranged from 15 to 25 inches in the Connecticut river valley. The storm total of 25.7 inches was the 2nd heaviest storm total snowfall on record, behind the 29.8 inches received on December 25th through 28th, 1969.

Snowfalls in the Connecticut River valley were as high as 25 inches in some areas. High winds created snow drifts as high as six feet, which caused numerous problems, including the blocking of numerous heat vents that resulted in the build-up of carbon monoxide, sending 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. 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.

NOAA defines "**Winter Weather**" as a "winter precipitation event that causes a death, injury, or a significant impact to commerce or transportation, but does not meet locally/regionally defined warning criteria. A Winter

Weather event could result from one or more winter precipitation types (snow, or blowing/drifting snow, or freezing rain/drizzle)."

By comparison, a "**Winter Storm**" event is defined as a "winter weather event that has more than one significant hazard (i.e., heavy snow and blowing snow; snow and ice; snow and sleet; sleet and ice; or snow, sleet and ice) and meets or exceeds locally/regionally defined 12 and/or 24 hour warning criteria for at least one of the precipitation elements."

Caledonia County had 113 *winter weather* events reported in the NOAA Storm Events database from September 1, 2000 to September 30, 2021. Collectively, $509,500 in property damage was reported county-wide. No crop damage was reported, nor deaths or injuries directly attributed to the winter weather. The greatest amount of damage reported was from winter weather on November 29, 2016:

"A warm front moved across Vermont during the morning hours of November 29th bringing light amounts of precipitation. Precipitation in the form of freezing rain moved into central and eastern VT around daybreak and lasted for several hours with less than one tenth ice accretion. There were dozens of vehicle accidents and thousands of commuters stranded/impacted as state roads and Interstates 89/91 were closed or impassable in spots. One vehicle accident in Bridgewater along Route 4 resulted in a fatality."

The NOAA database reports that there 94 *winter storm* events reported over the same period with collective property damage of $1,435,000, and collective crop damage of $20,000. There was no deaths or injuries directly attributed to the storm events. The three most damaging events incurred $75,000 in property damage each:

February 5, 2001: *"A storm system developed off the coast of Virginia early Monday, February 5, 2001 and moved northeast . It moved across extreme southeast coastal New England late Monday night and into the Gulf of Maine early Tuesday, February 6th. Steady snow spread across the area by the afternoon of Monday, February 5th and continued overnight and was heavy at times. The snow tapered off to flurries Tuesday morning, February 6th. Some minor automobile accidents were reported. Barn roofs collapsed in the Towns of Craftsbury and Holland (Orleans county), apparently due to the weight of the snow after the storm ended. Across the counties, generally 10 to 14 inches of snow fell, with Sutton (Caledonia county) reporting 14.4 inches, Chelsea (Orange county) with 12 inches, and Greensboro (Orleans county) with 10 inches."*

December 9, 2014: "*Low pressure moved north along the eastern seaboard on December 9th and then stalled across New England through December 11th before lifting northeast into the Canadian Maritime. This storm was comprised of three phases. The initial phase was rain and wet snow that moved into Vermont during midday of December 9th and changed to a heavy, wet snow during the evening and early night. The second phase was a band of moderate snowfall that impacted much of central and northern Vermont during the afternoon and evening hours of December 10th, then the last phase was scattered snow showers eventually ending on December 11th and 12th. Total snowfall totals across Vermont ranged from 3 to 6 inches in Essex county to 12 to 20 inches across much of the spine of the Green Mountains into the Champlain Valley. The heavy, wet nature of the snowfall with snow to water ratios of 8:1 or less accounted for snow-loaded trees that resulted in more than 175,000 power outages in the region from December 9th through December 12th. This was the 2nd most power outages due to weather in the state of Vermont."*

November 26, 2018: "*A storm that brought blizzard conditions to parts of the Midwest on Sunday, November 25th moved into the Ohio River Valley - Southern Great Lakes on 11/26. The storm slowed considerably in the eastern Great Lakes, thus allowing a secondary low pressure system to develop near the Delmarva Peninsula during the evening of 11/26 and proceeded to move to near Boston by the morning of November 27th. Precipitation moved into the North Country by the afternoon of November 26th, falling as snow at elevations above 1500 feet and rain at lower elevations. By early morning of November 27th, the atmosphere cooled enough to allow for precipitation to changeover to snow. Highest snowfall totals at elevations above 1500 feet, where more than 12-15 inches fell. The heavy wet snow accounted for more than 40,000 outages, effecting 100,000 customers without power due to snow loading on power lines.*"

Ice

The Vermont State Hazard Mitigation Plan considers ice to have greater impacts from those associated with snow. Our warming winters can lead to prolonged patterns of melting and refreezing, not to mention wintry mix of freezing precipitation. Pre-storm road temperatures and surface conditions affect the potential for ice accumulation on roads and walkways. Roads and walkways washed clear of salt and sand by rain, for example, are more likely to form ice. Subsequent snow accumulation can hide the snow, hiding the icy layer beneath. A search of NOAA winter storm records reveals that ice accumulation or icy conditions were involved in 11 of Caledonia County's winter weather events and 15 of its winter storm events. Ice accumulation on powerlines can lead to significant and prolonged power outages as well. For example:

January 18, 2015: *"Low pressure tracked across eastern New England during the nighttime and early morning hours of January 18th-19th. The initial precipitation across Vermont was in the form of rain with air temperatures in the 30s to around 40 degrees. However, after more than a week of temperatures frequently near zero, road sub-surface temperatures were in the teens and 20s. Therefore, as rain fell and dusk approached, wet roads quickly became icy roads and lead to numerous vehicle accidents and closures of state and interstate roads."*

Icy conditions can be especially challenging for dirt roads. Of particular concern is Witherspoon Road which frequently experienced freezing surfaces. Portions of the road had become impassable from sheet flow, causing wheel tracks to become rain gutters. In 2014, this road received extensive work, including full excavation of the roadway, installation of new geotextile fabric and subbase, drainage, ditching, culvert replacement, slope stabilization, and clearing and grubbing. The total cost was more than $660,000.

Caledonia County's most recent significant ice storm event was from January 6, 1998.

"A storm system moved from the Tennessee Valley on Wednesday (January 7) and Thursday (January 8) into New England thereafter. A cold front across New England and New York associated with an Arctic High Pressure system across Canada resulted in a flow of low level cold air into Vermont. Warm moist air riding over this low level cold air resulted in icing across portions of this area. Significant icing was generally restricted between 1500 and 2500 foot level. Ice accumulations during this event were generally 3/4 of an inch or less. The impact on the region ranged from ice accumulations damaging tens of thousands of trees. Downed power lines resulted from the weight of the ice with several thousands 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."

Cold

Figure 3.4 depicts historic winter temperatures in Caledonia County (St. Johnsbury) through the most recent complete winter season 2020-2021. The blue bars illustrate the highs and lows, juxtaposed with the normal temperature ranges from 1990-2021 shown in brown. Historic highs (red) and lows (blue) for each day are also shown, with records going back to 1894. The coldest temperature ever recorded was -43° on December 30, 1917 and again on February 16, 1943. "Cold" and "extreme cold" have relative meanings for different parts of the country, but sub-zero temperatures are considered extremely cold in northern Vermont. According to data from the past 20 years, sub-zero temperatures can occur between November and March. (Table 3.10).

