Town of Shaftsbury
Hazard Mitigation Plan

Shaftsbury, Vermont

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I. Introduction

A. Purpose

Hazard mitigation actions are intended to reduce potential losses from natural hazards such as flooding, landslides, wildland fire, and similar events. Hazard mitigation plans identify, assess, and prioritize those hazards and present actions that a community can undertake to reduce risks and damage from those natural hazards (Federal Emergency Management Agency 2013a).

This plan identifies, describes, and prioritizes potential natural hazards that could affect the Town of Shaftsbury in Bennington County, Vermont and provides specific measures to reduce or avoid those effects. The Federal Emergency Management Agency (FEMA), within the U.S. Department of Homeland Security and the Vermont Department of Emergency Management both advocate the implementation of hazard mitigation measures to save lives and property and reduce the financial and human costs of disasters.

The format of this plan is as follows. Section II provides a profile of the town, including a discussion of the environmental setting, demographics, and settlement patterns. Section III describes the planning process along with lists of members of the planning team and dates of meetings and public and agency review. Section IV analyzes the following hazards:

- Flooding and Fluvial Erosion
- Winter Storms
- High Wind Events
- Hail
- Temperature Extremes
- Drought
- Wildfire
- Earthquake
- Landslides and Rock Falls
- Invasive Species
- Hazardous Materials Spill
- Infectious Disease Outbreak

Section V assesses vulnerability, and Section VI discusses mitigation goals and actions, including current programs and town capabilities. Section VII describes how the plan will be maintained and updated.

B. Mitigation Goals

The Town identified the following mitigation goals:

1. Reduce injury and loss of life resulting from natural disasters.
2. Reduce damage to public infrastructure, minimize disruption to the road network and maintain both normal and emergency access.
3. Establish and manage a program to proactively implement mitigation projects for roads, bridges, culverts, water supply systems and other municipal facilities to ensure that community infrastructure is not significantly damaged by natural hazard events.
4. Design and implement mitigation measures so as to minimize impacts to rivers, water bodies and other natural features, historic structures, and neighborhood character.
5. Increase the economic resiliency of Shaftsbury by reducing the economic impacts incurred by municipal, residential, agricultural, and commercial establishments due to disasters.
6. Incorporate hazard mitigation planning into other community planning projects, such as Town Plan, Capital Improvement Plan, and Town Local Emergency Management Plan
7. Ensure that members of the general public continue to be engaged in the hazard mitigation planning process.

II. Town Profile

A. Regional Context

The Town of Shaftsbury is located in southwestern Vermont in Bennington County and is bordered by the Towns of Bennington, Woodford, Glastenbury, Sunderland and Arlington in Vermont and the towns of White Creek and Hoosick in New York (Map 1). The town is approximately 43 square miles in area.

B. Demography and Land Use

The American Community Survey Estimate of 2017 showed that Shaftsbury had a population of 3,487. The Town is estimated to have lost about 100 residents since the 2010 census. The population density is 33.16 people per square mile which is lower than the state average density of 65.13 people per square mile and much lower than the national average density of 82.73 people per square mile. The reasons for the loss in population are both a net migration and overall death rates surpassing birth rates. Population projections from the Agency of Commerce and Community Development indicate the population will likely continue to decrease (Town of Shaftsbury 2019). Therefore, development pressures for the town, as for Bennington County, are minimal.

Most of Shaftsbury is relatively undeveloped. Forested lands make up nearly 70% of land area, while pasture/hay and field crops make up approximately 14%, wetlands 6.1% and developed lands approximately 3%. Map 2shows land cover types.

C. Economic and Cultural Resources

There are over 100 businesses in Shaftsbury, most of which have less than five employees. The larger employers include the town, Shaftsbury Elementary School, the William E. Dailey Companies, a division of Peckham Industries, Dailey Precast, Clear Brook Farm, Mighty Food Farm, Whitman's Feed Store/Poulin Grain, T&M Enterprises Inc and Casella Waste Management, which acquired TAM (Town of Shaftsbury 2019; InfoGroup 2020). The town has two areas designated by the Vermont Agency of Commerce and Community Development as Village Centers: Shaftsbury Center and South Shaftsbury. Most commercial development is in South Shaftsbury (Map 3).

D. Critical Facilities

Critical facilities within the town are listed in Table 1 and shown in Map 4.

Table 1. Shaftsbury critical facilities (see Map 4).
Source: Shaftsbury Planning Committee

Label	Name	Description
1	Shaftsbury Fire House #1	Fire station
2	Shaftsbury Fire House #2	Fire station
3	Shaftsbury Town Office	Town office
4	Shaftsbury Medical Association	Medical office
5	Shaftsbury State Police Barracks	Vermont State Police
6	Shaftsbury Substation	Utility
7	Shaftsbury Water Treatment Plant	Utility
8	North Bennington Water Reservoir	Water supply
9	Howard Park	Town park
10	Paulin, Inc.	Local business
11	William E. Daily, Inc.	Local business
12	Shaftsbury Town Garage and Transfer Station	Town garage and solid waste facility
13	North Shaftsbury Tower	Communications tower
14	Shaftsbury VPR Tower	Communications tower
15	Shaftsbury Elementary	Public elementary school

III. Planning Process

A. Planning Team

The process started with a meeting with the Shaftsbury Select Board to review the planning process. The Board appointed the team listed in Table 2 below.

Table 2. Planning committee members

Name	Affiliation
Dave Kiernan	Town Administrator
Shelly Stiles	Town Zoning Administrator
Mike Yanotti	Town Road Foreman
Paul Dansereau	Town Emergency Management Director
Tim Scoggins	Town Select Board Chair (left team in December 2020)
Art Whitman	Town Select Board (joined team in December 2020

B. Public Involvement

All meetings of the planning team were open to the public and held via Zoom. Meeting dates are listed below. Minutes were posted on the town web site. All meetings were warned, and notices posted on the town website (Table 3).

Table 3. Dates of planning meetings and public and agency review

Meeting	Date (s)
Shaftsbury Select Board Initial Meeting	April 6, 2020
Planning Team Meeting #1	July 8, 2020
Planning Team Meeting #2	August 24, 2020
Planning Team Meeting #3	September 30, 2020
Planning Team Meeting #4	October 28, 2020
Planning Team Meeting #5	December 9, 2020
Planning Team Meeting #6	January 27, 2021
Select Board Meeting on Distributing Plan Select Board Meeting on Distributing Plan Select Board Meeting on the Draft Plan	February 1, 2021 February 15, 2021 March 15, 2021

A limited number of businesses were contacted and Clearbrook and Mighty Food Farm expressed concerns over windstorms, drought and extreme heat which can damage crops and infrastructure. Peckham Industries expressed concern over those hazards as well as flooding and erosion or anything that could cause power outages or damage infrastructure thereby preventing workers or materials from getting to and from their sites.

The plan was posted on the Town website on February 15, 2021 and comments from the public and others requested. The plan was also sent to the Bennington County Regional Commission, Local Emergency Planning Committee #7, and the towns of Arlington, Sunderland, Glastenbury, Woodford, Bennington, White Creek and Hoosick for comment.

Jim Sullivan from BCRC submitted a comment regarding preparation for responses to any rail car derailment and issues with stored propane rail tankers. Rail traffic is single track through Shaftsbury and there is not a rail siding used for storage of propane tankers. The line itself is a low-speed freight only segment that averages one southbound and one northbound train per day. Rail crossings are maintained by the railroad and are under the jurisdiction of the State. To enhance preparations for any rail incident the Emergency Management Director, Emergency Management Coordinator, and ranking Fire Officers will attend a FEMA Rail Car Incident Response course over two days in April 2021. He also noted an error on the landslide potential map indicating a rockfall that has since been eliminated. The map was amended to address that.

IV. Hazard Assessment

A. Hazard Assessment

This section addresses each of the potential natural hazards based on data from the following sources:

a. Local knowledge.
b. The National Climate Center storm events database (National Oceanographic and Atmospheric Administration 2019).
c. FEMA lists and descriptions of past disaster declarations.
d. The Vermont Department of Forests, Parks and Recreation data on wildfires.
e. HAZUS runs on potential earthquake damage.
f. The Pownal, Sunderland, Peru, Danby, and Bennington cooperative weather stations data and temperature and precipitation normals from 1981 to 2010 (National Oceanographic and Atmospheric Administration 2020b).
g. Palmer Hydrologic Drought Index calculated from 1985 to 2019 from NOAA.
h. Hazardous materials spills from VT ANR.
i. Infectious disease outbreaks listed from the Vermont Department of Health (note these fluctuate, so only recent data are used).
j. Observations of invasive species compared to the state and federal lists of noxious species.
k. The Vermont Emergency Management (2018).
l. New England Weather, New England Climate (Zielinski and Keim 2003), Vermont Weather Book (Ludlum 1996).

m. Federal Emergency Management Agency 2015 Flood Insurance Study, Bennington County, Vermont and Incorporated areas, Federal Emergency Management Agency Study Number 5003CV000A.
n. Fuel types and potential for wildfire from LANDFIRE (http://www.landfire.gov/) and from the Vermont Department of Parks, Forests and Recreation.
o. National Weather Service 2014. Advanced Hydrologic Prediction Service, stream gauge information for the Hoosic River near Williamstown, MA. Available via: http://water.weather.gov/ahps2/hydrograph.php?wfo=aly&gage=wilm3.
p. SHELDUS records which were not as complete as NOAANOAA and, therefore, not used.
q. Earthquake data from the Northeast Earthquake Maps and Catalog (http://www.bc.edu/research/westonobservatory/northeast/eqcatalogs.html).
r. Vermont Agency of Natural Resources and Vermont Agency of Agriculture, Food and Markets on invasive species and surveys completed within Sunderland.
s. Identification of ranking of the potential for landslides by Josh Duncan (2015), a student at Green Mountain College using a modified protocol based on Clift and Springston (2012).

With respect to NOAA data, there have been numerous changes to that database in just the last few years. While NOAA data goes back to 1950, there was a dramatic change in 1996 in the way data were collected. The number of events recorded in years prior to 1996 is far less than from 1996 onward. Therefore, for the best reliable data, we used only data from 1996 onwards. We have also looked at the other sources of historical weather data. The cooperative weather observers for Peru, Sunderland and Pownal in Vermont have the most consistent long-term data, though some is available from the North Adams, MA observer. The only stream gauge is in Bennington near the New York border. There are no weather stations that record or keep long term data records in Shaftsbury.

Finally, we reviewed several studies on potential impacts of climate change developed by the Intergovernmental Panel on Climate Change (Christensen et al 2013), the Vermont Agency of Natural Resources (Tetra Tech 2013), the University of Vermont (Galford et al. 2014), the Global Climate Change Research Program (Horton et al 2014), and the U.S. Forest Service (Rustad 2012). The relationship between climate change and the frequency and extent of natural hazards is a developing science, and we described, where appropriate, how climate change might affect hazards in the future.

B. Flooding and Fluvial Erosion

1. Description

a. Flooding

Flooding and associated fluvial erosion are the most frequent and damaging natural hazards in Vermont. The National Weather Service (2010) defines a flood as “any high flow,

overflow, or inundations by water which causes or threatens damage." A flash flood is …" a rapid and extreme flow of high water into a normally dry area, or a rapid water rise in a stream or creek above a predetermined flood level." These are usually within six hours of some event, such as a thunderstorm, but may also occur during floods when rainfall intensity increases, thereby causing rapid rise in flow. The NWS uses the following impact categories:

- Minor Flooding - minimal or no property damage, but possibly some public threat.
- Moderate Flooding - some inundation of structures and roads near stream. Some evacuations of people and/or transfer of property to higher elevations.
- Major Flooding - extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations.
- Record Flooding - flooding which equals or exceeds the highest stage or discharge observed at a given site during the period of record keeping.

Floods may reach these magnitude levels in one or more reaches, but not necessarily all. Runoff from snowmelt in the spring, summer thunderstorms, and tropical storms and hurricanes can all result in flooding in Shaftsbury. Ice jam flooding can occur on Vermont rivers when substantial ice forms followed by several days of warmth, snowmelt and any rainfall leading to ice breakup. As the ice breaks up on the rivers, chunks of ice form jams which cause localized flooding on main stem and tributary rivers. Ice jams are most prevalent during the January thaw (late January) and in March and April as spring approaches.

Flash floods can occur after spring melt of mountain snow, following large storms such as Tropical Storm Irene, or after significant thunderstorms. Map 5 shows the location of both flood hazard zones and river corridors (formerly fluvial erosion hazard zones).

Most development in Shaftsbury is located in the valleys along Vermont Route 7A and 67A. Streams near large areas of development include Paran Creek, Little White Creek and Furnace Brook. These streams can be very flashy, and while some flood losses are the result of inundation, more often flood losses are caused by fluvial erosion. Fluvial erosion can range from gradual bank erosion to catastrophic changes in the location of the river channel (Vermont River Management Program 2010). There are no dams located in Shaftsbury.

b. Fluvial Erosion

In Vermont, most rivers flow through relatively confined valleys, but still meander over time across the floodplain. The Vermont Hazard Mitigation Plan (2018) states that 75% of flood damages as measured in cost are due to erosion rather than inundation. River corridors provide an area within which a river can move across the landscape as it dissipates energy and transports and deposits sediments. Where rivers are constricted by bridges and other structures or rip rap, the water moves at higher velocity, resulting in downcutting and collapse of the banks. This may undermine structures within the corridor.

2. Previous Occurrences

Ludlum (1996) describes numerous storm events that have affected Vermont since settlement, but the local impacts of these are difficult to trace. The 1927 flood was the largest disaster in the history of the state. The state received over six inches of rain, with some areas receiving 8-9 inches. Following a rainy October, this storm occurred from November 2nd through the 4th causing extensive flooding. Two storms occurred in March of 1936. Heavy rains and snowmelt caused significant flooding. Two years later, the 1938 hurricane caused both flooding and extensive wind damage. The remnants of Hurricane Belle (August 9-10, 1976; DR-518) caused flooding damage in portions of Vermont.

Table 4. Total number of flood events by type and year for Bennington County.
Source: National Oceanographic and Atmospheric Administration 2019

Year	Flash Flood	Flood	Total
1996	3	6	9
1997			
1998	1	3	4
1999	2		2
2000	4	1	5
2001			
2002	1		1
2003		2	2
2004	1	5	6
2005		5	5
2006			1
2007	1	1	2
2008			
2009	2		2
2010			
2011	3	3	6
2012			
2013	4		4
2014			
2015			
2016			
2017		1	1
2018		1	
2019		8	8
Total	22	37	59

Table 4 shows a total of 59 flood events in Bennington County from 1996 to 2019, using NOAA data. These have been primarily minor and affected either specific streams, such as the Batten Kill, the Hoosic and the Walloomsac, or specific towns.