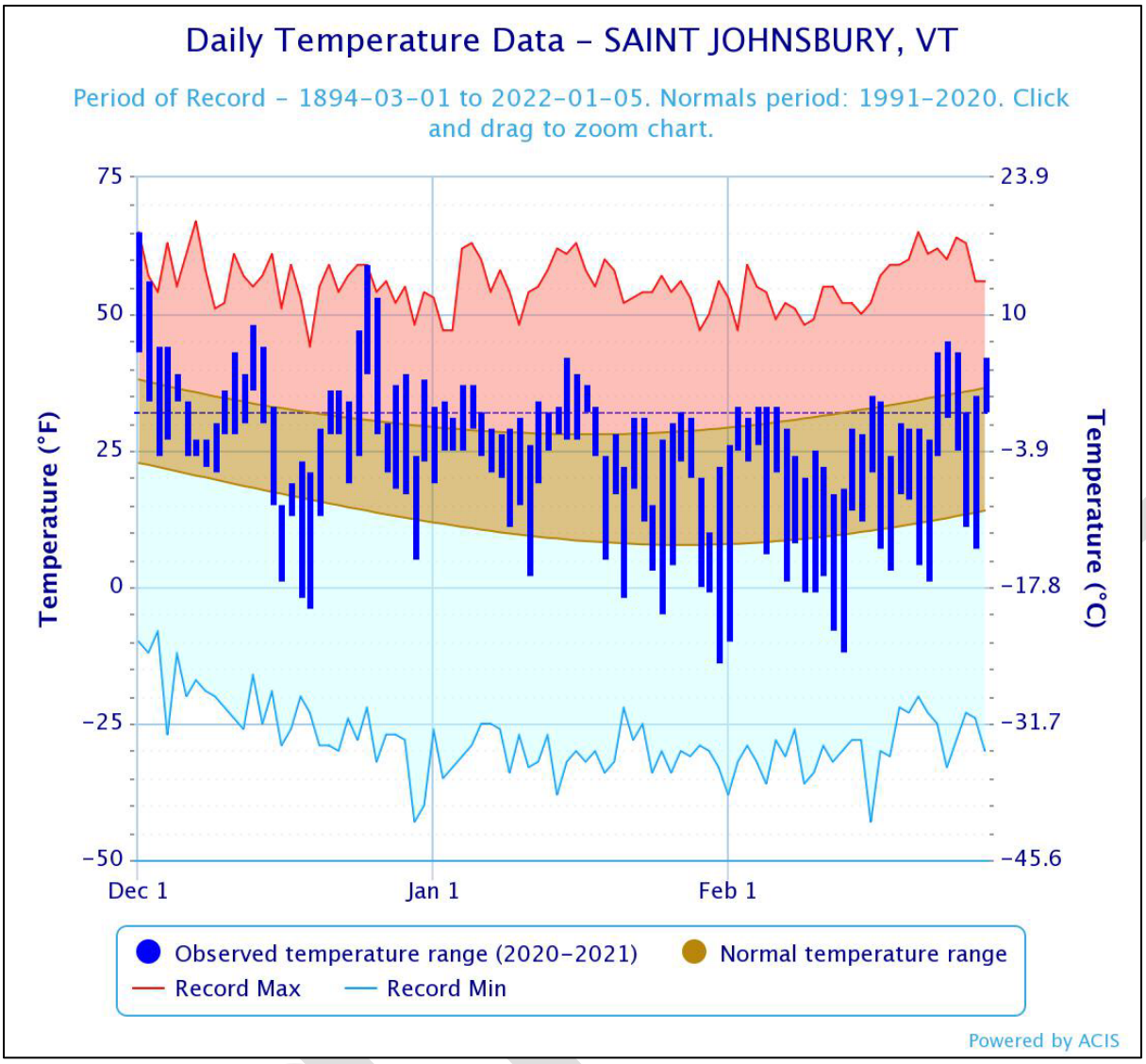
Table 3.10: First and Last Sub-Zero Temperatures in Caledonia County, 2000-2020

	First Date	Last Date
Mean	December 13	March 8
Minimum (Earliest)	November 17 (2019)	February 6 (2010)
Maximum (Latest)	January 17 (2007)	March 25 (2014)

Source: National Weather Service

Cold temperatures are exacerbated by the **wind chill factor**, when increased wind speeds accelerate heat loss from exposed skin, and the wind chill is a measure of this effect. While no specific rules exist for determining when wind chill becomes dangerous, the threshold for potentially dangerous wind chill conditions is usually considered to be about -20°.

Figure 3.4: Winter Temperatures, Normal Ranges, and Historic Records



Source: NOWData. is a project of the Regional Climate Centers, the National Centers for Environmental Information, and the National Weather Service.

The NOAA Storm Event database has five events with extreme cold/wind chill in Caledonia, with lows ranging from -23°F to -30°F from 2000 to present. There were no records of property damage, injuries, or deaths recorded.

Extreme cold is likely to impact everyone town-wide: Water pipes can freeze or burst, car batteries can die. Those who are especially vulnerable to the impacts of extreme cold are residents in older structures and energy-burdened households. According to most recent American Community Survey 5-year estimates (2019), Ryegate's housing stock is relatively old. More than a third of Ryegate's housing units (36%) were built in 1939 or earlier, compared to Caledonia (31%) and Vermont (26%). Nearly half of Ryegate housing units are at least 50 years old. Older structures are likely to be "leaky" and poorly insulated, which can nearly double average heating energy use. Heating challenges are further exacerbated by energy burden, which is measured as energy spending as a percentage of income. Energy burden, according to a 2019 study by Efficiency Vermont, is fairly high in the rural Northeast Kingdom. While the average energy burden statewide is about 10%, Ryegate's overall energy burden is considered "moderate" at 11.1%.. The greatest

determinant of energy burden is income, not fuel cost, so even though many residents are able to reduce their costs by burning wood, they still struggle to make ends meet.[4] Ryegate has recently formed a local energy committee, which can help raise awareness of low- or no-cost home weatherization services, such as HEAT Squad and Northeast Employment and Training.

Structure fires were originally profiled as a hazard in the 2014 Ryegate Hazard Mitigation Plan. Since that time, occurrences have diminished significantly. This is attributed to the Town Fire Department's commitment to ongoing chimney inspections. Nevertheless, structure fires should be considered a vulnerability of cold temperatures, since fires are more likely to occur during the winter heating months. According to FEMA, Vermont's crude death rate (per million in population) of 17.6 is well above the national crude rate of 11.2. These rates should be viewed with caution, since they are based on very small numbers of actual deaths. Nevertheless, the relative risk of fire in Vermont is 1.6, still slightly above the overall national risk of 1.0.[5] The age of Ryegate's housing stock, as well as its dispersed settlement pattern are complicating factors. Residents living in remote areas accessible by class roads may face a delayed response time for emergency vehicles.

Table 3.10: Severe Winter Weather Summary Table

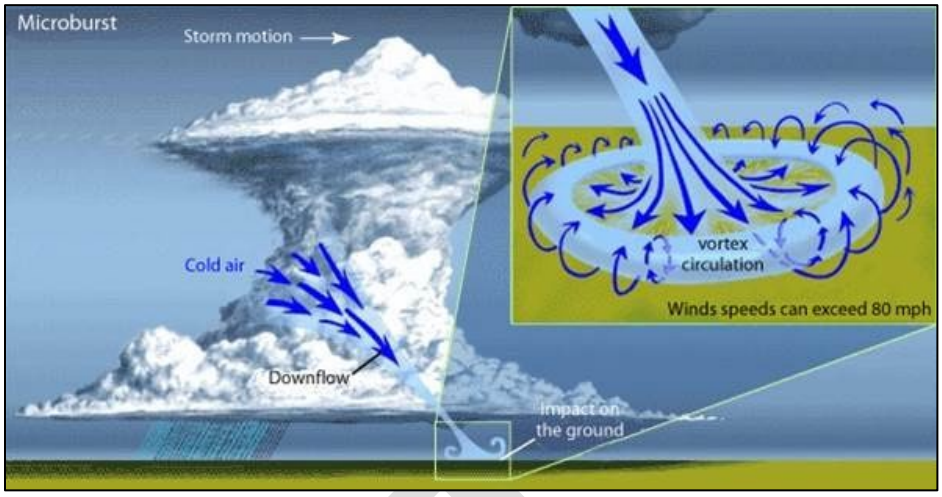
Type	Location	Vulnerability	Extent	Observed Impact	Likelihood/Probability
Ice	Townwide	Roads, powerlines, senior populations, individuals with no backup heating source	The storm of 1998	Thousands without power in region for prolonged period, Loss of income on farms; vehicular accidents	>75% in any given year
Snow	Townwide	Large, older structures, barns, local farms, elderly populations	15-25" on February 14, 2007	$200,000 in property damage county-wide; collapsed barn roofs, 100 cattle killed; indirect injuries from car accidents; heart attacks from snow removal.	>75% in any given year
Cold	Townwide	Town-wide; residents in older and poorly insulated homes; energy-burdened households; structure fires that occur during heating season	-30° on January 16, 2009 recorded in St. Johnsbury in most recent history; -43° recorded in 1917 and 1943.	Numerous dead vehicle batteries, broken water pipes in region.	>10% but < 75%

[4] Efficiency Vermont: 2019 Energy Burden Report https://www.efficiencyvermont.com/news-blog/whitepapers/vermont-energy-burden
[5] FEMA: Fire in the United States, 2008-2017, November 2019, 20th Edition. https://www.usfa.fema.gov/downloads/pdf/publications/fius20th.pdf

Severe Summer Weather

Thunderstorms/Microbursts

The National Weather Service defines a *microburst* as a localized column of sinking air (downdraft) within a thunderstorm, that is usually less than or equal to 2.5 miles in diameter. See the image from the National Weather Service.



Source: NOAA

Ideal conditions for microbursts occur in hot humid conditions and can be exacerbated by instability, high levels of precipitative water, and converging air in the middle of a thunderstorm. It occurs when large amounts of water or hail are suspended in the updraft. Evaporational cooling and sinking air weaken the updraft to the point where it can no longer hold up the large core of rain or hail. Subsequently, the core plummets to the ground, spreading out in all directions. The location where the microburst first hits the ground incurs the greatest damage, which include high winds (profiled below.) The phenomenon usually lasts just a few minutes, but the damage can be intense.

Forecasting for microbursts is near to short term (6-12) and is based on the atmospheric conditions likely to lead to a microburst. However, microbursts can also occur without any warning at all. When forecasters interpreter use radar data to identify a microburst, they look for converging air within the mid-levels of a thunderstorm. Unfortunately, microbursts can form quickly and between radar scans. The microburst can be wet or dry, and when if wet, can include rapid downpours and flash flooding.

Wind

Wind is usually the most destructive component of a microburst, but high winds can also result from hurricanes, tropical storms (covered under flooding), and tornadoes. The 2018 State of Vermont Emergency Hazard Mitigation Plan considers wind to be a moderate risk. High winds are the byproduct of any of the following events:

- Wind Storm: high wind event without precipitation.
- Hurricanes/Tropical Storms;
- Thunderstorm: high wind event with the potential for compounding impacts due to precipitation, including microbursts.
- Tornado: a violently rotating column of air extending from a thunderstorm; not common in Vermont. Nevertheless, one tornado was reported in neighboring Peacham. This event was reported on August 3rd, 2010 on Fujita Scale of EF0, ("Gale," which is the lowest ranking. The tornado had a width of 50 feet and a path 0.14 miles, causing significant tree damage. No damage reported in Ryegate.

Hurricanes are rare in Vermont, as are tornadoes. Winter weather can occasionally produce damaging winds, but Ryegate is primarily vulnerable to winds associated with thunderstorm and microbursts. The most likely damage is downed trees and power outages. Nine out of 17 respondents (60%) to the Ryegate Hazard Mitigation Survey reported that they had gone without power for a day or longer. Six lost perishable food, and four went without running water for a day or longer.

The National Oceanic and Atmospheric Administration (NOAA) lists four types of wind events that have affected Caledonia County in the past 20 years (9/01/2000 through 9/30/2021):

- **Strong Wind**: Non-convective winds gusting less than 50 knots (58 mph), or sustained winds less than 35 knots (40 mph). 22 events reported in the NOAA Storm Event Database from 9/1/2000 to 9/30/2021 in Caledonia County. No impacts reported specifically for Ryegate; however, the hazard mitigation team confirmed that the strong wind event reported 11/01/2019 lead to extensive power outages in town.
- **High Wind**: sustained non-convective winds of 35 knots or greater lasting for 1 hour or longer, or winds (sustained or gusts) of 50 knots for any duration, on a widespread or localized basis. 9 events reported in the NOAA Storm Event Database from 9/1/2000 to 9/30/2021 in Caledonia County. No impacts reported specifically for Ryegate.
- **Thunderstorm Wind**: winds arising from convection (occurring within 30 minutes of lightning being observed or detected), with speeds of at least 50 knots (58 mph), or winds of any speed (non-severe thunderstorm winds below 50 knots) producing a fatality, injury, or damage. 111 reports in the NOAA Storm Event Database from 9/1/2000 to 9/30/2021 in Caledonia County, with six events reported with impacts occurring in Ryegate.
- **Tornado Wind**: 1 event reported in the NOAA Storm Event Database from 9/1/2000 to 9/30/2021 in Caledonia County. These are rare in Vermont This event was reported on August 3rd, 2010 on Fujita Scale of EF0, ("Gale," which is the lowest ranking.) The tornado had a width of 50 feet and a path 0.14 miles, causing significant tree damage. No damage reported in Ryegate.

The Beaufort Wind Scale was one of the first scales to estimate wind speeds and the effects was created by Britain's Admiral Sir Francis Beaufort in 1805 to help sailors estimate the winds via visual observations. The scale starts with 0 and goes to a force of 12. The Beaufort scale is still used today to estimate wind strengths. The table below, which focuses on specifications for land, provides perspective on the wind strengths that can be expected in Ryegate.

Table 3.11: Beaufort Wind Scale

	Speed			
Force	MPH	Knots	Description	Specifications for Land
0	0-1	0-1	Calm	Calm; smoke rises vertically.
1	1-3	1-3	Light air	Direction of wind shown by smoke drift, but not by wind vanes.
2	4-7	4-6	Light Breeze	Wind felt on face; leaves rustle; ordinary vanes moved by wind.
3	8-12	7-10	Gentle Breeze	Leaves and small twigs in constant motion; wind extends light flag.
4	13-18	11-16	Moderate Breeze	Raises dust and loose paper; small branches are moved.
5	19-24	17-21	Fresh Breeze	Small trees in leaf begin to sway; crested wavelets form on inland waters.

6	25-31	22-27	Strong Breeze	Large branches in motion; whistling heard in telegraph wires; umbrellas used with difficulty.
7	32-38	28-33	Near Gale	Whole trees in motion; inconvenience felt when walking against the wind.
8	39-46	34-40	Gale	Breaks twigs off trees; generally impedes progress.
9	47-54	41-47	Severe Gale	Slight structural damage occurs (chimney-pots and slates removed)
10	55-63	48-55	Storm	Seldom experienced inland; trees uprooted; considerable structural damage occurs.
11	64-72	56-63	Violent Storm	Very rarely experienced; accompanied by wide-spread damage.
12	72-83	64-71	Hurricane	This is approaching a Category One Hurricane, according to the Saffir-Simpson Wind Scale: Well-constructed frame homes could have damage to roof, shingles, vinyl siding and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.

Source: NOAA

Table 3.12: Wind Events with Impacts in Ryegate

Date	Type	Magnitude	Description & Impacts in Ryegate
7/22/2005	Thunderstorm	55 kts	A cold front extended from northern Maine to extreme northern New York and then into Pennsylvania early on Friday, July 22. The front helped trigger thunderstorms as it moved across Vermont during the afternoon. Severe thunderstorms resulted in strong winds which blew down trees between the towns of Peacham and Ryegate in the Vermont county of Caledonia. $10,000 in damage.
8/1/2005	Thunderstorm	50 kts	A weak surface trough combined with surface dew points around 65 degrees and an upper level disturbance to produce severe thunderstorms across eastern Vermont. In Caledonia county, Trees and power lines were blown down in Ryegate. $10,000 in damage.
6/10/2008	Thunderstorm	55 kts.	A very energetic mid-atmospheric disturbance moved across the Great Lakes during the afternoon and evening of June 10th. This developed a surface low along a cold front, which moved across Vermont during the afternoon and evening hours. These features moved into a very warm, humid and unstable airmass draped across Vermont that resulted in two rounds of widespread severe thunderstorms. Trees and wires down. Extended power outages. $25,000 in damages reported County-wide.
8/19/2011	Thunderstorm	50 kts	On August 19th, a weak frontal boundary and mid-atmospheric disturbance was located across the spine of the Green Mountains in a moderately unstable air mass with very weak flow. A few thunderstorms developed in the afternoon and sluggishly moved across southern and eastern Vermont with very heavy rainfall. However, two storms did produce very localized wet microbursts near Ryegate (Caledonia county) and Barnard (Windsor county). Several trees down due to thunderstorm winds in South Ryegate. $5,000 in damage.
7/4/2012	Thunderstorm	50 kts	A moderately strong upper level disturbance ahead of a surface cold front moved across southern Quebec during the afternoon and evening hours of July 4th. These disturbances moved into a warm and unstable air mass and developed thunderstorms in southern Quebec, which moved across northeast Vermont during the afternoon hours and the Champlain Valley during the evening. Both episodes contained widespread wind damage and frequent

			lightning. Several trees downed by thunderstorm winds. $10,000 in damage.
11/01/2019	Strong Wind	46 kts	A developing area of low pressure moved from the Gulf of Mexico on during the night of the 30th and moved north into the eastern Great Lakes as it intensified during the evening of October 31st. As the surface low moved across Ontario during the night of October 31st, its associated cold front slowly edged across Vermont during the early morning hours of November 1st. The upper level pattern was very strong and dynamic with a direct moisture feed from the Gulf of Mexico, thus delivering copious amounts of moisture into the northeast and NY. Several trees down. Several without power in Ryegate for more than a day.
9/15/2021	Thunderstorm	50 kts	A cold front moved across a moderately unstable air mass across central and southern VT during the afternoon of September 15th. Showers and thunderstorms developed in the southern Champlain Valley and Upper Hudson Valley of New York and moved into central and southern VT. Trees and powerlines downed by thunderstorm winds. $10,000 in damage.