Hurricanes and tropical storms that form in tropical waters have historically affected New England but are relatively infrequent. Besides the 1938 storm, Tropical Storm Belle brought significant rains to Vermont in 1976 and Hurricane Gloria brought rain and wind damage in 1985. Shaftsbury has been subjected to two major tropical storms in the past twenty years. Hurricane Floyd was a Category 4 storm before hitting North Carolina, and then was reduced to a tropical storm when it reached southern New England. Tropical Storm Irene was the remnant of Hurricane Irene, which was a Category 1 hurricane.

The following describes events that have occurred since 1996, using the National Weather Service (2010) categories, which affected Shaftesbury or nearby areas. These events were described in the National Climate Database records (2015). It should be noted that only the January 1996 event occurred in the winter, with all other events in the spring, summer, or fall.

<u>January 19 to 20, 1996 (DR-1101 1/19 to 2/2 1996)</u>: An intense area of low pressure which was located over the Mid-Atlantic region on Friday morning January 19th produced unseasonably warm temperatures, high dew points and strong winds. This resulted in rapid melting of one to three feet of snow. In addition to the rapid snowmelt one to three inches of rain fell as the system moved northeast along the coast. This resulted in numerous

road washouts and the flooding of several homes across the county. *Note that this was also categorized as a High Wind event.

April 24, 1996: Significant rains on Tuesday evening April 23 resulted in flooding along the Walloomsac and Batten Kill Rivers in Bennington County. The Walloomsac River crested 1.5 feet over flood stage at North Bennington and the Batten Kill crested one foot over flood stage at Arlington. The flooding resulted in several road closures but much of the flooding was minor.

May 11 to 12, 1996: Rainfall in excess of 2 inches fell during this period over much of Vermont.

December 1 to 2, 1996: One to three inches of rain fell across the county resulting in flooding along the Batten Kill and Walloomsac.

January 24 to 26, 1999: The combination of rain and very mild temperatures produced rapid snow melt in southern Vermont. This runoff and ice jams triggered flooding on the upper Batten Kill near Arlington and on the Walloomsac River near Bennington.

September 16 to 17, 1999 (DR-13079/16-21 1999): The remnants of Hurricane Floyd brought high winds and heavy rainfall (3-6 inches) to southern Vermont. Many smaller tributaries reached or exceeded bankfull. Estimated wind gusts exceeded 60 mph, especially over hill towns. Power outages occurred across southern Vermont. A Cooperative Weather Observer recorded 4.94” of rain in Sunderland.

July 14 to 17, 2000 (DR- 1336 7/14-18 2000): Thunderstorms caused torrential rainfall with flash flooding washing out sections of roadways in northeast Bennington County and southern Bennington County. Route 7 was closed due to flooding and rockslides and Route 67 was closed due to flooding. Numerous other roads were closed, with some washed out. This rain produced enough runoff to cause the Batten Kill to exceed the six-foot flood stage by about a foot at Arlington, Bennington County, representing a 47-year high. A Cooperative Weather Observer recorded 3.39” of rain in Sunderland.

March 29 to 30, 2003: Up to two inches of rain fell across southern Vermont. The gage on the Batten Kill in Arlington crested at 6.3 feet, which is 0.3 feet above flood stage, and the gauge on the Walloomsac crested at 8.19 feet compared to the 7.5-foot flood stage.

July 21 to 18 August 2003 (DR-1488 7/21-8/18 2003): Severe storms and flooding affected Vermont including Bennington County (Note: this event does not appear in the NOAA data). A Cooperative Weather Observer recorded sporadic and sometimes large amounts of precipitation during that period in Sunderland.

March 31 through April 2, 2004: As much as three inches of rain fell from March 31st through April 2nd across southern Vermont. This rain combined with the last of the snow melt to produce an excessive runoff of water. As a result, flooding took place in Bennington County.

The gage on the Batten Kill River in Arlington, rose to 6.9 feet, nearly a foot above the 6-foot flood stage during the predawn hours of April 3rd.

November 30, 2005: On November 30, widespread rainfall of 1-1.5 inches and snow melt increased river levels resulting in minor flooding on the Batten Kill River at Arlington, Vermont. The river exceeded the 6.0-foot flood stage with a crest of 6.5 feet at 2:00 PM EST.

April 16 to 17 2007 (DR-1698 4/15-21 2007): An intense coastal storm spread heavy precipitation across southern Vermont, starting as a mixture of snow, sleet and rain which changed to all rain. Liquid equivalent precipitation totals ranged from three to six inches leading to minor flooding across portions of southern Vermont. A Cooperative Weather Observer recorded 3.54" of rain in Sunderland.

August 28-29, 2011 (DR-4022 8/27-29 2011): Tropical Storm Irene produced widespread flooding, and damaging winds across the region. Rainfall amounts averaged four to eight inches and fell within a twelve-hour period. A Cooperative Weather Observer recorded 5.16" of rain in Sunderland. In Bennington County, widespread flash flooding and associated damage was reported countywide, with many roads closed due to flooding and downed trees and power lines. Strong winds also occurred across southern Vermont, with frequent wind gusts of 35 to 55 mph, along with locally stronger wind gusts exceeding 60 mph. The combination of strong winds, and extremely saturated soil downed trees leading to widespread long duration power outages.

September 7, 2011: Large amounts of moisture from the remnants of Tropical Storm Lee interacted with a frontal system producing heavy rainfall with total rainfall amounts ranging from three to seven inches. This led to widespread minor to moderate flooding across southern Vermont.

January 12, 2018: After a frigid end of December and beginning of January, an unseasonably warm airmass was pumped into western New England on January 12th on southerly winds. The temperatures reached the 50s and 60s during the day. Showers also developed in the warm airmass ahead of a cold front and were heavy at times, with some locations receiving one to two inches of rainfall. The combination of warm temperatures and heavy rainfall caused river ice to dislodge and resulted in ice jams in spots. Flooding occurred due to a combination of ice jam movement and heavy rainfall. Several roads were closed or damaged and a trailer park experienced flooding.

January 24, 2019: Following a heavy snowfall event on January 19-20 over southern Vermont, a strong low-pressure system tracking through southern Canada ushered in an unseasonably warm and moist airmass on January 24th. Temperatures surged into the 40s to mid-50s. Steady rainfall occurred during much of the 24th as a secondary low-pressure system developed over the Mid-Atlantic and tracked into southern New England. One four inches of rain was recorded over southern Vermont. The combination of the rainfall along with the mild temperatures

melting some of the snow resulted in flooding over portions of the region along with minor to moderate river flooding on the Walloomsac River. Some flooding due to ice jams also occurred.

c. Extent and Location

There are no stream gauges within the town of Shaftsbury. The closest is a gauge in Arlington that is only periodically monitored. There are no stations measuring fluvial erosion. Finally, no post Irene flood elevation data were collected in Shaftsbury. Shaftsbury has the Floodway and Zones AE and A mapped within the town. There have been no NFIP-designated repetitive losses within Shaftsbury. Therefore, based on local knowledge of past events and FEMA and VT ANR mapping, Map 5 show the most likely extent of damages from flooding or fluvial erosion.

In addition to the above events, the Peru, Pownal and Sunderland Cooperative Observers recorded precipitation. Table 5 shows those months by year where that value exceeded the 90th percentile, which varies by site and month. Several events of that magnitude have occurred where flooding was not recorded in NOAANOAA records or local knowledge. High precipitation events could indicate unreported localized flooding events and, therefore, provide additional information on potential flooding extent.

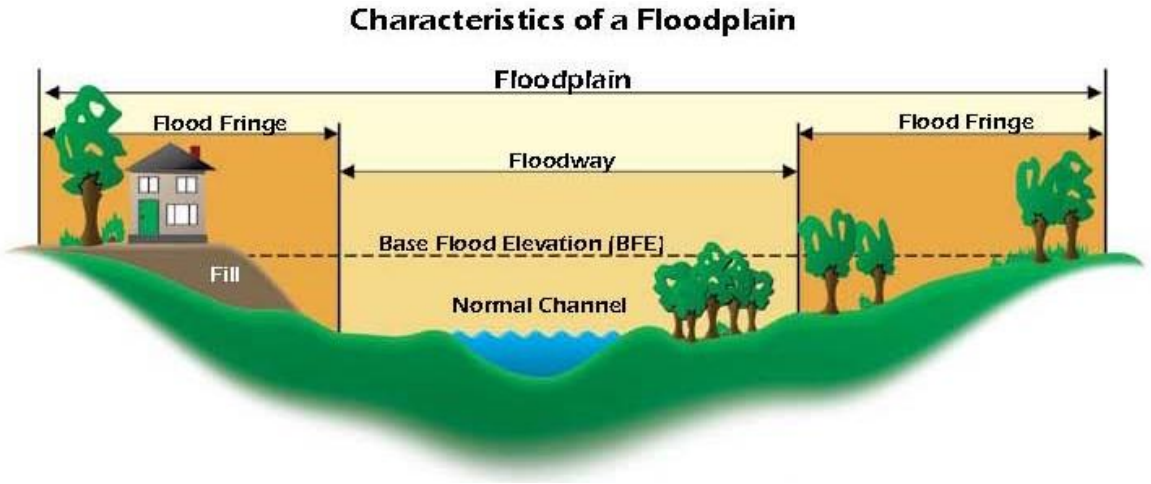
Table 5. Months where rainfall exceeded the 90th percentile (precipitation totals, in inches, in parentheses) of monthly precipitation at the Peru, Pownal and Sunderland Cooperative Observer Stations from 1990 to 2013 for Pownal, 1980 to 2017 for Peru and 1990 to 2013 for Sunderland.
Source: National Oceanographic and Atmospheric Administration 2020a

Sunderland		Pownal	Peru
Month	Year	Year	Year
January	1990, 1998, 1999 (5.97”)	1996, 1998, 1999, 2006 (3.88”)	1990, 1999, 2006, 2012 (5.04”)
February	2002, 2008, 2011 (3.58”)	1981, 1984, 2008 (3.54”)	1981, 2002, 2008, 2016 (5.28”)
March	2001, 2007, 2008 (5.35”)	1980, 1999, 2001, 2007 (4.65”)	1980, 1986, 2001, 2008 (6.13”)
April	1993, 1996, 2002, 2007, 2011 (4.75”)	1983, 1990, 1993, 1996 (4.80”)	1983, 1996, 2007, 2017 (6.43”)
May	1990, 2000, 2006 (6.31”)	1984, 1990, 2013 (6.47”)	1984, 1990, 2012, 2017 (8.29”)
June	1998, 2002, 2006 (7.66”)	1998, 2000, 2002, 2013 (7.32”)	1998, 2006, 2013, 2015 (9.26”)
July	1996, 2004, 2008 (6.87”)	1984, 2004, 2010 (6.20”)	1988. 1996, 2000, 2013 (7.31)”
August	1990, 2003, 2011 (7.37”)	1990, 1991, 2003, 2011 (7.37”)	1985. 1990, 2003, 2011 (8.32”)
September	1999, 2003, 2011 (5.75”)	1999, 2004, 2011 (6.03”)	1987, 1999, 2003, 2011 (6.92”)
October	2005, 2007, 2010 (7.05”)	1987, 1995, 2010 (5.81”)	1987, 1995, 2010 (9.02”)
November	2002, 2004, 2005 (5.28”)	1985, 1988, 2005 (5.81”)	1983, 1986, 1988, 2002 (6.36”)
December	1996, 2003, 2008 (6.42”)	1983, 1990, 2003, 2011 (4.77”)	1983, 1996, 2008, 2014 (6.74”)

The average annual precipitation in Vermont has increased 5.9” since 1960. This trend is predicted to continue so that Vermont streams will have higher flows and possibly experience more frequent and greater flooding events (Galford et al. 2014).

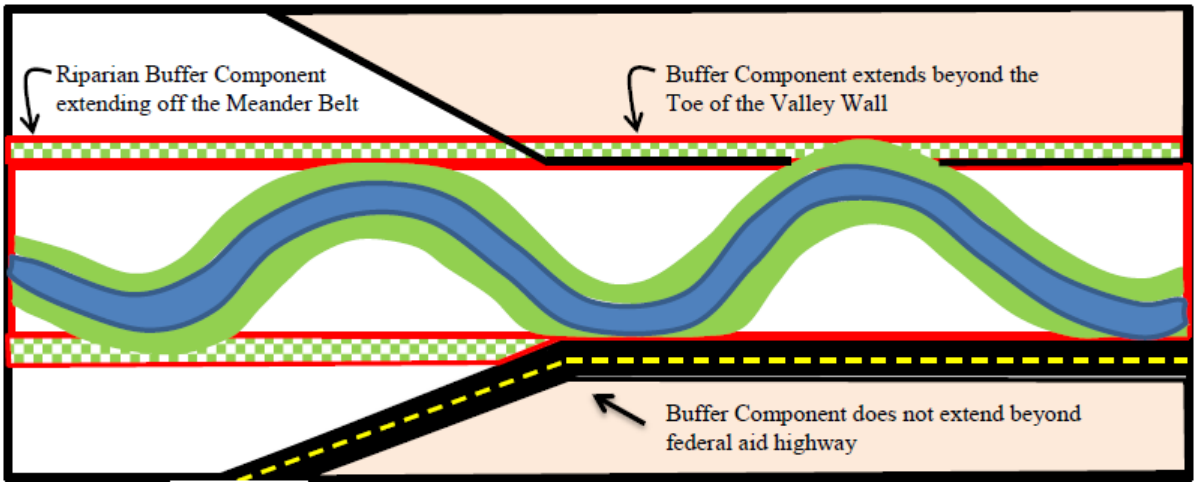
Special Flood Hazard Areas: these are areas mapped by FEMA and using the LIDAR derived zones that were adopted in late 2015. Table 6 shows the number of structures, by type, in the special flood hazard and river corridors, and both areas are shown in Map 5. Figure 1 below shows the parts of a typical floodplain. The Vermont Hazard Mitigation Plan (2018) states that large portions of the state have rivers with no mapped special flood hazard areas though damages from flooding still occur on those streams.