Heat

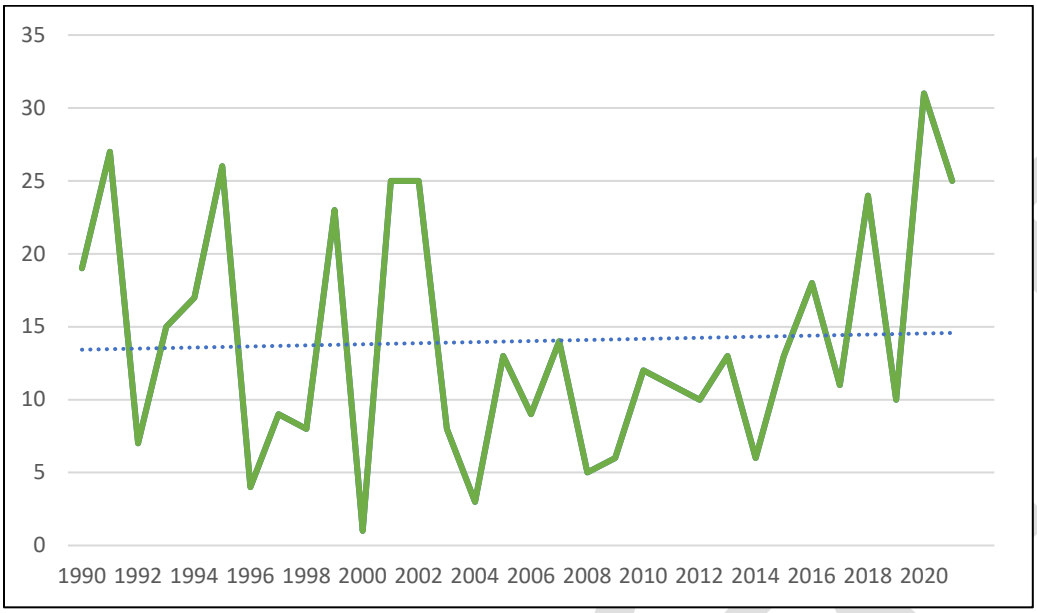
The Centers for Disease Control reports that more people die from heat than other weather-related events.[6] Although more 700 people die from heat in this country each year, the actual number of deaths are most likely underreported, because heat can exacerbate other underlying conditions such as heart and respiratory disease, leading to death. The impacts of extreme heat can be particularly devastating in regions such as the Northeast Kingdom, where residents are not accustomed to high temperatures and are less likely to live in air-conditioned structures. Vermonters are at greater risk for serious heat-related illnesses, and even death, when the statewide average temperature reaches 87°F or hotter.[7] Working with the Vermont State Climate Office, the Vermont Department of Health analyzed 14 years of temperature and mortality data, and ten years of surveillance data for emergency department (ED) and urgent care visits. The research found that on days when the statewide average temperature reach 87°F, ED visits for heat-related illnesses, such as heat exhaustion and heat stroke, increased eightfold, and there was one additional death per day among individuals aged 65 and older. Deaths due to heart disease, stroke, and neurological conditions were relatively more common on these days reaching at least 87°F, as compared to cooler days. Children and the elderly are considered especially vulnerable to heat-related illnesses.

The NOAA Event Database has no extreme heat events for Caledonia County. July is traditionally the hottest month of the year, with the greatest number of days over 87°, but hot days can occur from May through September, with occasional outliers in April. Using 87° as a standard, the hottest July on record for the St. Johnsbury area was 1955, with 23 days reaching 87° or more, and the hottest summer on record was 1949, with a total of 39 days reaching 87°. In the most recent three decades, the summer of 2020 was the hottest, with 31 days of 87° days. Although there are significant variations from year to year, the total

[6] Centers for Disease Control, Heat Related Illness: Picture of America Report,
[7] Vermont Department of Health: Heat Vulnerability in Vermont, Local Indicators of Heat Illness Risk. 2016. https://www.healthvermont.gov/sites/default/files/documents/2016/12/ENV_EPHT_heat_vulnerability_in_VT_0.pdf

number of 87° days is trending upward. (Figure 3.5), and the Vermont Department of Heath anticipates an increase to an average of 33 days per year by the end of century.[8]

Figure 3.5: Total of 87° of hotter, 1990-2021 (St. Johnsbury)



Source: National Weather Service, NOAA

Table: 3.13: Severe Summer Weather Risk Summary Table

Type	Location	Vulnerability	Extent	Observed Impact	Likelihood/Probability
Microbursts/ Wind	Townwide	These can occur anywhere, with little or no warning, can be accompanied by high winds and flash flooding	55 kts, Beaufort Scale 10, Storm	Downed trees and powerlines. Extended power outages, leading to loss of refrigeration and water. Road washouts.	>75% in any given year
Heat	Townwide	Children, elderly, people with underlying health conditions	Summers of 1949, 1955 (historic); summer of 2020	Increased ER visits (observed by Vt. Dept. of Health) no local data	>10% but < 75% in any year

Drought

Drought is defined as a shortage of water relative to need. According to the Vermont 2018 Hazard Mitigation Plan, drought is a complex phenomenon for several reasons:

- It 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.

[8] Vermont Department of Health: Vermont Climate and Health Profile Report: Building Resilience Against Climate Change in Vermont, September 2016

- The effects of drought can linger long after the drought has ended.
- Drought is an inherent, cyclical component of natural climatic variability and can occur at any place at any time, making it difficult to determine the onset, duration, intensity, and severity, all of which affect the consequences and corresponding mitigation techniques.

Extended periods of drought during a Vermont growing season can be devastating for state agriculture and can result in loss of potable water when wells run dry. Although the surface waters may appear to have recovered from a period of drought following a return to normal precipitation, replenishing groundwater levels is a longer process. Drought conditions are also favorable for wildfires, while small town fire departments that rely on river water will have limited capacity for fighting fires. Low water levels can also affect recreation and fishing. Low water levels, paired with rising temperatures, can trigger occurrence of blue-green algae. And, in rural areas that rely solely on private drinking sources, low water levels in wells can yield higher concentrations of metals and chemicals in drinking water, making the water unsafe to drink.