Figure 2. Typical floodplain



River Corridors: River corridors (Figure 2) have been mapped by the Vermont Agency of Natural Resources using geospatial data and will be modified by VT ANR river scientists using available

Figure 1. River corridors



field data. The data were used to calculate the "meander belt width" or area within which a river would move across the valley. As rivers shift their location both vertically and horizontally, erosion of adjacent lands can occur and threaten properties that may be outside of special flood hazard areas. The additional buffer allows for placement of structures beyond the meander belt width and provides for space for the changes in river geometry, bank stabilization

and establishment of woody buffers to provide resistance to erosion from the movement of the channel (Vermont River Management Program 2010).

Table 6. Structures by type in flood hazard zones in Shaftsbury, VT.
Source: Vermont Open Geodata Portal 2020

Type	Number in special flood hazard zone	River Corridor
Single-Family	1	26
Mobile Home	4	2
Commercial	1	2
Industrial	2	0
Community Recreation	0	1
Other	2	2
Camp	1	2
Total Number of Structures	11	35

d. Probability, Impact, and Vulnerability

Based on data from 1996 to 2019, 16 moderate or major flood events have affected areas within or near Shaftsbury. However, there are a limited number of structures within the special flood hazard areas or river corridors. So, while there is a 10-25% chance of such an event occurring in any given year, the potential for property damage is substantially less.

Table 6 tallies the number of structures by type within the river corridor and special flood hazard area. Shaftsbury has a total of 1,461 single family residences, 79 mobile homes, 5 multi-family dwellings 71 commercial/industrial establishments, 31 camps, and 18 government, church, public gathering, and school buildings. As shown in Table 6, there are 11 structures in the special flood hazard area and 35 in the river corridor recently mapped by VT ANR, and since these areas overlap, some structures are in both. Therefore, the potential proportion damaged within the town from severe flooding would range from 1-10% with injuries of 1-10%. Most services recover in less than seven days, though help for specific property owners may take significantly longer.

C. Winter Storms

1. Description

Winter storms are frequent in Vermont. Winter storms may consist of heavy snow, mixed precipitation, or ice storms and all may be accompanied by strong winds. Potential damages can include power outages, traffic accidents, and isolation of some areas. For

example, the October 4, 1987 storm stranded travelers in the area and knocked out power for several days. Members of the planning team recalled this storm as particularly troublesome as trees still had leaves on, so power outages were extensive. The "Blizzard of ’93," one of the worst storms last century, virtually shut down Vermont on the weekend of March 13-14, forcing the closure of roads and airports. This was one of the most powerful snowstorms on record. Snowfall amounts ranged from 10 to 28 inches across the state. In rare cases, the weight of snow may collapse roofs and cause other structural damage. Wind can also accompany snowstorms, increasing the effect of the snow damages. In addition to snow, ice storms occur when the lower levels of the atmosphere and/or ground are at or below freezing, and rain is falling through warmer air aloft. The precipitation freezes upon contact with the ground, objects on the ground, trees, and power lines.

Table 7. Total number of winter storm events by type and year for Bennington County.
Source: National Oceanographic and Atmospheric Administration 2019

Year	Blizzard	Heavy Snow	Ice Storm	Winter Storm	Winter Weather	Totals
1996		5		2		7
1997		1		7	2	10
1998				2	1	3
1999				4		4
2000		1		6		7
2001				6		6
2002				2		2
2003				5		5
2004				2		2
2005	1	3		2		6
2006						0
2007		3	1	6	4	14
2008		4	1	1	11	17
2009		3		1	10	14
2010		3		1	2	6
2011				5	5	10
2012				4	2	6
2013		2		1	3	7
2014		2		4		6
2015		2			6	8
2016		1			5	6
2017	1	3		1	7	12
2018		2		5	4	11
2019		1		5	4	10
Totals	2	36	2	75	68	183

2. Previous Occurrences

Table 7 summarizes the 183 winter storm events that have occurred in Bennington County since 1996. As can be seen, a high number of events occurred in 1997, 2007, 2008, 2009, 2011, 2017, 2018 and 2019. Using NOAA data, we categorized the extent of each storm with storms ranked as “High” if they produced more than twelve inches of snow or were categorized by the NOAA as producing heavy or record snows or blizzards or significant icing. The Blizzard of 1993 was categorized as “Extreme.” The NOAA also reports numerous storms producing one to over three feet of snow in the Green Mountains, but these were not listed as they did not affect major population centers. The following is a summary of significant events.

January 2 to 3, 1996 Heavy Snow: A major winter storm developed over the Gulf Coast states on January 2nd and tracked northeast along the eastern seaboard during January 3rd. Heavy snow fell across southern Vermont with the average snowfall ranging from ten to twelve inches.

November 26, 1996 Winter Storm: Snow and heavy freezing rain brought down trees and power lines with 10,000 customers losing power.

March 14, 1997 Winter Storm: Low pressure tracked from northern Ohio northeast to southern Ontario, Canada, producing several hours of heavy snow across Bennington and Windham Counties. The snow changed to sleet and eventually to freezing rain which caused significant icing. Snowfall totals generally ranged from 2 to 5 inches with up to 8 inches in the Green Mountains. The icing resulted in treacherous driving conditions along with downed trees and power lines. Scattered power outages occurred across this region.

March 31 to April 1, 1997 Winter Storm: Heavy, wet snow, totaling 12 inches in Shaftsbury and elsewhere in Bennington County, resulted in widespread power outages and road closures with some areas without power for several days.

January 6 to 7 2002 Winter Storm: Southern Vermont received over 12 inches of snow, closing schools and businesses, and resulting in some vehicular accidents.

November 17, 2002 Winter Storm: A mixture of snow, sleet, and freezing rain, along with strong winds and trees still with leaves resulted in downed trees and powerlines.

December 25 to 26, 2002 Winter Storm: Snowfall rates of 1-3 inches/hour resulted in over a foot of snow across the county.

January 23, 2005 Blizzard: Frequent whiteout conditions were observed by plow crews.

January 15 to 16, 2007 Ice Storm: Freezing rain and sleet resulted in widespread downed trees and power lines with accompanying widespread power outages.

February 14, 2007 Heavy Snow: Snowfall in excess of two feet across portions of Bennington County resulted in closed schools and businesses. Strong winds created near blizzard conditions during parts of the event.

March 16 to 17, 2007 Heavy Snow: Widespread snow of 10-18 inches fell across southern Vermont resulting in adverse impacts to travel and businesses.

April 12 to 16, 2007 Winter Storm: Heavy, wet snow, ranging from 8-12 inches downed trees and power lines causing widespread outages.

December 16 to 17, 2007 Winter Storm: Heavy snow mixing with sleet and accumulating 8 to 14 inches resulted in difficult travel and the closing of schools and some businesses Monday morning with some power outages. This followed storms on December 2-3 and 9-10.

February 12 to 13, 2008 Winter Storm: Snow accumulated to 4-7 inches but was accompanied by freezing rain with ¼ to 1/3 of an inch of ice.

December 11 to 12, 2008 Ice Storm: Rainfall in rates of ¼ to 1/3 of an inch/hour fell creating ice accumulations of ½ to ¾ of an inch. Snow and sleet mixed in in some areas. An estimated

15,000 customers lost power and businesses and schools were shut for several days. Very cold temperatures followed the storm.

December 19 to 20, 2008 Heavy Snow: Heavy snow closed businesses and schools and caused treacherous driving conditions.

January 1 to 3, 2010 Heavy Snow: A strong storm brought 10 inches to over two feet of snow across Bennington and Windham counties.

February 23 to 24, 2010 Heavy Snow: Heavy snow totaling one to two feet fell across southern Vermont with highest amounts in elevations above 1500 feet.

February 26 to 27, 2010 Heavy Snow: Just after the storm described above, a second storm brought one to two feet in higher elevations with lesser amounts below 1000 feet in elevation.

December 26 to 27, 2010 Winter Storm: Heavy snow falling at rates of 1-3 inches/hour resulted in one to two feet of snow. Winds were strong and gusted to 35-45 mph.

January 12, 2011 Winter Storm: A strong storm resulted in 14 inches to three feet of snow falling at rates of three to six inches/hour.

February 1 to 2, 2011 Winter Storm: Snowfall was generally 10-18 inches but ranged to 25 inches in some areas.

February 25, 2011 Winter Storm: Snow fell at rates of one to two inches/hour with totals of 12 to 17 inches across southern Vermont.

October 29 to 30, 2011 Winter Storm: While not yet winter and with trees with much of their foliage still on, 5 to 14 inches fell across Bennington County. Trees and power lines came down due to the weight of the wet snow.

January 1 to 2, 2014 Heavy Snow: Widespread snow accumulated 8-17 inches followed by very cold temperatures.

February 13 to 14, 2014 Winter Storm: Snow fell at rates of up to three inches/hour. Over the two days of the storm, 8-21 inches fell in southern Vermont. At times, winds gusted to 40 mph as the storm left the area.

November 26 to 27, 2014 Winter Storm: An early storm affected southern Vermont over the Thanksgiving period with 8-15 inches of total accumulation.

February 2, 2015 Heavy Snow: Snow accumulations ranged from 9-15 inches.

February 7 to 10, 2015 Heavy Snow: One to two feet of snow fell, with higher amounts in higher terrain.

February 9, 2017 Heavy Snow: A Nor'easter left 8-14 inches of snow across Bennington County.
March 14 to 16, 2017 Blizzard: This significant coastal storm resulted in 18 inches of snow at low elevations and 35 at high elevations. High winds and blizzard conditions resulted in poor visibility.

January 3 to 4, 2018 Heavy Snow: Snowfalls of 7 to 15 inches accompanied by winds gusting between 30 and 45 miles per hour spread snow across the county. The event was followed by very cold temperatures.

February 4 to 5, 2018 Heavy Snow: Snowfalls of 5 to 14 inches were widespread across the county.

March 7 to 8, 2018 Winter Storm: Heavy snow with rates of up to three inches/hour resulted in one to three feet of snow in upslope locations.

March 13 to 15, 2018 Winter Storm: Snowfall rates of up to three inches/hour fell, especially in higher elevations.

November 26 to 28 2018 Winter Storm: Heavy, wet snow brought down trees and powerlines.

January 19 to 20 2019 Winter Storm: Heavy snow followed by wind chills of -20 to -40^0 F resulted in closing of businesses and schools.

December 1 to 2 2019 Heavy Snow: A major storm brought accumulations of 18-28 inches across southern Vermont.

3. Extent and Location

As discussed above, we described extent based on snow depth from records from the National Oceanographic and Atmospheric Administration (NOAA). The National Oceanographic and Atmospheric Administration also publishes climate "normals" or averages for various stations including Pownal and Sunderland. The average annual snowfall for the period 1981 to 2020 was 60.8 inches for Pownal and 75.1 inches for Sunderland. December, January, February, and March are the primary months for snowfall. Extreme snowfall in one, two- and three-day events has ranged from 12 to over 20 inches (National Oceanographic and Atmospheric Administration 2020a). The skill of road crews in Vermont means that only the heaviest snowstorms (>12 inches) or ice storms significantly affect roads and populations.

Increasing temperatures that are predicted to occur will likely reduce total winter snowfall. If precipitation falls as rain in the winter, winter river flows will be higher due to the

lower evapotranspiration in the winter. Freezing rain may become more frequent, with resulting impacts to the transportation and power systems (Galford et al. 2014).

4. Probability, Impact and Vulnerability

There is a 100% probability of a moderate or greater snowstorm affecting Bennington County, including Shaftsbury, in any given year. These are large-scale events, though local impacts may vary greatly. Roads and power lines are most vulnerable, with traffic accidents the most likely to create injuries.

D. High Wind Events

1. Description

High wind events can occur during tropical storms and hurricanes, winter storms and frontal passages. Thunderstorms can produce damaging winds, hail and heavy rainfall, the latter potentially producing flash floods. The NOAA recorded 158 wind events in Bennington County since 1996. Thunderstorms tended to occur in the spring and summer while events categorized as "strong wind" tended to occur during the winter months.

Tornadoes are formed in the same conditions as severe thunderstorms. Intense, but generally localized damage can result from the intense winds. The primary period for tornado activity in New England is mid-summer (Zielinski and Keim 2003). Tornadoes will generally follow valleys in the northeast and dissipate in steep terrain. The NOAA recorded three tornadoes in Bennington County since 1990.

2. Previous Occurrences

Table 8 below summarizes the total number of significant wind events including thunderstorms, strong winds, and tornadoes from 1996 to 20189 The 1998 tornado registered F2 on the Fujita damage scale. The 2002 tornado in Bennington County registered F1 while the 2003 tornado was an F0 to F1 (National Oceanographic and Atmospheric Administration 2015). The Fujita scale is based on wind speed and typical damage. An F0 tornado has winds of less than 73 miles per hour and could damage chimneys, branches and bring down shallow rooted trees. An F1 tornado has winds of 73-112 miles per hour and could damage roofs, push mobile homes off foundations and blow cars off roads. An F2 tornado has winds of 113-157 miles per hour and could tear off roofs, destroy mobile homes and snap trees (http://www.spc.noaa.gov/faq/tornado/f-scale.html).

Wind speed data is not available for most wind events due to the lack of weather stations. The only recording gauge is at the Bennington Airport. NOAANOAA data rarely included estimates of wind speed. Generally, wind speeds of greater than 55 miles per hour are

considered damaging (NOAA 2006). Events that occurred in or near Shaftsbury are described below.

Table 8. Summary of wind events in Bennington County.
Source: National Oceanographic and Atmospheric Administration 2019

Year	High Wind	Strong Wind	Thunderstorm Winds	Tornado	Funnel Cloud	Totals
1996	5					5
1997	2	2	6			10
1998	1		8	1		10
1999	2		4			6
2000	1		1			2
2001			3			3
2002			3	1		4
2003	1			1		2
2004						0
2005	1		3			4
2006	3		3			6
2007	3		6			9
2008		3	5			8
2009	2		1			3
2010	5		3		1	9
2011	1		8			9
2012			3			3
2013			6			6
2014			3			3
2015			2			
2016		1	7			8
2017	4	3	5			12
2018	2	5	7			14
2019	1	9	3			13
Totals	40	23	91	3	1	158

July 15 through 18, 1997 Thunderstorm Winds: Severe thunderstorms downed trees in Dorset, Manchester, and Shaftsbury.

August 21, 1997 Strong Wind: Winds of up to 40 mph downed trees in North Bennington, Dorset and Sandgate resulting in approximately 1,000 customers without power.

November 27, 1997 Strong Wind: Winds of 40-50 mph downed trees and power lines resulting in approximately 1,500 customers without power.

May 29 through 31, 1998 Thunderstorm Winds and Tornado: Strong thunderstorms generated an F2 tornado in New York, which became an F1 after crossing into Vermont. The tornado

followed Route 67 through North Bennington and South Shaftsbury. Approximately 8,000 customers lost power for several days.

September 16 to 18, 1999 (DR-13079/16-21 1999): Remnants of Hurricane Floyd (see flooding and flash flooding) brought winds gusting to over 60 mph and downed trees and power lines in southern Vermont.

November 2, 1999 High Wind: A wind gust of 66 mph was recorded at the Bennington Airport, though no damages were reported.

June 5, 2002 Thunderstorm Winds and Tornado: Thunderstorms originating in New York produced an F1 tornado that touched down in Woodford Hollow.

July 21, 2003 Tornado: A supercell originating in New York created a tornado there, then created a second tornado in Pownal and Bennington. Those, along with thunderstorm winds, downed trees and caused minor damage.

June 6, 2005 Thunderstorm Winds: Trees were blown down in Shaftsbury.

April 23, 2006 High Winds: High winds from a low-pressure system uprooted trees in Arlington.

October 28 to 29, 2006 High Winds: Strong winds, some reaching 60 mph, blew from the evening of the 28th through parts of the 29th with trees reported down in Sunderland and Arlington.

December 1, 2006 High Wind: The wind gauge at the at Bennington Morse Airport measured a gust of 57 mph.

March 2, 2007 High Winds: High winds were associated with snow and freezing rain. Winds measured at Bennington Morse Airport reached 59 mph.

April 16, 2007 High Winds: Low pressure caused strong winds with 175 downed trees near Route 30 in Dorset.

June 1, 2007 Thunderstorm Winds: Thunderstorms resulted in downed trees near the recreation center on Route 7A in Arlington.

December 16, 2007 High Winds: A snowstorm brought 8-14 inches of snow along with strong winds that combined to down trees and powerlines.

December 30, 2008 High Winds: Strong wind gusting 45-55 mph brought down trees and caused power outages.

June 30, 3009 Thunderstorm Wind: A wind gust of 59 mph was recorded at the Bennington Morse Airport.

December 9, 2009 High Winds: High winds, measured up to 59 mph at the Bennington Morse Airport, caused power outages in Bennington, Dorset, Manchester, Pownal, Sandgate, Shaftsbury, and Sunderland.

May 8, 2010 Thunderstorm Winds: Thunderstorms generated winds in excess of 40 mph downing trees in Arlington and Manchester Center.

July 17, 2010 Funnel Cloud: A funnel cloud was reported on Route 279 in Bennington.

August 22, 2010 High Winds: Strong winds formed during passage of a cold front and downed trees and wires in Arlington, Bennington, Shaftsbury, and Sunderland.

September 30 to October 1, 2010 High Winds: A low-pressure system and remnants of an offshore Tropical Storm Nicole created winds gusting to over 55 mph with power outages reported.

May 26, 2011 Thunderstorm Winds: Thunderstorm winds resulted in downed trees in Arlington.

June 9, 2011 Thunderstorm Winds: A pre-frontal trough formed a line of severe thunderstorms that moved across eastern New York and southern Vermont.

August 28 to 29, 2011 (DR-4022 8/27-29 2011): Along with flooding described above, Tropical Storm Irene brought 35-55 mph winds with gusts exceeding 60 mph resulting in downed trees and powerlines.

September 4, 2011 Thunderstorm Wind: A wind gust of 64 mph was measured at Bennington Morse Airport.

October 29 to 30, 2012 High Winds: Superstorm Sandy brought strong winds of 40-60 mph, with a gust of 58 mph recorded at the Bennington Morse Airport.

September 11, 2013 Thunderstorm Winds: Thunderstorm winds downed trees in Arlington.

July 3, 2014 Thunderstorm Winds: Thunderstorms again affected Arlington as well as Dorset.
June 21, 2016 Thunderstorm Winds: Strong storms occurred throughout southern Vermont with a wind gust of 61 mph measured in Bennington and power outages across the region.

October 22 to 23, 2016 High Winds: Winds with gusts up to 50 mph affected parts of southern Vermont.

January 10 to 11, 2017 High Winds: Winds of 40-60 mph caused some power outages in the county.

March 2, 2017 High Winds: Winds of 30-45 mph were widespread across the county.

May 5, 2017 High Winds: Winds up to 68 mph were observed in Bennington.

May 18, 2917 Thunderstorm Winds: Thunderstorms created winds that brought down power lines in some areas.

July 1, 2017 Thunderstorm Winds: A microburst brought down trees in Sandgate. The estimated windspeed based on the damage was 100 mph.

October 30, 2017 High Winds: Winds brought down trees, limbs, and wires across the county.

April 4, 2018 High Winds: Strong winds with gusts of 40-50 mph brought down power lines across southern Vermont.

June 18, 2018 Thunderstorm Winds: A hot airmass in the daytime led to thunderstorms in the evening with numerous power outages and trees down. Route 7A in Shaftsbury and Sunderland was closed for a time.

April 3, 2019 Strong Wind: Winds of 35-55 mph across the county resulted in downed trees and powerlines.

c. Extent and Location

Damaging winds, including the previous occurrences described above, are those exceeding 55 miles per hour (National Oceanographic and Atmospheric Administration 2006 and undated). There are no wind gauges that record windspeed data in Shaftsbury. Therefore, we used what was available from NOAA data described above for windspeed During a November 1999 event, winds were measured at 66 mph at the Morse Airport in Bennington. Higher winds were likely created during the tornadoes. High wind events can strike anywhere. Where storms are funneled up the valleys, damage can be significant, but most likely less than 10% of structures would be affected. Again, power outages could last up to seven or more days. There are no weather stations nor any records of wind data in Shaftsbury.

d. Probability, Impact and Vulnerability

Wind events causing moderate or greater damage occur almost every other year (40-50%) in Bennington County, and can range from localized events from thunderstorms to wide

ranging events from larger storms. The primary vulnerability would be power outages from downed trees and lines and the potential expected probability would be 10-75% in Shaftsbury.

E. Hail

The National Climate Data Center has 30 reports of hailstorms in Bennington County between 1996 and 2019, all associated with thunderstorms. On June 1, 2011, a strong thunderstorm brought three-inch (baseball size) hail to Shaftsbury, which may be an historic occurrence according to NOAA records,

Hail was also reported by a Cooperative Weather Observers on May 25, 1999, May 8, 2000, July 18, 2000, July 5, 2001, August 4, 2001, June 2, 2002, August 1, 2008, and August 15, 2009 in Sunderland and on June 10, 2008 and May 8, 2010 in Peru.

c. Extent and Location

Hail can be very localized or can cover wide areas and has the potential for damaging crops, automobiles, or glass within structures, as well as causing injury. Generally, however, hailstorms affect relatively small areas as they form in thunderstorms, which are localized.

d. Probability, Impact and Vulnerability

Hailstorms are generally local, affecting subareas within the town, though a group of thunderstorms can cause hail in multiple locations over a wide area. From past occurrences, one thunderstorm per year generates hail that was recorded. So, the possibility of hail occurring in Shaftsbury could range from 10-75%. The potential vulnerability would be localized to damage to structures or automobiles, though there could also be damage to vegetation. In general, these impacts would be localized.

F. Temperature Extremes

1. Descriptions

Temperature extremes entail periods of either excessive heat or extreme cold. Excessive heat is generally defined as periods when the normal high temperature is exceeded by ten degrees. So, in the summer, this would equal 88-89 degrees in Shaftsbury (Table 9). Excessive heat is recorded at other times but does not have the health consequences of summer periods. In addition, the heat index, which factors in the high relative humidity levels of summer, is also a factor. The Vermont Department of Health has determined that serious heat related injuries and deaths occur when the temperature reaches or exceeds 87^0 F (Vermont Department of Health 2016). Using the Sunderland Cooperative Observer data this occurred 151 times between 1990 and 2017 or about eight time per year.

Extreme cold is not well defined. For those involved in outdoor activities, extreme cold, accompanied by wind, is when exposed skin would be subject to frostbite. However, for periods of power outages that might accompany winter storms, extreme cold could be thought of as when temperatures fall below freezing as that would not only affect health but could result in pipes freezing and the loss of water supplies.

Table 9. Bennington and Sunderland normal temperatures and precipitation for 1981 to 2010.
Source: National Oceanographic and Atmospheric Administration: *http://www.NOAA.noaa.gov/land-based-station-data/climate-normals/1981-2010-normals-data*

Month	High Temperature (^{0}F)		Low Temperature (^{0}F)		Mean Temperature (^{0}F)		Precipitation (in)	
	Sunderland	Bennington	Sunderland	Bennington	Sunderland	Bennington	Sunderland	Bennington
January	28.5	30.7	9.5	11.6	19.0	21.1	3.44	2.75
February	33.7	34.7	11.2	15.3	22.5	25.0	2.82	2.24
March	40.9	43.8	19.5	22.7	30.2	33.3	3.55	3.15
April	54.3	56.7	31.0	34.3	42.7	55.1	3.47	3.27
May	65.8	37.0	41.3	43.3	53.5	55.1	4.33	3.66
June	75.3	75.0	49.6	52.4	62.5	63.7	4.66	4.13
July	78.5	79.4	54.5	57.0	66.5	68.2	4.55	4.34
August	77.1	77.7	53.0	57.0	65.0	66.4	4.40	4.00
September	69.6	70.4	44.2	47.4	56.9	58.9	3.83	3.57
October	57.3	58.7	34.4	36.4	45.8	47.5	4.28	3.69
November	45.9	47.5	27.9	29.7	36.9	38.6	3.98	3.11
December	34.4	35.7	17.2	19.5	25.8	27.6	3.95	2.79
Annual Average	55.1		32.8		43.9		47.26 Total	40.70 Total

The station normal reports for the Cooperative Weather Observers indicate an average of one day per year when the maximum temperature would equal 90 degrees in Sunderland and two days in Bennington, 55 days when the maximum temperature would be less than 32 degrees in Sunderland and 45 in Bennington, and 172 days when the minimum temperature would be less than 32 degrees in Sunderland and 156 days in Bennington.

2. Extent and Location

Extreme temperature is a widespread phenomenon. The populations affected could be small if one is considering outdoor workers alone or large if the entire town were subject to a power outage. Temperatures above 90^0F occur approximately one or two days per year. The highest recorded temperature at the Sunderland Cooperative Weather Observer station was 95^0F on August 24. 2002. High temperatures of 94^0F were recorded on August 15, 2002, and again on July 22 and 23, 2011. The coldest recorded temperatures by the Sunderland Cooperative Weather Observer were -24^0 F on January 28, 2005 with -22^0 F recorded on both January 22nd and 29th in 2005.

Over the past several years, a phenomenon known as the "polar vortex" has affected the United States due to distortions in high level winds. These have resulted in prolonged cold periods in Vermont. Wind chill, which factors wind speed with air temperature, can result in greater effects of cold, including frostbite. Data on wind chill is not maintained, but temperatures of less than 0 degrees Fand winds greater than 15 mph can result in frostbite in 30 minutes or less as temperatures fall and wind speed increases (Vermont Hazard Mitigation Plan 2018).

Average temperatures in Vermont have risen 2.7^0F since 1941 with an increase of 1.5^0F since 1990. Winter temperatures have risen more than summer temperatures. If these trends continue, the number of days above 90^0F will likely increase and minimum temperatures also increase (Galford et al 2014).

3. Probability, Impact and Vulnerability

Extreme heat is relatively rare with occurrences of approximately less than one day a year. Extreme cold, here defined as less than freezing temperature, is a frequent phenomenon in Vermont. Impacts of either type of event could be widespread, and vulnerability is dependent on the populations exposed.

G. Drought

1. Description

There are several types and definitions of drought: meteorological, climatological, atmospheric, agricultural, and hydrological. The latter is based on stream flow and groundwater availability and is probably most important from a natural hazard assessment perspective. Reductions in precipitation over long enough periods, particularly during the growing season when plants take up moisture, can result in hydrologic drought.

2. Past Occurrences

The Palmer Hydrologic Drought Index (PHDI) is an indicator of potential surface and groundwater availability based on climatic conditions. The categories of drought include moderate drought, severe drought, and extreme drought. Table 10 shows periods when the index showed severe and extreme droughts using data from 1985 to 2019. No drought conditions were recorded from 2003 through 2015.

Table 10. Years and number of months when the PHDI indicated severe or extreme droughts from 1895 to 2019.
Source: National Oceanographic and Atmospheric Administration. Source: *ftp://ftpncdd.noaa.gov/pub/data/cirs/climdiv/* (Richard Heims, personal communication)

Year	Extreme	Severe
1907		1
1908	2	1
1909	1	2
1910		2
1911	5	4
1912		2
1913		5
1914		5
1915	3	1
1921		2
1922		1
1930		1
1931		1
1941		5
1942		2
1949		1
1953		2
1957		1
1959		1
1963		3
1964	1	6
1965	8	1
1995		2
1999		1
2001	2	1

Table 10. Years and number of months when the PHDI indicated severe or extreme droughts from 1895 to 2019.
Source: National Oceanographic and Atmospheric Administration. Source: *ftp://ftpncdd.noaa.gov/pub/data/cirs/climdiv/* (Richard Heims, personal communication)

Year	Extreme	Severe
2002	1	1
2016		1
Total	23 months; 8 years	59 months; 27 years

3. Extent and Location

The National Oceanographic and Atmospheric Administration calculates this index back to 1895. Since then, severe droughts occurred in 27 years or 22% while extreme drought occurred in 8 years or 6%. Severe and extreme droughts have been of short duration, except occurrences in the early 1960s. Mild to moderate droughts have been more frequent. Severe and extreme droughts are likely to affect those properties with shallow wells. Based on well data from VT ANR, there are 13 public systems in Bennington County. They include the North Bennington Water Department. which supplies water to North Bennington as well as parts of Bennington and Shaftsbury. There are also public systems serving three motels, Dailey Precast LLC and two parks, including Shaftsbury Lake State Park. The town has 927 private wells with 74 having a depth of less than 100 feet. Source protection areas were mapped by the Vermont Agency of Natural Resources and are primarily dependent on topography (Map 6).

4. Probability, Impact and Vulnerability

The water supply system for Shaftsbury consists of private wells, and several public systems, also from wells (Map 6).

Based on the Palmer Drought Severity data, there is a 22% chance of a severe or extreme drought occurring in any one year. Except for long-term drought, most wells should supply sufficient water, though structures with shallow wells are most likely to be affected. Drought may affect the potential for wildfire, which is discussed below. Increasing temperatures or changes in precipitation patterns due to climate change may affect the frequency, length, and degree of drought.