High winds, low humidity, and extreme temperatures can all amplify the severity of the drought. The severity of a drought depends on the duration and extent of the water shortage, as well as the demands on the area's water supply. Drought classification categories range accordingly:

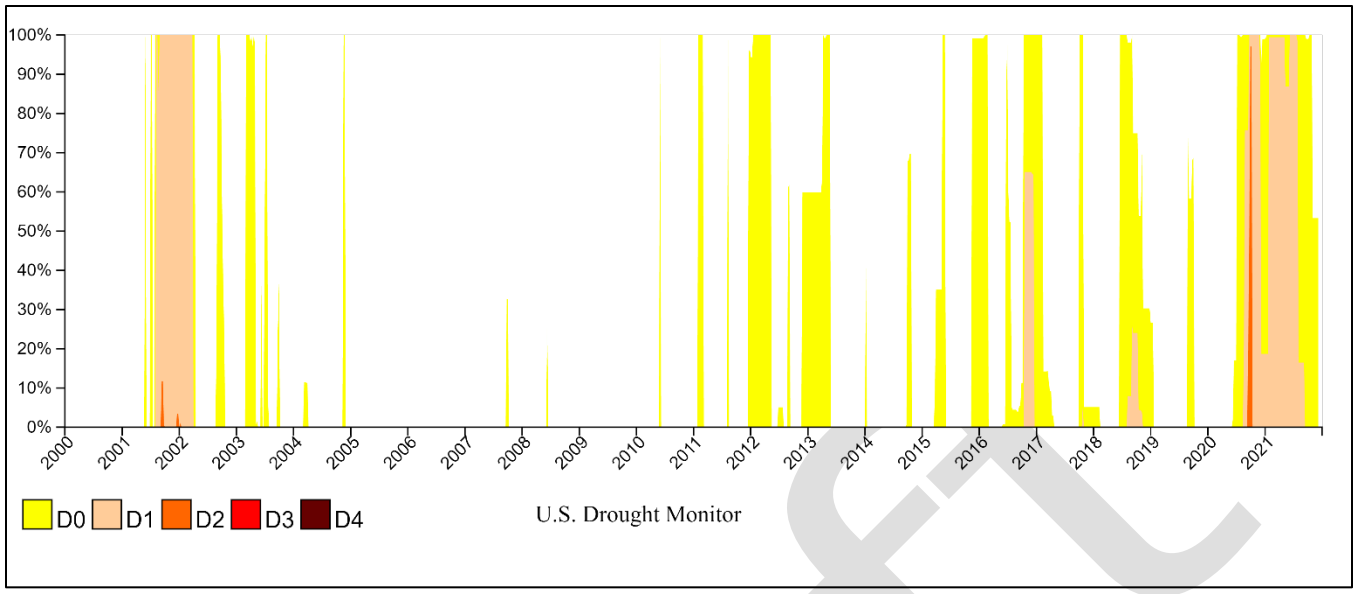
Table 3.14: Drought Severity Table

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

Source: U.S. Drought Monitor https://droughtmonitor.unl.edu/About/AbouttheData/DroughtClassification.aspx

It seems paradoxical that while climate change is generally bringing increased levels of precipitation that Vermonters should experience drought. However, climate change also is linked to climate instability and extremes, as is evidenced by recent annual precipitation data in Figure 2.2. According to NOAA data, Caledonia County's annual precipitation in 2020 was abnormally low – 37.87" – which marks a -3.42" departure from the base mean from 1901-2021. In June 2020, USDA issued a drought disaster declaration for all ten Vermont counties, making farmers eligible to apply for emergency loans. With drought conditions persisting for more than a year, the State of Vermont reactivated its Drought Task Force in July 2021. The following chart illustrates the extended period of drought conditions in Caledonia County. The period of severe drought (D2) in Caledonia County was for four consecutive weeks, from September 17, 2020 to October 8, 2020:

Figure 3.6: Drought Conditions in Caledonia County, 2000-Present



Source: US Drought Monitor

The Agency of Natural Resources maintains a crowd-sourced database called the ANR Drinking Water Drought Reporter. https://anrmaps.vermont.gov/websites/droughtreporter/

The database contains two water outages from spring-fed wells in Ryegate Corner reported in August and September of 2020.

Table 3.15: Drought Risk Summary Table

Type	Location	Vulnerability	Extent	Observed Impact	Likelihood/Probability
Drought	Townwide	Crop damage, loss of drinking water, unsafe drinking water, higher occurrence of algae blooms, increased risk of wildfire	Drought declaration in June 2020, lasting into late 2021. Four week period in D2 conditions in Caledonia County, September to October 2020.	Water outages in two wells in Ryegate Corner	>10% but < 75% in any year

Infectious Disease/Outbreak

The FEMA 2020 National Preparedness Report notes, “The COVID-19 pandemic resulted in the first ever Stafford Act major disaster declaration of all 50 states, five territories, and the District of Columbia for a naturally occurring infectious disease.”

In March of 2020, by Executive Order No. 01-20, the Governor declared a State of Emergency for Vermont, and restrictions to protect public health were enacted.

While a variety of measures were recommended by the Center for Disease Control and the Vermont Department of Health to help curb the spread of disease, including frequent hand-washing, wearing masks, and keeping a distance of 6 feet from other persons, vaccination was identified as the best way to keep from getting and spreading COVID-19. In Vermont, the vaccine was first made available to residents and staff of long term care facilities in December 2020, and then to those 75 and older in mid-January 2021. Availability of the vaccine continued to expand to successively younger age-groups.

The Vermont State of Emergency was extended for over a year until all restrictions were lifted on June 14 of 2021, at which time the benchmark of an 80% vaccination rate for the eligible population of Vermont was reached.

The Vermont Department of Health has been tracking statistics on COVID-19 within the State and developed a page on its website devoted to COVID-19 information. From March 5, 2020 to December 29, 2021, there were 142 cases of COVID-19 in the Town of Ryegate. Statewide, there have been 68,957 cases through the end of 2021, with 480 deaths. As of December 16, 2021, 71-80%% of the eligible population in Ryegate were vaccinated. https://www.healthvermont.gov/covid-19/current-activity

The Centers for Disease Control and Prevention (CDC) provides direction on how to mitigate the impacts of the COVID-19 pandemic and slow the spread. The CDC website includes a page entitled "Implementation of Mitigation Strategies for Communities with Local COVID-19 Transmission" https://www.cdc.gov/coronavirus/2019-ncov/community/community-mitigation.html

While these measures were developed specifically in response to the COVID-19 Pandemic, they can be utilized to reduce the spread of other similar infectious diseases.

Until now, infectious diseases have ranked fairly low in Vermont, and hazard mitigation plans do not typically include hazard mitigation strategies. The COVID-19 crisis is still unfolding, and the long-term impacts are still unclear. With so many individuals unable to work or working reduced hours, food insecurity, defined as a lack of consistent access to enough food for an active, healthy life[9], may have increased. In a University of Vermont survey, 441 Vermonters, were interviewed at the following intervals: March/April 2020, June 2020, and March/April 2021. Key findings indicate that food security rates increased during the pandemic. Of those surveyed, 31.9% were food insecure at some point during the pandemic. Of those, 46.9% were food insecure prior to the pandemic, but the remainder were newly food insecure. Those who were more likely to experience food insecurity were people without a college degree, those with a job disruption, households with children, women, and younger people.10 A community hotline was set up to field requests for assistance in Ryegate, but no calls were received.

COVID's disruption to daily lives in Ryegate, however, has been monumental. While "social distancing" was an appropriate response to mitigate the spread, all sectors of Ryegate's population experienced some form of disruption, especially those with no broadband or spotty broadband coverage. The pivot to a virtual

[9] Feeding America. What is Food Insecurity? https://hungerandhealth.feedingamerica.org/understand-food-insecurity/

[10] University of Vermont. Food Security Impacts of the COVID-19 Pandemic: Following a Group of Vermonters During the First Year https://scholarworks.uvm.edu/calsfac/186/

environment has demonstrated that reliable broadband is a vital utility for business, work, school, healthcare, and civic involvement.

> "High-speed broadband connectivity and devices are, without question, a requirement for the pursuit of an education, participation in the workforce, and access to safe and convenient healthcare services. High-speed broadband is not a luxury, but a foundational category of infrastructure that Vermont policymakers have determined needs to extend down every Vermont road, past every business and every home." Vermont 10-Year Telecommunications Plan, June 10, 2021

Unfortunately, the Northeast Kingdom, Vermont's most rural region, has not been well served by commercial Internet providers. In March 2020, Ryegate was one of 27 towns to join NEK Broadband, a Communications Union District. The organization's purpose is to ensure that every e911 address in the Kingdom can access robust reliable internet service speeds. This is a long-term process which that will require funding will come through state and federal grants, subsidized loans, and the fees from internet subscribers for services provided.

Table 3.16: Infectious Disease Risk Summary Table

Type	Location	Vulnerability	Extent	Observed Impact	Likelihood/Probability
Infectious diseases	Townwide	Seniors, people with underlying conditions.	Statewide emergency declaration from March 13, 2020 to June 14, 2021.	142 known cases of COVID in Ryegate as of December 29, 2021.	>10% but < 75% in any year.

Invasive Species

Invasive species are defined as plants, insects, and other organisms that were either accidentally or intentionally introduced from other place and that can negatively impact agriculture, recreation, forestry, human heath, the environment, and the economy. Invasive plants, which are categorized as either terrestrial or aquatic, can cause environmental devastation by changing soil composition, changing water tables, and disrupting insect cycles. They often lack food value upon which wildlife depends. Invasive animals can threaten biodiversity by preying upon native species or out-competing for food and nutrients.

Human activity is most likely to contribute to the spread of invasive species. Non-native insects, for example, can inadvertently get transported into the region via wooden shipping crates or firewood. Aquatic invasives can be in introduced on boats, either in the ballast water or on the hull. Landscaping and cultivating can spread invasives as well, as is the case with garlic mustard and Japanese knotweed, and these plants can readily establish a monoculture. Climate change also contributes to the spread of invasives. Warmer temperatures, for examples, weakens native species such as maple, yellow birch, and American Beech, while allowing for forest pests such as the hemlock woolly adelgid to overwinter and reproduce.

Vermont Invasives (www.vermontinvasives.org) is an educational resource created by the State of Vermont and the University of Vermont Extension. The site provides encourages users to learn to identify and report sitings of invasives. According to Vermont Invasives:

> "Non-native, invasive terrestrial plants are one of the greatest threats to the health of Northeastern forests. They negatively impact forest regeneration, forest structure, ecosystem function, recreation and wildlife habitat, are costly to manage, and can be harmful to human health."

This site also identifies three non-native insects which currently threaten Vermont: the emerald ash borer (EAB), Asian long-horned beetle (ALB) and hemlock wooly adelgid (HWA). These three pests threaten more than 14 different species of trees in Vermont, including maple, elm, horse chestnut, willow, ash, poplar, European mountain ash, hackberry, and hemlock.

A forest pest that is native but nonetheless destructive is the forest tent caterpillar (FTC), an insect that feeds on hardwoods. The Department of Forests, Parks and Recreation (VT FPR) monitors forest tent caterpillar and the Vermont Natural Resources Atlas maps the extent of infestations of this insect. An aerial survey in 2016 mapped at least 24,500 acres of FTC defoliation. Heaviest defoliation occurred in Essex, Lamoille, Orleans and Caledonia counties. The nearest mapped damage sites are in Groton and Topsham, showing 50% to 75% leaf defoliation. Forest tent caterpillars are especially of concern to maple syrup producers. Technical advice for land managers, sugar bush owners, arborists and home owners is available from VT FPR through the Orleans County Forester or VT FPR's Forest Biology Lab at 802-879-5687.

Japanese knotweed is usually found in wet habitats, along river and stream banks, and in disturbed areas such as roadsides and old fields. In Vermont, knotweed covers miles of shoreline on every major river in the state. Japanese Knotweed has already taken over along the Wells River, covering vast the riparian areas. While the roots of varied native vegetation help to stabilize riverbanks, Japanese Knotweed can contribute to erosion. Japanese Knotweed grows quickly – as much as three to four inches a day -- spreading quickly to crowd out other native species to create a monoculture. Knotweed's very shallow root system does not support the stability of river banks. Removal of the plant takes years, because its thick rhizomes can overwinter and grow as long as 60 feet. Herbicides, such as glyphosate, can be effective in eliminating knotweed, but their use poses ecological hazards as well. Japanese Knotweed can be unwittingly spread by dredging, excavating, and improperly disposing of yard trimmings.

The Emerald Ash Borer (EAB) is probably already in Ryegate, since it has already been spotted in neighboring Groton. (First discovered in 2017 to be in Caledonia). The EAB burrows through the ash tree's inner bark, depriving the tree of water and nutrients. A healthy tree infested by EAB can die within one to four years. Ash trees account for about 5% of the state's forest composition, and most are expected to die, resulting in safety hazards from falling trees, loss of tree cover (and loss of capacity to sequester carbon), and riverine debris in high water and flooding events.

Ryegate citizens are also on the lookout for hemlock wooly adelgid, an invasive pest that feeds of hemlock trees. The pest was first spotted in Vermont in 2007 and, until now, has been primarily located in southern

counties, where winters have been milder. With rising temperatures, however, this invasive pest is more likely to survive the winter -- and is more likely to be cause more mortality among hemlocks.

> "The threat of invasive species is not going away. It's a long-term stewardship issue that must become a daily part of how we look at and care for the woods that provide us with beauty, recreation, forest products and our heritage." www.vtinvasives.org

Ryegate depends mainly on the actions of concerned citizens to slow the spread of invasives. In 2012, a citizen participated in trainings with Vermont Coverts and in 2013, the Vermont Forest Pest First Detector. Both these organizations are a huge help to Towns trying to become involved in education and proactive work. The Ticklenaked Pond Assn has done a very good job in monitoring and removing eurasian milfoil from the Ticklenaked Pond. There is also interest in creating a local conservation commission.

Table 3.17: Invasive Species Summary Table

Type	Location	Vulnerability	Extent	Observed Impact	Likelihood/Probability
Invasives	Townwide	Areas subject to dredging, landscape or disposal or yard wastes are especially at risk for invasive plants. Ponds and streams are especially vulnerable to human activity. Ash trees, particularly those along public rights-of-way and trails.	Japanese knotweed is established along the Wells River. Emerald Ash Borer is probably present, but not confirmed.	Large stands of Japanese Knotweed along the Wells River, which may lead to riverine erosion and degradation of fish habitat, if left unchecked.	> 75% chance in any given year.

Natural Hazards Not Profiled

Wildfire

Wildfires are relatively rare in Vermont. Wildfire conditions in Vermont are typically at their worst either in spring, when dead grass and fallen leaves from the previous year are dry and new leaves and grass have not come out yet, or in late summer and early fall, when that year's growth is dry. An early snow melt, as we are experience in spring of 2022, can increase the risk for wildfire.

The 2020 State Fire Marshall's Report cites 325 brush, or brush and grass combination fires statewide for that year, which is a 169% increase from 2019. Nevertheless, the majority of Ryegate Fire Department responses are road-related, such as collisions with wildlife. Ryegate is more likely to experience air quality impacts from wildfires from other regions of the country or Canada.

Landslide

Landslides are sudden failures of steep slopes and can cause significant damage to streams, infrastructure, and property. Landslides can be caused by fluvial processes, as discussed above. Landslides can also be caused by slope steepening due to non-fluvial erosion, increased loading on the top of a slope, or pore-water issues. Landslides can destroy or damage structures and infrastructure that lie either above or below the slope. While the Town has some steep sloped roads, there is no evidence to support concern over landslides.

The 2018 Vermont State Hazard Mitigation Plan notes that while minimal data exists on damages associated with landslides, they often occur in tandem with periods of significant rainfall and erosion. Disaster declarations and estimates specific to landslide-only damages are not well defined. The 2018 Plan also notes that

> "Vermont has not previously developed a landslide inventory or an adequate tracking system to establish frequency of this hazard. Slope instability, which can be the result of increased ground saturation due to increased rainfall or significant snowmelt, is further exacerbated by human activity, often in the form of infrastructure construction. Roads that sit along steep slopes near rivers are especially vulnerable to damage or complete failure from a landslide event."

While fluvial erosion can constitute a landslide, there is little in way of historical data on Vermont landslide events. However, following tropical storm Irene in 2011, the magnitude of rain caused widespread damage, including significant scouring of riverbanks and stream channels. The most common types of landslides in Vermont are slides, which take two general forms; rotational slumps and translational slides. The translational slides occur on a wide variety of unstable slopes underlain by weathered, dense till, as well as slopes underlain by sandy to clayey lacustrine deposits, whereas the rotational slumps are more common on unstable slopes underlain by sandy to clayey lacustrine deposits. Both rotational and translational failures imply that the material has internal cohesion; otherwise the material would disintegrate into some sort of flow. An active landslide is one that has moved within the last year. The sides and upper margin of such a landslide are generally sharp and any exposed slide surfaces are bare of vegetation or have only the beginnings of pioneer vegetation on them. An inactive landslide has not moved within the last year, but it is in a setting in which it could be reactivated. One that has been inactive for several years may be largely revegetated, at least with pioneer vegetation. Inactive landslides are common near actively migrating stream meander bends where the site of landslide activity has shifted downstream as the stream meander has shifted downstream. The inactive slides may very well be reactivated if another meander bend migrates down from upstream. We define a relict slide as one where there is no evidence of movement for many years and the likely causative agent is no longer present. An example would be a former stream cut bank formed by stream erosion in early Holocene time. If the stream has since cut down vertically and moved away in such a fashion that it is now trapped by bedrock and would be unable to move back to the old cut bank, that cut bank could be considered relict. Such a feature is generally completely revegetated and the edges have been softened by erosion. The Vermont Geological Society has developed a Protocol for Identification of Areas Sensitive to Landslide Hazards in Vermont (2012). This protocol was used in Chittenden County, Vermont with inclusion into the State Hazard Mitigation Plan. Fourteen potential parameters were

considered as to their effect on landslide hazard. These included locations with respect to the marine limit of the Champlain Sea, aspect, distance to stream, elevation, hydrologic group, NDVI, profile curvature, roughness, slope angle, slope height, soil type, stream power index, surficial geology, and topographic wetness index. The protocol is applicable to areas in Ryegate but currently, there is no data.