Table 11 below shows categories from the U.S. Drought Monitor for Vermont. Much of southwestern Vermont, including Shaftsbury, has been under the D0 category (Abnormally dry). The planning team has not observed the types of conditions listed in Table 11 for that category, though they may have occurred at times and in scattered locations.

Table 11. Potential impacts of drought in Vermont.
Source: United States Drought Monitor – Vermont, Available via https://droughtmonitor.unl.edu/CurrentMap/StateDroughtMonitor.aspx?VT

Category	Impact
D0	Crop growth is stunted; planting is delayed
	Fire danger is elevated; spring fire season starts early
	Lawns brown early; gardens begin to wilt
	Surface water levels decline
D1	Irrigation use increases; hay and grain yields are lower than normal
	Honey production declines
	Wildfires and ground fires increase
	Trees and landscaping are stressed; fish are stressed
D2	Voluntary water conservation is requested; reservoir and lake levels are below normal capacity
	Specialty crops are impacted in both yield and fruit size
	Producers begin feeding cattle; hay prices are high
	Warnings are issued on outdoor burns; air quality is poor
	Golf courses conserve water
	Trees are brittle and susceptible to insects
D3	Fish kills occur; wildlife move to farms for food
	Water quality is poor; groundwater is declining; irrigation ponds are dry; outdoor water restrictions are implemented
	Crop loss is widespread; Christmas tree farms are stressed; dairy farmers are struggling financially
	Well drillers and bulk water haulers see increased business
	Water recreation and hunting are modified; wildlife disease outbreak is observed
D4	Extremely reduced flow to ceased flow of water is observed; river temperatures are warm; wells are running dry; people are digging more and deeper wells
	Vermont has had little or no experience in D4 so no impacts have been recorded at that level in the Drought Impact Reporter

H. Wildfire

1. Description

Wildfire or wildland fire is any unplanned fire affecting open lands including forests, grasslands, or other features. The potential for wildland fire is dependent on fuel types, which vary with vegetation, topography, and weather. Fire intensity, measured by the amount of energy released in a fire and exhibited by the length of flames, and rates of spread dictate the degree of wildland fire hazard and methods of control. Table 12 shows how wildfires can be categorized based on size.

Table 12. Wildland fire size classes. Source: National Wildfire Coordinating Group 2011		
Magnitude (Size)	Description	Probability
Class A	< ¼ acre	High
Class B	¼ to 10 acres	High
Class C	10 to 100 acres	Moderate
Class D	100 to 300 acres	Low
Class E	300 to 1000 acres	Very low
Class F	1000 to 5000 acres	Very low
Class G	>5000 acres	Very low

In Vermont, forests tend to be dominated by northern hardwood species such as sugar maple (*Acer saccharum*), birch (*Betula* spp.), white pine (*Pinus strobus*) and hemlock (*Tsuga canadensis*). These species tend to create relatively low flammability fire, so that surface fires have low intensity and rates of spread, thereby limiting fire hazard (Anderson 1982). Most of the land area in Shaftsbury is covered by broadleaf litter fuels that exhibit fires of low intensity and slow rates of spread.

In both forested and open settings, structures may be threatened by even small wildfires. These wildland-urban interface areas are the most likely areas where resources will be needed to suppress wildland fire and to reduce potential hazards.

Fire behavior is most extreme during periods when the relative humidity is low, generally less than 35-45%. These conditions are most prevalent in the spring, following snow melt, between March and late May or early June. After that, vegetation becomes increasingly green, and the resulting moisture in the live vegetation (fuel) reduces flammability significantly. Precipitation and evapotranspiration increase ambient relative humidity levels so that fires in the summer are generally rare and limited in size.

Fall again brings drying fuels and weather conditions increasing fire hazard. However, relative humidity levels increase after dark, and shorter days also limit the amount of time for fuels to dry and intense, fast moving fires to occur (North Central Research Station 2005).

2. Past Occurrences

According to records from the Vermont Department of Forests, Parks and Recreation (Erik Lars, personal communication), from 1992 to 2019, 169 wildfires occurred in Bennington County, the largest of which was 110 acres in Sandgate in 1994. Twenty wildfires occurred in Shaftsbury. Seven of those were from one to three acres and one, occurring in 2015, was 5 acres.

3. Extent and Location

Low intensity fires with relatively slow rates of spread could occur in the forested areas which comprise most of Shaftsbury's land cover. Fires on steep slopes could present control problems due to terrain and as fire will spread more rapidly. Throughout the town there may be pockets of heavier fuel loads, such as brush, or more flammable fuels, such as cured herbaceous vegetation and shrubs. These areas are generally located in the valleys near developed areas.

4. Probability, Impact and Vulnerability

Shaftsbury likely has some structures within the "wildland urban interface," which represents areas where structures directly abut wildland fuels (Federal Register 2001). The community wildfire plan completed for Arlington, Glastenbury, Sandgate, Shaftsbury, and Sunderland (Batcher and Henderson 2013) mapped urban interface boundaries of 0.1, 0.2 and 0.5 miles from existing structures based on calculations of potential fire spread given typical fuel types. As discussed below, the risk of wildfire in Shaftsbury is low except for higher potential in old field vegetation.

Map 7 shows wildfire risk, as determined by the Vermont Department of Forests, Parks and Recreation (2010) and mean fire return interval from LANDFIRE. For most of the forested area, the return interval exceeds 100 years, meaning that the natural return interval is relatively long. This return interval is shorter for areas dominated by herbaceous vegetation in the fields within valley, and these areas tend to be the locations of the small, more frequent brush fires that are suppressed by the Shaftsbury Fire Department. The wildfire risk is low or nonexistent, especially in developed areas where there is little or no fuel.

Deciduous and coniferous forests create litter that is relatively low in flammability so that wildfires have relatively low intensity and rates of spread. The main hazard is for wildland fire fighters working in steep terrain. The natural fire return intervals in most forests in Vermont are more than 50 years and greater as shown in Map 7 (Malamud et al. 2005). Recurrence is likely related to precipitation rather than the buildup of fuels, so drought recurrence is already factored into these interval estimates. Therefore, the potential for large fires is limited due to the fuel characteristics. However, large roadless areas and steep topography can make suppressing wildland fires that do occur difficult. Settled areas have a low vulnerability to fire.

I. Earthquake

1. Description

Vermont has no active faults but has experienced minor earthquakes. Table 14 below shows the most recent occurring within the state, though there have been others, located

outside, that have been felt in Vermont (Springston and Gale 1998). The U.S. Geological Survey predicts a two percent probability of an earthquake causing considerable damage in Vermont sometime in the next 50 years (Springston and Gale 1998).

2. Past Occurrences

Data from the Weston Observatory at Boston College (Northeast Earthquake Maps and Catalog) was used to identify earthquakes occurring within 100 miles of Shaftsbury since 1990. No earthquakes occurred in either Shaftsbury or Bennington County during that period. Figure 3 below plots the number of earthquakes by year by magnitude, which is described in Table 13 below.

Table 13. Earthquake magnitude and intensity scale descriptions.
Source: U.S. Geological Survey 2010.
http://earthquake.usgs.gov/learn/topics/mag_vs_int.php

Magnitude	Modified Mercalli Intensity	Description
1.0-3.0	I	I. Not felt except by a very few under especially favorable conditions
3.0- 3.9	II-III	**II**. Felt only by a few persons at rest, especially on upper floors of buildings. **III**. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck.
4.0-4.9	IV-V	**IV**. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. **V**. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
5.0-5.9	VI-VII	**VI**. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. **VII**. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.

Table 13. Earthquake magnitude and intensity scale descriptions.
Source: U.S. Geological Survey 2010.
http://earthquake.usgs.gov/learn/topics/mag_vs_int.php

Magnitude	Modified Mercalli Intensity	Description
6.0-6.9	VII-IX	**VII**. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken. **VIII**. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. **IX**. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
7.0 and higher	VIII or higher	**VIII**. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. **IX**. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations. **X**. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. **XI**. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly. **XII**. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

Figure 3. Plot of earthquake and magnitude for occurrences within 100 miles of Bennington County, VT. Source: Northeast Earthquake Maps and Catalog 2015

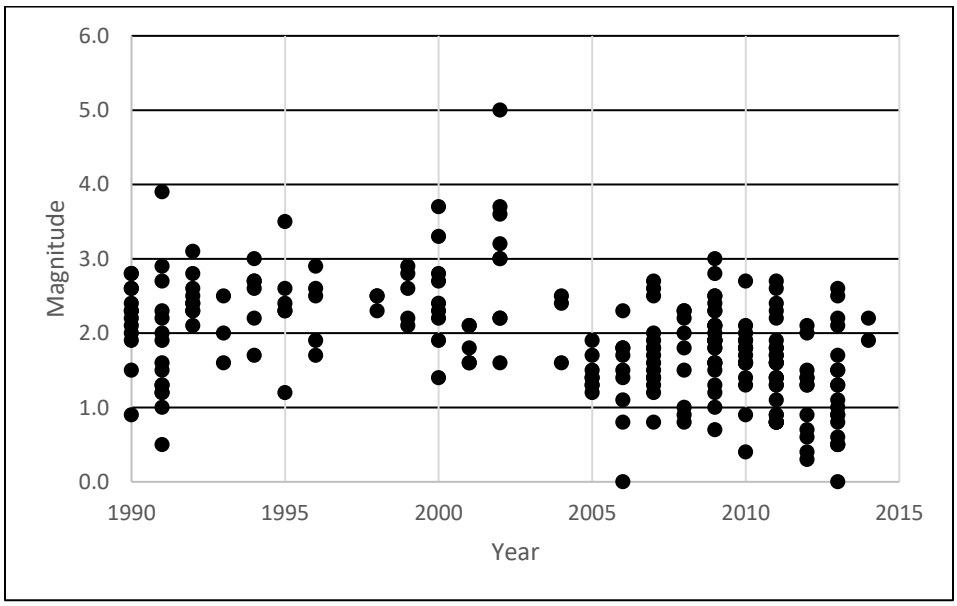


Table 14. Earthquakes in Vermont. Source: Vermont Geological Survey (Ebel et al. 1995) http://www.anr.state.vt.us/dec/geo/EBEL.htm consisting of excerpts from: A Report on the Seismic Vulnerability of the State of Vermont by John E. Ebel, Richard Bedell and Alfredo Urzua, a 98-page report submitted to Vermont Emergency Management Agency in July 1995; Vermont Hazard Mitigation Plan 2018.

Location	Date	Magnitude	Mercalli Intensity
Swanton	July 6, 1943	4.1	Felt by nearly everyone; many awakened with some dishes and windows broken and unstable objects overturned
Brandon	March 31, 1953	4.0	Felt indoors by many, but by few outdoors. Sensation would be similar to a heavy truck striking a building
Middlebury	April 10, 1962	4.1	Felt by nearly everyone; many awakened with some dishes and windows broken and unstable objects overturned
Plattsburgh	April 20, 2002	5.1	Resulted in shaking felt in Vermont

3. Extent and Location

Table 14 shows earthquakes that have occurred in Vermont based on the 1995 report. No earthquakes have been recorded in Shaftsbury or in Bennington County. Those occurring within 100 miles have ranged in magnitude from barely registered to 5.0, with most in the range of 1.0 to 3.0 (Figure 3). No damage was recorded in any of these in Shaftsbury. In 2003, the Vermont Geological Survey completed simulations using FEMA HAZUS software of potential damage within Bennington County from a 500-year recurrence earthquake centered in Middlebury, VT, Tamworth, NH and Goodnow, NY. The results indicated minimal damage and injury from any of these events to Shaftsbury (Kim 2003).

d. Probability, Impact and Vulnerability

Based on the 2003 HAZUS analyses, both the probability and impact of an earthquake of a magnitude that could potentially occur in Vermont are low. However, earthquake prediction science is very limited. However, the Vermont Hazard Mitigation Plan (2018) states that low probability (500-year) earthquakes could cause substantial damage and would result in disruptions to transportation and power supplies.

J. Landslide

1. Description

Landslides are typically associated with periods of heavy rainfall or rapid snow melt and tend to worsen the effects of flooding that often accompanies these events. Some landslides move slowly and cause damage gradually, whereas others move so rapidly that they can destroy property and take lives suddenly and unexpectedly. Gravity is the force driving landslide movement. Factors that allow the force of gravity to overcome the resistance of earth material to landslide movement include saturation by water, steepening of slopes by erosion or construction, and alternate freezing or thawing. Table 15 shows how landslides can be categorized.

Table 15. Landslide and debris flow types.
Source: USGS 2006

Magnitude	Description	Probability
Localized	Falls: abrupt movements of rocks and boulders, generally on steep slopes	Low to moderate
Topples	Topples: movements involving some forward rotation as material moves downhill	Low to moderate

Table 15. Landslide and debris flow types. Source: USGS 2006		
Magnitude	Description	Probability
Flows	A range of land movement generally involving a mass of loose soil, rock, organic matter, air, and water moving downhill rapidly and possibly covering a wide area. One form called creep involves slow movement of material and is often recognizable by trees growing so as to remain vertical while bent near the ground as they grow to keep up with the slow material flow.	Highly variable but can be fairly common.

2. Past Occurrences

No landslides were reported during Tropical Storm Irene in Shaftsbury and none have been reported from previous storm events in the Town. One rockfall area was identified by the Vermont Agency of Transportation (Eliason and Springston 2007) on US Route 7 in Shaftsbury

3. Extent and Location

Using a protocol developed for the Vermont Geological Survey (Clift and Springston 2012), Dale (2015) used geographic information system data and analyses to develop a potential landslide map for the town. Map 8 shows that the areas of medium and high potential for landslides are primarily on the steeper slopes. There are only limited areas of high landslide potential, and these far from settled areas, the road system and other infrastructure. The total area of high potential is approximately 0.21% of the area of the town or 59 acres.

4. Probability, Impact and Vulnerability

Map 8 shows few areas of high potential for landslides, so the probability of those affecting settled areas is low and therefore the potential impact and vulnerability are both low. The potential for rockfalls is limited as well.

K. Invasive Species

1 Descriptions

Invasive species are organisms that are not native to a geographic area and which can or do cause economic or environmental harm. Invasive species are characterized by organisms that spread rapidly, can displace native species, and have few or no predators to keep their populations in check. At the same time, they have characteristics that may reduce the value and use of natural resources. For example, bush honeysuckle can become a dominant shrub in some forests reducing the potential for tree regeneration. Japanese knotweed colonizes stream banks, and does not hold soil well, leading to increased streambank erosion (Vermont Invasives 2020; Vermont Hazard Mitigation Plan 2018). There has been limited mapping of invasives in Shaftsbury. The Early Detection and Distribution Mapping System (EDD Maps) system for mapping of invasives by professionals and citizen scientists in New England.

Vermont has two invasive species lists: Class A species are on the Federal Noxious Weed List but are not known to occur in Vermont (Table 16). These are listed in 7 C.F.R. 360.200, a section of the Code of Federal Regulations. Class B species are known to occur in the state and are considered a threat (Table 17).

Table 16. Designated Class A noxious weeds.
Source: Vermont Agency of Agriculture, Food and Markets, https://agriculture.vermont.gov/public-health-agricultural-resource-management-division/plant-health-and-pest-management/plant-0

Scientific Name	Common Name
Cabomba caroliniana	Fanwort
Egereia densa	Brazilian elodea
Hydrilla verticillata	Hydrilla
Hygrophila polysperma	East Indian Hygrophila
Myriophyllum aquaticum	Parrot feather
Salvinia auriculata	Giant salvinia
Salvinia biloba	Giant salvinia
Salvinia herzogii	Giant salvinia
Salvinia molesta	Giant salvinia
Vincetoxicum hirundinaria	Pale swallow-wort

Class B species are known to occur in the state and are considered a threat (Table 16). The table also indicates species observed in Sunderland.

Table 17. Designated Class B noxious weeds in Vermont. Source: Vermont Agency of Agriculture, Food and Markets *https://agriculture.vermont.gov/public-health-agricultural-resource-management-division/plant-health-and-pest-management/plant-0*Those with a * have been identified in Shaftsbury. Source: Early Detection and Mapping System: *http://www.eddmaps.org/tools/query/*; Those marked with ** were identified in Batten Kill surveys (Mary Beth Deller) and those with *** by the planning team	
Scientific Name	Common Name
Acer ginnala	Amur maple
Acer platanoides	Norway maple
Aegopodium podagraria	Bishop's goutweed or goutweed
Ailanthus altissima	Tree of heaven
*Alliaria petiolata***	Garlic mustard
*Berberis thunbergii***	Japanese barberry
Berberis vulgaris	Common barberry
Butomus umbellatus	Flowering rush
*Celastrus orbiculatus**	Oriental bittersweet
*Euonymus alatus***	Burning bush
*Fallopia japonica***	Japanese knotweed
Hydrocharis morsus-ranae	Frogbit
Iris pseudacorus	Yellow flag iris
Lonicera japonica	Japanese honeysuckle
Lonicera maackii	Amur honeysuckle
Lonicera morrowii	Morrow honeysuckle
Lonicera tatarica	Tartarian honeysuckle
Lonicera x bella	Bell honeysuckle
Lythrum salicaria *	Purple loosestrife
Myriophyllum spicatum	Eurasian watermilfoil
Najas minor	European naiad
Nymphoides peltata	Yellow floating heart
Phragmites australis)* **	Common reed
Potamogeton crispus)	Curly leaf pondweed
Rhamnus cathartica **	Common buckthorn
*Rhamnus frangula**	Glossy buckthorn
Trapa natans (A)**	Water chestnut
Vincetoxicum nigrum	Black swallow-wort

The bush honeysuckles (*Lonicera* spp.) have been observed along roadsides. Buckthorn (*Rhamnus cathartica***) and Japanese barberry (*Berberis thunbergii***) have invaded forests

and wetland edges and Japanese knotweed (*Fallopia japonica***) has invaded stream banks and other disturbed areas.

In addition to the species listed above, the following should be considered invasive species: Wild parsnip (*Pastinaca sativa* **) is abundant along roadsides and can cause skin burns when chemicals in the plant on exposed skin interact with sun, which can harm those who work on or along roads or utility rights of way. Cow parsnip or wild chervil (*Anthriscus sylvestris*) also dominates roadsides and can invade meadows. Reed canary grass (*Phalaris arundinacea*) can invade wetlands and crowd out native plants. Multiflora rose (*Rosa multiflora***), is listed as an invasive species in many states and has invaded roadsides and areas along the Batten Kill.

Table 18 shows aquatic invasive species listed by the Vermont Agency of Natural Resources.

Table 18. Aquatic invasive species in Vermont.
Source: Watershed Management Division, Department of Environmental Conservation: http://dec.vermont.gov/watershed/lakes-ponds/aquatic-invasives/

Scientific Name	Common Name
Dreissena polymorpha	Zebra mussel
Alosa pseudoharengus	Alewife
Orconectes rusticus	Rusty crayfish
Didymosphenia geminata	Didymo[1]
Bythotrephes longimanus	Spiny Waterflea
Corbicula fluminea	Asian clam
Nitellopsis obtusa	Starry Stoneword
Myriophyllum heterophyllum	Variable-leaved Watermilfoil

2. Past Occurrences

Invasive species are present and represent a continuous hazard that will vary with their abundance and their impacts on structures and infrastructure.

3. Extent and Location

The extent of invasive plants in Shaftsbury and in Bennington County has not been fully mapped, but Map 9 shows available data. Insects and pathogens have the potential for dramatically altering the composition and structure of forests as well as affecting trees in settled areas. Hemlock wooly adelgid (*Adelges tsugae*) has dramatically reduced hemlock trees south of Vermont and has been found in Pownal, VT. Emerald ash borer (*Agrilus planipennis*) is a significant threat to forests as it kills all ash species. Borers are often dispersed through

[1] Recently this species has been determined to be native, but that status may change.

movement of firewood. Emerald ash borer was found in Stamford and Pownal in 2018 and in Bennington and Shaftsbury in 2020

In addition to the above insects, there are other insects and pathogens that are affecting Vermont forests. These may constitute an emerging hazard (Schultz et al 2015). Climate change may increase the abundance and ranges of forest pest species such as hemlock wooly adelgid and invasive species currently found in more southerly locations (Rustad 2012).

4. Probability, Impact and Vulnerability

The likelihood of increased abundance of invasive species is 75-100% and potential impacts to forested areas are very high. Invasive insects that can cause tree death, particularly the emerald ash borer, could result in road closures, power outages and property damage. Increases in the abundance of invasive plant species could limit regeneration of native trees and shrubs and affect the long-term integrity of the forests (Vermont Department of Forests, Parks and Recreation 2010, Vermont Invasives 2016). Invasive species such as Japanese knotweed along streams can exacerbate fluvial erosion. That species outcompetes native species that have a greater capability of holding soil in place (Vermont Hazard Mitigation Plan 2018).

L. Hazardous Material Spill

1. Descriptions

Hazardous wastes are materials that are flammable, corrosive, toxic, or labeled with warning or caution labels. These materials are used in industry, in the home or on farms and are transported regularly.

2. Past Occurrences

The Vermont spill site list indicates there have been 72 spills reported in Shaftsbury since 1978, and these are listed in Table 19 below.

3 Extent and Location

All the spills listed in Table 19 affected small sites or areas. Roads that carry substantial traffic include US Route 7, Vermont 7A and Vermont 67, and a spill on these roads could affect a large portion of the town. Of concern in any hazardous materials spill would be the impact on water resources. Map 10 shows the transportation system (roads and railroad lines and crossings) in relation to surface waters including streams and wetland and groundwater protection areas. Hazardous intersections have been identified by the Vermont Agency of

Transportation and the planning committee. Roads with average grades greater than 10% also present hazards, particularly when roads are wet or during winter storms.

4. Probability, Impact and Vulnerability

Given the number of past spills, hazardous materials spills occur less than annually and affect very small areas. Increased truck traffic also increases the possibility of a major spill. However, many areas are vulnerable due to the extensive transportation system and proximity of surface and groundwater resources to that system. Most hazardous materials are transported via US Route 7. However, all local roads carry materials that could spill and affect aquatic resources as well as individual wells.

The overall likelihood of a hazardous materials spill on an annual basis is probably between one and ten percent. The likelihood of injuries, except in the case of direct injuries from a traffic accident, is likely low. However, the long-term impacts of a spill could be extensive if aquatic resources and/or water supplies were affected.

Table 19. Hazardous materials spills in Shaftsbury, VT
Source: Vermont Department of Environmental Conservation Spills Database: http://dec.vermont.gov/waste-management/spills

Complaint#	Facility Name	Address	Year	Product	Nature of Incident	Quantity	Responsible Party
WMD035	roadside	395 Granger Hollow Rd	2020		Pole mounted transformer leak	2 Gallons	GMP
WMD217	Keen Residence	63 Holiday Drive	2020		Above Ground Tank line (piping), fitting, filter leak	30 Gallons	George and Brenda Keen
WMD241	Roadside	98 Vt Route 67	2020		Bucket with diesel spilled onto roadway.	5 Gallons	Unknown
WMD115	Paulin, Inc.	1250 US Route 7A	2019		Diesel spilled out of a port at top of tank during delivery.	10 Gallons	Paulin, Inc.
WMD304	William E Dailey Inc Garage	RT 7A	2019		contamination found during tank closure	Unknown Gallons	William E. Dailey, Inc
WMD333	Paulin Mobil Station	1250 RT 7A	2018		subsurface impacts under dispenser during piping/disp. replacement	--	Paulin Inc
WMD467	Roadside	RT 7A and Airport Road	2018		Hydraulic Equipment Failure	15-25 Gallons	TAM, Inc.
WMD534	Roadway	697 Buck Hill Road	2018		Transformer leak	<1 Gallons	GMP
WMD534	Roadway	697 Buck Hill Road	2018		Transformer leak	<1 Gallons	GMP
WMD442	Levin Residence	183 Rollin Road	2017		Historic heating oil release (UST)	UNK --	Ruth Levin
WMD442	Levin Residence	183 Rollin Road	2017		Historic heating oil release (UST)	UNK --	Ruth Levin

Table 19. Hazardous materials spills in Shaftsbury, VT
Source: Vermont Department of Environmental Conservation Spills Database: http://dec.vermont.gov/waste-management/spills

Complaint#	Facility Name	Address	Year	Product	Nature of Incident	Quantity	Responsible Party
WMD576	Roadside	307 Stateline Road	2017		Transformer/Capacitor release	<1 Gallons	GMP
WMD593	Paulin Mobil Station	1250 RT 7A	2017		Above Ground Tank overfill with release from fill port	40-45 Gallons	SL Dudley Transportation
WMD603	Paulin Mobil Station	1250 RT 7A	2017		Oil out vapor port of tanker truck	5-10 Gallons	SL Dudley Transportation
WMD215	Adelberg-Miller Schoolhouse	2261 Maple Hill Road	2016		Heating Oil UST leak	unknown --	Adelberg-Miller
WMD216	Adelberg-Miller Residence	2284 Maple Hill Road	2016		Heating Oil UST leak	unknown Gallons	Adelberg-Miller
WMD026	roadway	near 240 Church St	2015		hydraulic tank release	10 Gallons	Casella Waste Management, Inc.
WMD421	TAM Waste Management	639 North Road	2013		Elbow leaks during refueling of the AST	2-10 Gallons	John Ray and Sons
WMD504	William E Dailey Inc	1358 VT RT 7A	2012		diaphragm pump on truck not shut-off	15-20 Gallons	William E Dailey Inc
WMD085	Poulins Mobil	1250 RT 7A	2011	diesel	Hose failure during delivery to AST	20 Gallons	JP Noonan
WMD122	Kittell Residence	344 Cleveland Ave	2011	kerosene	Oil leaked from valve	130+ Gallons	John Kittell
WMD371	roadside	Dupont Rd	2010	hydraulic oil	hydraulic line failure	Unknown	William Daily
WMD036	Ed Calvin residence	174 Holiday Drive	2009	#2	AST overfill	2 Gallons	Pyrofax
WMD071	N/A	RT 7A North	2009	hydraulic fluid	hose failure on front plow	30 Gallons	Vtrans
WMD174	Paulin Inc.	Route 7A	2009	gasoline	Spill during delivery to ASTs	23 Gallons	JP Noonan
WMD196	N/A	1493 Shard Villa	2009	transformer oil	Transformer Spill	8 Gallons	CVPS

Table 19. Hazardous materials spills in Shaftsbury, VT
Source: Vermont Department of Environmental Conservation Spills Database: http://dec.vermont.gov/waste-management/spills

Complaint#	Facility Name	Address	Year	Product	Nature of Incident	Quantity	Responsible Party
WMD453	Roadside	Rt 7	2009	Diesel Fuel	Fuel line leak on truck	3-5 Gallons	Enpro
WMD560	Brownell's Salvage Yard	818 White Creek Rd.	2009	Auto fluids	Various releases at salvage yard		Brownell
WMD548	Ronald Jennings	1915 RT 7A	2008	#2	AST overfill	3 Gallons	Pyrofax
WMD116	#18 pole 1-2	Rt 7A near Depot Rd	2007	transformer oil	transformer leak	<1 Gallons	CVPS
WMD421	N/A	RT 9	2007	gasoline	vehicle accident	15 Gallons	N/A
WMD293	Shaftsbury Transfer Station	North Rd	2006	hydraulic oil	hydraulic leak	1 Gallons	TAM Inc
WMD525	TAM Property	217 Holiday Drive	2006	diesel fuel	pump left on	15 Gallons	TAM Inc
WMD544	N/A	Hidden Valley Rd	2006	trans oil - non-PCB	transformer leak	<1 Gallons	CVPS
WMD255	Levigne Property	Lake Perrin Rd	2004	unknown sheen	sheen on stream	Unknown	N/A
WMD064	Rt 7 Southbound	North of Exit 3	2003	diesel	tractor trailer/car accident	60 Gallons	Michael Tatro
WMD348	Jean Coleman	86 Bouplon Hollow Rd	2003	#2	spill during delivery	--	Agway
WMD151	N/A	Rt 7 North	2002	diesel	truck spill	15 Gallons	Rist Transportation
WMD019	Roy Berkely Residence	W Mountain Rd	2001	#2	leaking UST	Unknown	Berkly
WMD023	N/A	Rt 7 (see map in file)	2001	motor oil	motor oil	1.25 Gallons	Nathan Durfee
WMD108	Whitman's Feed Store	Rt 67	2001	NA	violation of Act 250 siting location	Unknown	Whitman's Feed Store
WMD444	Joe LaPlaca Residence	155 Bouplon Hollow Road	2001	kerosene	AST leak	500 Gallons	Joe LaPlanca
WMD234	Wm E Daley Corp	1424 Vt Route 7A	2000	transfer oil	coolant oil leak	1 Gallons	Wm E Daley Corp
WMD376	N/A	Route 7	2000	#2	fuel oil spill	10 Gallons	Whitcomb Construction Co