Earthquake

The risk of earthquake is quite low in Vermont -- low enough that it is not prudent to invest in mitigation. According to FEMA Seismic Hazard Maps, Ryegate, as is most of Vermont, is in a "Seismic Design Category B" area, which means that only moderate shaking is to be expected in an earthquake. Although the sensation can be extremely disconcerting, the potential for damage is slight. The nearest reported earthquake was of a 2.3 magnitude, which occurred on December 20, 2017 and was felt by people in the White River Junction area, nearly 50 miles from Ryegate.

Hail

The town does not consider hail a significant hazard. Hail storms tend to occur in the summer months and are very localized with a relatively low frequency. The NOAA Storm Event database reports that a hail event occurred in Ryegate on June 1, 2011, when a vigorous mid-atmospheric disturbance along with a warm front accounted for scattered thunderstorms that moved across New York and Vermont during the early morning hours (around 6:30). There were numerous reports of dime to penny size hail with one report of quarter size hail in Ryegate. Despite the magnitude (considered H4 "Destructive" on a Torro Scale), no fatalities or injuries, nor property or crop damages were reported. Relative to other hazards, the impact from hail is considered negligible to infrastructure, life, the economy and the environment, yet it can be particularly damaging to local farmers. Due to the unpredictability of hailstorms and the negligible impacts to infrastructure, life, the economy and the environment, there is little in the way of hail mitigation in Vermont. Most efforts related to hail are in the response and recovery sectors, not mitigation.

4. ASSESSING VULNERABILITY

In addition to the hazard-specific vulnerabilities identified in Section 3, the following sectors of Ryegate's population are more vulnerable to the impacts of natural hazards:

- Seniors. According to latest American community Survey 5-Year Estimates about 23% of the population is over the age of 65.
- People who live alone. Latest data show that about a quarter of Ryegate's 380 households are people who live alone.
- People below the poverty line. American Community Survey estimates show that 148 individuals in Ryegate have incomes that fall below 125% of the poverty level, and 15 individuals have incomes that fall below 50% of the poverty level. Low-income individuals will be more likely to feel the impacts of natural hazards because they may not have the ability to relocate from flood-prone areas. They are also likely to be energy-burdened and more likely to be deeply affected by fluctuating winter temperatures and rising fuel prices. Higher summer temperatures are more likely to be devastating because housing is more likely to lack air conditioning. Finally, business disruption from natural hazards are likely to deplete household savings.

Table 4.1 Critical Facilities

Location	Type	Description/Notes
Dodge Falls	Dam	
44* 11.22' N - 072* 08.65' W 44* 11.48' N - 072* 05.72' W 44* 12.29' N - 072* 03.77' W	DHART Landing Sites	
Green Mountain Power Washington Electric Coop	Electric utilities serving Ryegate	
2420 VT Route 302	Blue Mountain Union School	Emergency Shelter – Not in Ryegate, but in neighboring community (Wells River)
18 South Bayley Hazen Road	Ryegate Town Clerks Office/Town Offices	Critical services
57 Witherspoon Road	Ryegate Fire Department	Critical services
2360 Scott Highway	Ryegate Fire Department substation	Critical services
247 Weezner Drive	Ryegate Power Station	Critical services
East Ryegate	Fire District #2	Water Supply and groundwater source protection area
East Ryegate	Waste Water system	
Syms Pond Road in northern border with Barnet	Barnet FD #3	Surface water source protection area
US Route 5 VT Route 302 I-93	State and Interstate Highways	Major transportation corridors

Evaluation of Mitigation Actions

A full array of mitigation measures were examined in a public meeting. Mitigation strategies from the existing plan were updated. The results are shown in table 5.1.

Then new mitigation strategies for hazards not previously profiles were evaluated according to the following factors:

- What is the likelihood of securing funding for the action?
- Does the action protect threatened infrastructure and is it environmentally sound?
- Can the action be implemented quickly?
- Is the action socially and politically acceptable?
- Is the action technically feasible?
- Is the action administratively realistic given the capabilities of responsible parties?
- Does the action offer reasonable benefit compared to its cost of implementation?

Each criteria for new mitigation actions was rated on a scale of 1 to 5, 1 being "poor" and 5 being "excellent." The results are shown on Table 5.2. While not all of the new mitigation actions rank as highly as others, all were deemed acceptable for inclusion in the updated plan.

Table 5.1: Status of Mitigation Actions from the 2014 Ryegate Plan

#	2014 Mitigation Action	Hazard Addressed	2022 Status
2014-1	Pursue buyout of a repetitive loss structure in South Ryegate.	Flooding	This was completed in 2014. Remove.
2014-2	Reinforce bank of unnamed tributary to Wells River to prevent future damage to residential property in South Ryegate.	Flooding	Completed. Remove.
2014-3	Adopt and refine Statewide River Corridors and adopt fluvial erosion hazard area (river corridor) regulations and riparian buffer requirements to give rivers and streams maximum room for lateral movement to help stabilize streambanks.	Flooding	2016 efforts to update flood hazard regulations met strong opposition from the public. This will be a long-range mitigation action because additional outreach and discussion is required.
2014-4	Update flood hazard regulations to exceed minimum NFIP standards by prohibiting new development in the floodplain, increasing freeboard requirements for substantially improved properties and prohibiting	Flooding Water Supply Contamination	2016 efforts to update flood hazard regulations met opposition from the public. The regulations were updated to ensure that they met the minimum standards of CFR 44. This will be a long-range mitigation action because additional outreach and discussion is required.

	encroachments into the river corridor.		
2015-5	Update Ryegate Town Plan to include a flood resilience element, in accordance with Vermont Act 16, that incorporates findings and recommendations from the Local Hazard Mitigation Plan.	Flooding	Completed in 2018. The Municipal plan is set to expire in 2026, so the subsequent plan update should include reference to this hazard mitigation plan.
2015-6	Inventory and map flood loss properties, including repetitive loss properties. Encourage property owners to document damage from flood events, including repair costs, photographs, and high water mark.	Flooding	Did not occur. However, there may be opportunities to integrate data into Vermont Flood Ready online resource. Keep in plan.
2014-7	Research the cost of maintaining the town's "short structures," bridges shorter than 20 feet. Develop a townwide assessment of conditions and consider a plan for either financing improvements or strategically abandoning such structures.	Flooding	Northeastern Vermont Development Association developed an assessment of short structures in 2016. Remove.
2014-8	Research the feasibility of a shelter pre-agreement with the Red Cross.	Flooding	Delete. The Town has Blue Mountain as a shelter.
2014-9	Research what is required to join the Community Rating System and increase awareness of local flood hazards and the National Flood Insurance Program.	Flooding	Planning Commission explored the adoption of state model regulations, which would have helped to make Ryegate eligible. The proposed model regulations were met with strong opposition. The regional planning commission continues to explore other ways to make it easier for communities to join the program. This will be a long-range action that requires considerable outreach and education.
2014-10	Identify an alternate emergency shelter that is located outside of the 100-year floodplain.	Flooding	Delete. Arrangement with Blue Mountain is sufficient.
2014-11	Support and/or facilitate consensus-building public outreach activities that are aimed at identifying and	Flooding	This was completed in 2014 in a workshop held with the regional planning commission and the Agency of Natural Resources, in South Ryegate. River corridor regulations

	minimizing flash flood risks. (E.g. local or regional workshops).		were explored, but attendees voiced strong opposition to river corridor regulations.
2014-12	Maintain and update Local Emergency Operations Plan annually.	Flooding/All	Now called "Local Emergency Management Plan." This occurs annually.
2014-13	Adopt and maintain current VTrans Road and Bridge Standards to incorporate best practices to minimize washouts and damage (such as culverts).	Flooding	Town is current on standards.
2014-14	Regularly inspect and maintain town bridges and culverts and schedule to replace undersized culverts as identified by field inspection.	Flooding	Ongoing.
2014-15	Encourage the power companies to bury power lines. Amend zoning bylaws to require buried power lines when approving new planned unit developments and mobile home parks.	Severe Weather	Ongoing. Zoning bylaws were amended in 2017. Planned unit development and mobile home parks would be reviewed under conditional use review, and the Zoning Board of Adjustment has the discretion to request the burial of power lines
2014-16	Identify specific at-risk populations that may be exceptionally vulnerable in the event of a storm or long-term power outage.	Severe Weather	Informal relations among neighbors ensures that this already happens, but this can be strengthened with a formal network, such as "Neighbor-to-Neighbor" or similar organization. Actions could include the identification of telecommunication dead zones, and making people aware of hotspots. The Health Officer should be part of the effort, as well as Meals on Wheels, and other services geared to meet the needs of people who don't drive..
2014-17	Organize outreach to vulnerable populations to direct them to appropriate shelters if necessary.	Severe Weather	This activity can be folded into the mitigation action above.
2014-18	Identify and assess public structures that may need reinforcement for excessive snow loads.	Severe Weather	Public structures can handle excessive snow loads. Delete.

2014-19	Pursue energy efficiency and weatherization measures identified in the energy audits.	Severe Weather	The Town of Ryegate has formed an energy committee. It also works with HEAT Squad to encourage energy audits, which improve thermal efficiency AND improve cooling options in the warm months.
2014-20	Support public education about appropriate use of alternative heating sources, such as woodstoves and fireplaces.	Severe Weather	Energy committee is also involved in this. This action should be combined with the above, and alternative heating sources should include efficiency wood burning and open-source heat pumps, which can provide cooling in the warmer months.
2014-21	Make educational materials about Act 59 (statewide enforcement of energy efficiency building codes) available at town offices.	Severe Weather	The only mechanism for enforcing Act 59 is through the Certificate of Occupancy, which the Town's Zoning Bylaw does not require. This may be an appropriate activity for the Town Energy Committee. It is not appropriate to include. Delete.
2014-22	Educate public about emergency access shelters in the event of a winter storm or power failure.	Severe Weather	Ongoing. But it is duplicative of 2014-17 Delete.
2014-23	Regularly inspect trees in or near the public right of way, and remove them if necessary.	Severe Weather	Ongoing.
2014-24	Maintain snow removal equipment so that it is ready to be deployed.	Severe Weather	Ongoing. This is so basic, and it does not need to be codified in a plan. Delete.
2014-25	Remind residents to keep fuel burning vents unobstructed in the event of a heavy winter storm.	Severe Weather	Ongoing.
2014-26	Identify opportunities to incorporate enhancement to high crash locations, according to the AOT Road and Bridge Standards (The Orange Book).	Hazardous Materials	Hazard materials is not profiled, as man-made risks are not addressed in the LHMP. This is important, but the LHMP is not the appropriate vehicle. Delete.
2014-27	Participate in HazMat response training exercises.	Hazard Materials	Hazard materials is not profiled, as man-made risks are not addressed in the LHMP. This is important, but the LHMP is not the appropriate vehicle. Delete.
2014-28	Ensure that standards for emergency vehicular access (at least 12 feet wide, with	Structure Fires (now considered a vulnerability of	The Planning Commission and Zoning Board of Adjustment can ensure this when reviewing planned unit developments

	adequate turnaround space) are incorporated into the proposed update of the Zoning bylaws, especially for planned unit developments, which may allow for the creation of new roads or accesses.	severe winter weather)	through conditional review However, this may be a better enforced through the Town Road Policy.
2014-29	Identify repairs and costs associated with updating aging infrastructure of the East Ryegate Fire District #2 water system.	Structure Fires Water Supply Contamination	Keep. Possible use of ARPA funds.
2014-30	Map average response times for all properties. This can be done by identifying structures on all classes and roads and identifying response times based on year-round road conditions and passability.	Structure Fires	This is not a practical action for a non-profiled risk. Delete.
2014-31	Explore ways to improve aging building stock. This may be achieved through village center designation for South Ryegate and/or East Ryegate. This State of Vermont Program allows towns to establish designations for traditional centers of development. Although it is not a regulatory program, the program does provide access to tax credits for fit up (such as sprinkler systems) to incoming producing properties built before 1983.	Structure Fires	Ryegate was awarded three Village Center designations in 2020: South Ryegate, East Ryegate, and Ryegate Corner. These designations will need to be renewed in 2028.
2014-32	Make fire safety literature available from public facilities.	Structure Fires	Ongoing.
2014-33	Encourage installation of smoke detectors on every floor of every structure. This can be done in conjunction with town-wide events, such as Greenup day or Town Meeting day.	Structure Fires	Ongoing

2014-34	Encourage annual chimney cleaning.	Structure Fires	Ongoing
2014-35	Report fire data to the State Fire Marshall.	Structure Fires	Ongoing.
2014-36	Work with New Hampshire Department of Environmental Conservation to incorporate timed inundation levels in and around dams in the event of a dam failure. Map these levels and incorporate them onto local hazard maps.	Dam failure	Inundation levels have been mapped and added to the amended Hazard Mitigation Plan. Delete.
2014-37	Incorporate inundation tables into Flood Resilience element in update of Town Plan.	Dam failure	Inundation tables were added to the flood resilience element of the current Ryegate Town Plan. Delete.
2014-38	Develop and adopt source protection standards for Ryegate's source protection areas.	Water Supply Contamination	Prior to 2017, Ryegate's regulations had a "Resource Overlay" that allowed the discretion when siting and permitting development. However, the overlay had no standards and was not deemed enforceable by the regional planning commission. The Planning Commission considered draft source protection regulations for their 2017 update of the Zoning Bylaw, The planning commission can consider it in the future.
2014-39	Establish signage for source protection area to create better awareness of the risk of run-off contamination.	Water Supply Contamination	This technically is a man-made hazard, but it may be worthwhile to keep.
2014-40	Consider extending setbacks from streams and wetlands to 75 feet. (This is the standard established for logging operations). Require that this buffer strip be maintained in natural vegetation to control runoff and erosion.	Water Supply Contamination	Ryegate's Zoning Bylaws require a 50 foot vegetation strip along all waterbodies, which is deemed sufficient for bank stabilization for streams with a drainage of two square miles or less. (ANR) However, the strips can be widened if the water body is surrounded by steep slopes. Delete.
2014-41	Support outreach materials and PSAs that create better awareness of the dangers of runoff contamination.	Water Supply Contamination	Ongoing.
2014-42	Monitor and test water quality in state regulated source protection areas.	Water Supply Contamination	Ongoing.

Table 5.1 Evaluation of Mitigation Actions

1 = Poor 2=Below average or unknown 3=Average 4=Above Average 5=Excellent									
Hazard Type	**Mitigation Action**	**Funding Potential**	**Protection value/ Environmental Advantage**	**Time to Implement**	**Social and Political Acceptance**	**Technical Feasibility**	**Administrative Feasibility**	**Benefit to Cost**	**Total Score**
Severe winter weather	*Support the efforts of the Energy Committee to raise awareness of weatherization opportunities**	4.5	4.5	3.7	3.3	2.7	2.7	3.0	24.3
Drought	*Establish better data by encouraging use of the ANR drought reporter**	3.0	3.7	3.7	3.3	3.7	3.3	3.7	24.3
	*Add ANR groundwater data to Town Plan maps as available**	3.0	4.0	3.0	3.0	3.0	3.0	3.0	22.0
Infectious Diseases	*Support efforts of the Communications Union District*This could relate to ALL hazards*	4.0	4.5	3.8	4.0	3.0	3.5	4.3	27.2

Invasive Species	*Formalize road crew best practices for seasonal mowing. Mechanical control methods will reduce the spread of invasive species.*	4.0	4.0	4.0	4.3	4.0	4.0	4.3	28.7
	Support efforts to establish a Conservation Commission	3.5	3.0	3.5	3.0	3.0	3.0	3.0	22.0