Table 19. Hazardous materials spills in Shaftsbury, VT
Source: Vermont Department of Environmental Conservation Spills Database: http://dec.vermont.gov/waste-management/spills

Complaint#	Facility Name	Address	Year	Product	Nature of Incident	Quantity	Responsible Party
WMD068	N/A	Shaftsbury Hollow Rd	1999	hydraulic oil	Hydraulic line failure	15 Gallons	Shaftsbury Highway Dept
WMD415	Christine Prouty Property	Lot 48, Grove Rd	1999	drilling foam and cuttings	runoff from drilling operation	Unknown	Gould and Sons Drilling
WMD426	David Mance property	Rt 7 A	1998	#2	fuel delivery to disconnected system	200 Gallons	Patricia Main
WMD455	N/A	Rt 7	1998	diesel	Truck accident	200 Gallons	Marocchi Trucking
WMD094	N/A	Route 314	1997	Gasoline	Car Accident	100 Gallons	N/A
WMD260	Ross Residence	Rt 7a	1996	Heating Oil	Tank Rupture During Delivery	100 Gallons	Agway Energy Products
WMD245	Comar Residence	White Creek Rd	1995	#1	Oil Tank Leak Outside Trailer	Unknown	N/A
WMD282	N/A	Cole Spr Rd	1994	#2	Tank Overfill	5 Gallons	Johnson Fuels
239	N/A	Timber Trail Rd	1993	Oil	Poss Drinking Water Contaminant	Unknown	N/A
256	Greco Residence	West Mtn Rd	1993	Ceramic Glaze	Illegal Dump	Unknown	N/A
263	N/A	Route 7a	1993	Unknown	Contaminated Soil	Unknown	N/A
161	N/A	128 Trumbull Hill Rd	1992	#2	Oil Spill During Delivery	5 Gallons	Agway
040	N/A	Route 7a	1990	Diesel Fuel	Truck Rollover	Unknown	Unknown
098	Shaftsbury Town Garage		1990	#2 Diesel Fuel	Leaking Above Ground Tank	Unknown	Town of Shaftsbury
192	N/A	Hidden Valley Road	1990	#2 Fuel Oil	Overfill of Tank	Unknown	Agway
247	N/A	Parrin Rd and Rt 67	1990	Gasoline	Car Accident	Unknown	N/A
102	N/A	New Rt. 7	1988	Motor Oil	Oil Spill	Unknown	Cumberland Farms
013	N/A	Stanley Tools	1986	Hydraulic Oil	Tank Rupture	Unknown	Stanley Tools
177	N/A	Paulin's Store	1986	Gasoline	Tank Overfill	Unknown	N/A

Table 19. Hazardous materials spills in Shaftsbury, VT
Source: Vermont Department of Environmental Conservation Spills Database: http://dec.vermont.gov/waste-management/spills

Complaint#	Facility Name	Address	Year	Product	Nature of Incident	Quantity	Responsible Party
206	N/A	Rt 67a	1986	Electrocoat Resin	Spill	Unknown	Stanley Tools
028	N/A	Stanley Tool Plant	1984	# 6	Fuel Spill	Unknown	N/A
016	N/A	Rt 315	1983	Milk	Leaking Milk Truck	Unknown	C & B Milk Hauling
098	N/A	Stanley Tool Plant	1983	Formaldehyde	Chemical Spill	5 Gallons	Stanley Tools
046	N/A		1982	Gasoline	Lust	100 Gallons	N/A
083	N/A	Rt 7a	1982	Diesel Fuel	Truck Accident	100 Gallons	N/A
038	N/A	Private Residence	1981	Road Salt	Drum Found on Property	10 Gallons	N/A
049	N/A		1981	Unk	Drum Found	Unknown	N/A
016	N/A	Stanley Tools	1979	Liq. Process Waste	Pipe Broke	200 Gallons	Stanley Tools

M. Infectious Disease Outbreak

1. Descriptions

Infectious diseases are caused by bacterial infections, viruses, fungi, and other organisms that can spread through the human population. COVID-19 is currently affecting much of the world. As of February 2, 2021, there have been 12,196 cases in Vermont with 176 deaths (Source Vermont Department of Health Daily Update) . There have been 1,106 cases in Bennington County with 4 deaths (Source: New York Times daily update). The potential for transmission of COVID-19 has required people to wear protective masks and practice social distancing. As a result, businesses have been disrupted and, in some cases, closed; schools have been closed with students learning remotely, and many work from home if they can. The United States and Vermont went through a spike in cases in the spring and are experiencing a second spike with fall and winter. A vaccine has been developed and distribution is ongoing. The pandemic has become politicized with many viewing it as a hoax, and how many will actually accept vaccination is in question. However, vaccine doses are becoming more available and there is a major push to vaccinate much of the U.S. population.

2. Past Occurrences

The most prevalent infectious disease in Bennington County has been Lyme disease, carried by and transmitted by ticks. The symptoms can range from minor to very severe and are a clear threat to anyone in the town. Figure 4 shows those diseases tracked by the Vermont Department of Health.

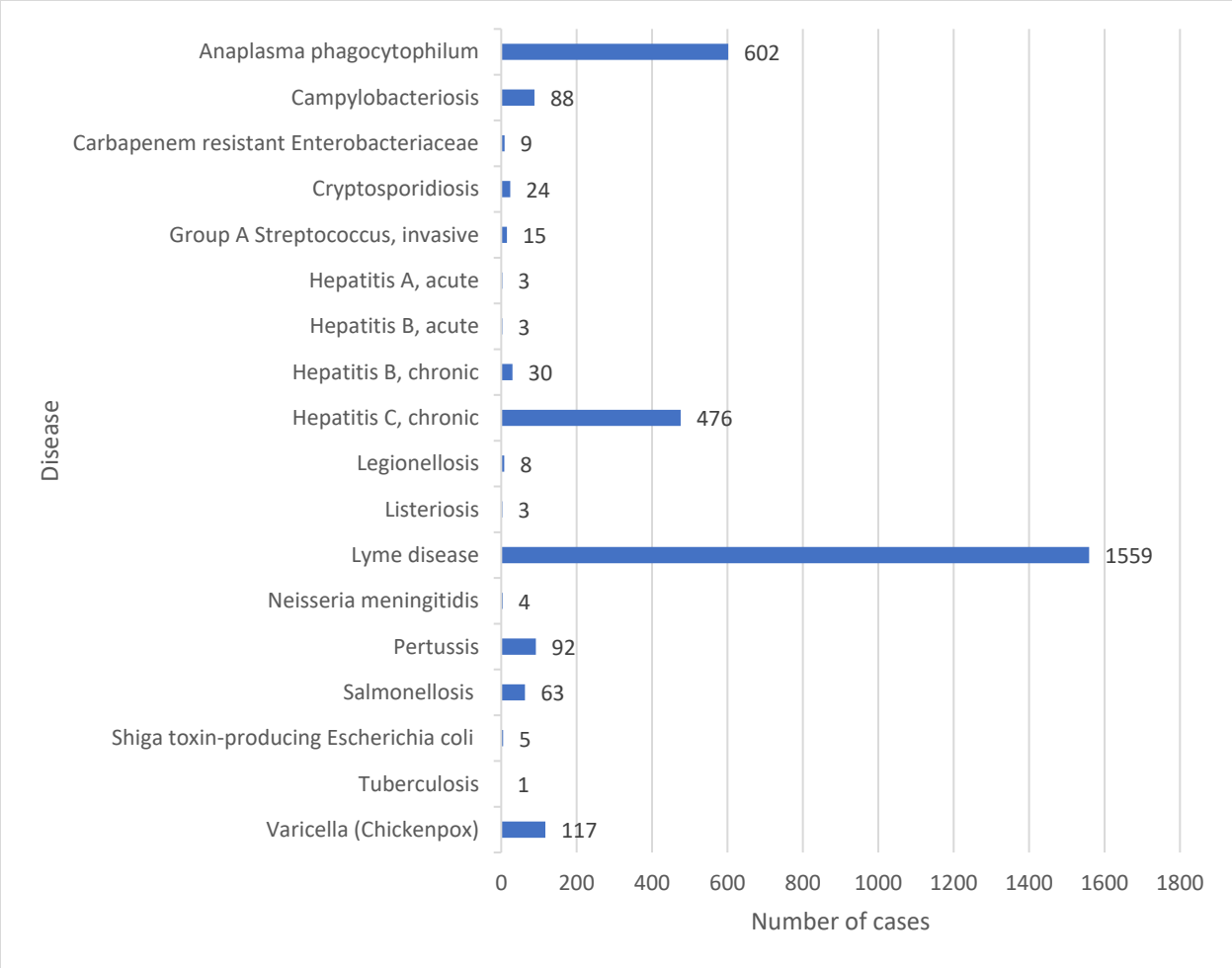


Figure 4. Disease cases in Bennington County from 2006 to 2019.
Source: Veronica Fialkowski, Vermont Department of Health

3. Extent and Location

In general, individuals and families are most affected by infectious diseases, but schools and businesses could be affected as well.

4. Probability, Impact and Vulnerability

Prior to COVID-19, there has been a low probability of a disease affecting a large portion of the town. However, COVID-19 has affected the state, regional and national economies, which has in turn affected Shaftsbury. Lyme disease presents at high probability of continued, isolated occurrences. Lyme disease, and other tickborne diseases could affect residents and those using recreational trails and visiting natural areas. Many of the carriers of infectious disease, such as ticks and mosquitoes, may be exacerbated by climate change and increased abundance of invasive species (Vermont Hazard Mitigation Plan 2018)

V. Vulnerability Assessment

A. Prioritization of Hazards

The information described above was used to prioritize hazards using criteria form the Vermont Hazard Mitigation Plan as described in Table 20 below.

Table 20. Vulnerability assessment factors (Vermont Hazard Mitigation Plan 2018)
Frequency of Occurrence: Probability of a plausibly significant event
1 = Unlikely <1% probability of occurrence per year
2 = Occasionally 1–10% probability of occurrence per year, or at least one chance in next 100 years
3 = Likely >10% but <75% probability per year, at least 1 chance in next 10 years
4 = Highly Likely 75% probability in a year
Potential Impact: Severity and extent of damage and disruption to population, property, environment, and the economy
1 = Negligible: isolated occurrences of minor property and environmental damage, potential for minor injuries, no to minimal economic disruption
2 = Minor: isolated occurrences of moderate to severe property and environmental damage, potential for injuries, minor economic disruption
3 = Moderate: severe property and environmental damage on a community scale, injuries or fatalities, short-term economic impact
4 = Major: severe property and environmental damage on a community or regional scale, multiple injuries or fatalities, significant economic impact

B. Priority Hazards

As can be seen in Section IV, the planning team undertook an exhaustive assessment of hazards that could affect Shaftsbury. They then scored those hazards based on the criteria in Table 20 to determine for which hazards actions would be needed. Table 21 shows the results of the scoring, with Flood and Flash Floods, Winter Storms, High Wind Events, Drought, Hazardous Materials Spills, Infectious Diseases, and Invasive Species ranked highest. Geographic area affected and potential impacts were key criteria in determining whether mitigation actions would be developed for specific hazards. The planning team determined that, while earthquakes ranked high, the score was likely due to the short warning time and, therefore, was not an accurate representation of the threat of this hazard.

Table 21. Vulnerability assessment				
Hazard	Number of Events	Frequency of Occurrence	Potential Impacts	Total Score
Floods and Flash Floods	59 events from 1996 to 2019	3	3	6
Winter Storms	183 events from 1996 to 2019	4	3	7
High Wind Events	158 events from 1996 to 2019	3	2	5
Hail	30 events from 1996 to 2017	3	1	4
Temperature Extremes	Annual >90 F – 1 day on average Annual maximum <32 F – 55 days Annual minimum < 32 F – 172 days	2>90 3< 32	3	5-6
Drought	Severe droughts have occurred in 27 years from 1895 to 2019	3	3	6
Wildfire	20 events from 1992 through 2019	2	2	4
Landslides and Debris Flows	No records	1	1	2
Earthquake	No events causing damage	1	1	2
Hazardous Materials Spills	72 events from 1979 to 2019	2	2	4
Infectious Disease Outbreak	Annual	4	3	7
Invasive Species	Ongoing	4	3	7

Shaftsbury had only minor damages from Tropical Storm Irene. A relatively small portion of the Town is within special flood hazard areas or river corridors. Wildfire potential is minimal and invasive species abundance has not been well documented. Vulnerabilities in the transportation system require monitoring, maintenance, and upgrades. Rockfalls and landslide potential (Map 10) also show some limited vulnerabilities to the transportation system. Other priority hazards such as infectious diseases could not be mapped as those hazards would likely affect the entire town and beyond.

VI. Mitigation Measures

A. Hazard Mitigation Goals

As part of the planning process, the Town identified the following mitigation goals:

1. Reduce injury and loss of life resulting from natural disasters.
2. Reduce damage to public infrastructure, minimize disruption to the road network and maintain both normal and emergency access.
3. Establish and manage a program to proactively implement mitigation projects for roads, bridges, culverts, and other municipal facilities to ensure that community infrastructure is not significantly damaged by natural hazard events.
4. Design and implement mitigation measures to minimize impacts to rivers, water bodies and other natural features, historic structures, and neighborhood character.
5. Increase the economic resiliency of Shaftsbury by reducing the economic impacts incurred by municipal, residential, agricultural, and commercial establishments due to disasters.
6. Incorporate hazard mitigation planning into other community planning projects, such as Town Plan, Capital Improvement Plan, and Town Local Emergency Operation Plan
7. Ensure that members of the general public continue to be part of the hazard mitigation planning process.

B. 2014 Shaftsbury Hazard Mitigation Plan

Shaftsbury completed a town hazard mitigation plan in 2015, which was approved by FEMA in 2015. Appendix 1 lists the actions from the 2015 plan and includes a column of which actions were completed, which carried over to this 2021 plan and which deleted. The priorities of the town for hazard mitigation have not changed since the 2015 plan, and many actions have been carried over to this plan.

Multiple Boards, Commissions, and staff have reviewed and worked on addressing the action items listed in the 2015 plan. The Town continues to improve its website, which serves as a platform to provide educational material to the residents. Being a small community, one of the main impediments to certain improvements is their high cost and the burden that can place on taxpayers. Any significant project requires financial aid from the State which often takes 2-4 years from planning to receipt of funds and construction.

Following is a review of actions addressed since 2015:

The Selectboard has invited solar power contractors to review the action of installing panels at the closed landfill site. All responded that the site is not economically viable at this time. The Board has also acted to enforce speed limits by entering into a contract with the

County Sheriff, and the placement of radar speed monitoring signs to calm traffic. Roads are also surveyed with speed studies to better direct enforcement.

- The Planning Commission and/or Zoning Administrator have reviewed driveway standards, and fluvial erosion standards.

- The Tree Warden has been working with the DPW in the removal of diseased trees and preparing for the arrival of the Emerald Ash Borer.

- The Emergency Management Director working with the Selectboard updates the Local Emergency Operations plan annually. A generator was acquired and installed at the Town shelter.

- Significant improvements have been made to reduce potential road flooding since 2014. Through the State Municipal Road General Permit program all of Shaftsbury roads have been inventoried and inspected. There is a new culvert inventory and many culverts have been replaced and stone pillows installed in a number of areas to reduce road damage due to high water. Grants have been obtained and work begun to replace large culverts in the Town. These types of projects are only possible through State grants. Our current grant took four years from application to funding.

- Extensive ditching has also taken place during this period along with a change in surface material to one that better withstands traffic and maintains its shape. The Town has also worked with State engineers to evaluate areas of roadway that need stream bank stabilization. Areas such as a section of White Creek Road have been identified and funding sources investigated. An area of VT Route 7A has been reviewed with the State. Federal funding to rebuild the road has been obtained by the State with construction planned for 2025-26.

- The Town acquired a generator for the town shelter.

An assessment of E911 data showed a total of 11 structures within the special flood as of 2019 (Table 6). One was a single-family home, four were mobile homes, two were camps, one was commercial and two industrial, and one other. There have been no new developments within the special flood hazard area since the 2015 Shaftsbury Hazard Mitigation Plan was adopted.

River corridors have been delineated by VT ANR (Map 5). Shaftsbury does not regulate this area. In 2019, there were 35 E911 structures of which 26 were single family homes, two were mobile homes, two were commercial, two were camps and the remainder other. The river corridor map was developed and revised in 2015. There have been no developments within the river corridor since 2015.

Shaftsbury joined the National Flood Insurance Program (NFIP) in 1985. There appear to be no flood insurance policies in effect (Flood Ready Vermont 2020). The Town Zoning Administrator reviews permits for development, including any proposed within special flood hazard areas or river corridors, to assure development is consistent with the town bylaws. The town does not restrict development within river corridors. There are no repetitive loss properties in Shaftsbury. As noted in Section IV. A, most of the vulnerable structures are single family homes. There are few commercial properties in either the special flood hazard area or river corridor.

C. 2019 Shaftsbury Town Plan

The town plan was substantially revised and adopted in 2019. Actions listed in the plan relevant to mitigation include:

- Incorporate requirements for erosion and sediment control as appropriate;
- Consider adopting ANR river corridor protections;
- Identify and prioritize homes and businesses at serious risk of flood damage for mitigation actions such as elevation/relocation or purchase and demolition;
- Avoid placing new critical infrastructure such as emergency services, power substations, and municipal buildings within the flood hazard areas;
- Develop and maintain mutual aid agreements for sharing road repair and maintenance with neighboring communities after disasters; and
- Address the potential for contamination of floodwaters with gasoline, diesel, septic waste, and industrial chemicals during storm events.

D. Shaftsbury Zoning Bylaws

The bylaws require a conditional use permit for certain activities within special flood hazard areas. Accessory structures, parking and replacement of septic and water systems are permitted as long as they do not reduce flood capacity of the area. New residential structures, new fill, and critical facilities are prohibited from the special flood hazard area.

E. Stormwater Management

The Vermont Clean Water Act, Vermont Act 64/H.35 and the Lake Champlain Phase 1 total maximum daily load (TMDL)[2] require that municipalities reduce sedimentation runoff from their road systems over a twenty-year period following attainment of stormwater permits between 2018 to 2021 (Vermont Agency of Natural Resources, 2017b). Towns are required to develop road stormwater management plans in the following steps:

[2] This is a regulatory term under the Clean Water Act identifying the maximum amount of a pollutant that a body of water can receive and still meet water quality standards.

1. Identify sections of roads connected to surface waters through ditches, culverts, or other drainage structures.
2. Inventory connected portions of the road network to determine if these sections meet the standards being developed by the Vermont Agency of Natural Resources.
3. Develop a long-term plan to bring all connected sections up to statewide design standards.

The Bennington County Regional Commission hired Fitzgerald Environmental Associates to complete both a stormwater master plan and to inventory hydrologically connected roads for erosion problems in Shaftsbury. Work was completed in 2018 and 2019 and the plans completed in 2019. The stormwater master plan identified forty-nine projects of varying complexity to reduce erosion and protect stormwater infrastructure (Fitzgerald Environmental Associates 2019). More detail on these projects can be found in the Fitzgerald Environmental Associates reports (2019) completed in 2018 and 2019 available from the Town. More specific design information will be developed for these for use in grant applications. In addition, partner organizations including the Bennington County Regional Commission and the Bennington County Conservation District are working with the Town to find funding to remedy these problem areas.

The road erosion survey identified the following categories of road condition:

Table 22. Road erosion survey results
Source: Vermont Agency of Natural Resources Municipal Roads Program 2020; Available via: https://dec.vermont.gov/watershed/stormwater/permit-information-applications-fees/municipal-roads-program

Category	# Segments
Does Not Meet	**147**
Very High	15
High	72
Moderate	60
Partially Meets	**168**
Moderate	61
Low	61
Fully Meets	**219**
Not Connected	65
Grand Total	599

Roads that do not meet standards generally lacked drainage ditches, had eroded ditches, or had unstable conveyances. Those segments categorized as “Very High” priority will need to be brought up to standards by 2025 to meet the municipal general permit requirements. All segments should be brought up to standard by 2036 .

Culvert surveys completed by BCRC indicate the following culvert conditions:

Table 23. Culvert condition for Shaftsbury culverts Source: VT AOT VTCULVERTS; available via: https://vtculverts.org/	
Culvert Condition	Number
Excellent	25
Good	162
Fair	1
Poor	112
Unknown	1
Total	301

Bridge conditions were not specified.

Along with addressing road erosion, the Town will need to address culverts that are undersized or in poor condition.

F. State and Regional Plans and Programs

1. Vermont Hazard Mitigation Plan (2018)

The Vermont Hazard Mitigation Plan (2018) identified a series of hazards shown in Table 24 below along with those we considered in this plan. The planning team used the state plan as a starting point and local knowledge to create a more specific set of hazards that they addressed.

Table 24. Comparison of hazards considered in the 2018 Vermont Hazard Mitigation Plan vs. the Shaftsbury Hazard Mitigation Plan	
2018 VT Hazard Mitigation Plan	Shaftsbury Hazard Mitigation Plan
Hazards	**Natural Hazards**
Drought	Drought
Earthquake	Earthquake
Inundation Flooding and Fluvial Erosion	Flooding and Fluvial Erosion
Hail	Hail
Wind	High Winds
Hurricane/Tropical Storm	High Winds and Flooding and Fluvial Erosion
Infectious Disease	Infectious Disease Outbreak
Invasive Species	Invasive Species

Table 24. Comparison of hazards considered in the 2018 Vermont Hazard Mitigation Plan vs. the Shaftsbury Hazard Mitigation Plan	
2018 VT Hazard Mitigation Plan	Shaftsbury Hazard Mitigation Plan
Landslides	Landslide/Debris Flow
Severe Thunderstorm	See High Winds and See Flooding and Fluvial Erosion
Snowstorm and Ice Storm	Winter Storms
Extreme Heat	Temperature Extremes
Extreme Cold	Temperature Extremes
Wildfire	Wildfire

2. Bennington County Regional Plan Policies and Actions (adopted March 19, 2015)

The Bennington County Regional Plan (Bennington County Regional Commission 2015) lists policies and actions supporting hazard mitigation, including several emphasizing protecting natural resources, maintaining village and urban centers, and avoiding development on sensitive lands. These include areas of steep slope and wetlands, along with surface and groundwater resources and forested lands (Sections VII and VIII). The regional plan also includes a flood resilience section (IX), which is required by Vermont statutes, describing potential hazards from flooding and fluvial erosion. The section encourages avoiding development in flood hazard areas, reconstruction of bridges and culverts that impede flows, undisturbed buffer areas along streams to provide for lateral movement and attenuation of overland flow, participation in the National Flood Insurance Program, updating of flood bylaws, adoption of up-to-date road and bridge standards and participation in the community rating system.

3. Vermont Agency of Natural Resources

The Vermont Agency of Natural Resources (VT ANR) has worked with Shaftsbury and other communities to adopt updated flood and river corridor regulations. VT ANR also has mapped river corridors and can regulate activities within those that are not subject to review by municipalities. VT ANR also reviews municipal permit applications for development within the special flood hazard area, permit applications for stream alterations, regulated activities within wetlands, and permits for transporting hazardous materials.

5. Act 250 Review

The Act 250 program provides a public, quasi-judicial process for reviewing and managing the environmental, social, and fiscal consequences of major subdivisions and

developments in Vermont. During Act 250 proceedings, agencies and the public can offer comments on such proposed developments.

6. Other Organizations

There are numerous organizations within Bennington County that provide assistance in health care, food, and services to seniors and other vulnerable populations.

G. Town Capabilities

Table 25 below summarizes town capabilities and areas needing improvement to enhance those capabilities.

Table 25. Capabilities of the Town of Shaftsbury

Plans, Policies, Ordinances	Description/Responsible Agent	Effectiveness	Improvements Needed
Town Plan	Planning Commission; Select Board (adoption of Town Plan)	The town plan was substantially revised and adopted in 2019	The town plan should be the primary document used to guide policies and actions by the town.
LEMP	Emergency Manager Director; Select Board (adoption of plan)	Annual updates required	Update and improve LEMP and replace with annually and as needed
Flood hazard bylaws	Planning Commission; Development Review Board; Zoning Administrator (permitting); Select Board (approval of bylaws)	The bylaws reflect some of the updates recommended by VT ANR following the publication of updates flood hazard maps	The town should adopt revisions to limit and, in some cases, prohibit development in river corridors as recommended in the town plan.
Mutual Aid for Emergency Services	Emergency Management Director; Select Board (approval of agreements); LEPC (coordination)	Needs some improvements and updates	Update mutual aid fire agreements with neighboring communities.
Mutual Aid for Public Works	Emergency Management Director; Road Foreman; Water Department; Select Board (approval of agreements); LEPC (coordination)	Needs some improvements and updates	Develop mutual aid agreements for road maintenance.

Table 25. Capabilities of the Town of Shaftsbury			
Plans, Policies, Ordinances	Description/Responsible Agent	Effectiveness	Improvements Needed
Zoning/Subdivision Regulations	Development Review Board and Zoning Administrator (permitting); Select Board (approval of bylaws)	Generally effective	There are sections of the bylaws that need clarification and revision
Wetlands/Rivers and Streams/Waterbodies/Steep Slopes/Groundwater Protection Regulations	Wetlands re primarily protected by VT ANR. The town bylaws do not address wetlands or groundwater resources but do address flood hazard areas (see above)	Provide some mitigation	Further assessment of natural resources could benefit improved development review.
Building Codes	State of Vermont (commercial only); Zoning Administrator (certain building codes in flood hazard zones)	Commercial building codes overseen by State of Vermont (Department of Public Safety)	Town does not oversee building codes for residential structures.
Water	Water Department; Select Board	Effective	Make upgrades to system as needed.
Road Maintenance Programs and Standards	Road Foreman; Select Board	Effective; Town adopted most recent State of Vermont (AOT) road and bridge standards	A capital plan for addressing road erosion and stormwater management is needed.
Events Management	Select Board Vendor permit	For parks	There are few significant events in the town
School Emergency Response	School administrators; Emergency Management Director	Needs some improvements	Update and review school emergency plans; LEPC should conduct onsite training.
Vulnerable Populations	Emergency Management Director and Health Officer	Needs some improvements and updates	Need means to identify and communicate with vulnerable populations.
Mobile Homes	Emergency Management Director and Health Officer	State of Vermont regulates mobile homes and mobile home parks	There are 11 mobile homes within Shaftsbury.

H. Mitigation Projects

Table 27 below lists mitigation actions for each of those hazards. Some will be implemented by the Town and others by agencies such as the Vermont Agency of Transportation. Mitigation actions are listed by the type of hazard. The criteria in Table 26 were used in establishing project priorities, with ranking based on the best available information and best judgment as these proposed projects would need further study and design work:

Table 26. Ranking criteria for mitigation actions.
Source: Vermont Hazard Mitigation Plan 2018

	Impact	Feasibility
High	• Significantly benefit the environment, OR • Significantly benefit people/vulnerable populations, OR • Significantly reduce risk in our built environment, OR • Significantly benefit the economy, OR • Create the opportunity to do one of the above (e.g., filling a data gap), AND Significantly reduce vulnerability to a high priority hazard (erosion, inundation, ice, snow)	Have political and community support, AND Are consistent with current state laws/policies, AND Have funding/other required resources available or identified, AND Are technically/logistically feasible
Medium	• Moderately benefit the environment, OR • Moderately benefit people/vulnerable populations, OR • Moderately reduce risk in our built environment, OR • Moderately benefit the economy, OR • Create the opportunity to do one of the above (e.g., filling a data gap), AND • Moderately reduce vulnerability to a profiled hazard	• Have political and community support, OR • Are consistent with current state laws/policies, OR • Have funding/other required resources available or identified, AND • Are technically/logistically feasible
Low	• Minorly benefit the environment, OR • Minorly benefit people/vulnerable populations, OR • Minorly reduce risk in our built environment, OR • Minorly benefit the economy, OR • Create the opportunity to do one of the above (e.g., filling a data gap), AND • Minorly reduce vulnerability to a profiled hazard	• Have political and community support, OR • Are consistent with current state laws/policies, OR • Have funding/other required resources available or identified, OR • Are technically/logistically feasible

Prior to the implementation of any action, a benefit-cost analysis would be completed to assure the action would be feasible and cost-effective. Funding sources listed in Table 26 include:

Town of Shaftsbury General Fund

VT Agency of Transportation funding for road projects and stormwater management

FEMA Flood Management Assistance Grants

Hazard Mitigation Grants (HMGP)

Building Resilient Infrastructure and Communities (BRIC) grants

Vermont Division of Parks, Forests and Recreation grants

Vermont Ecosystem Restoration Program Grants from VT ANR

Table 27. Mitigation actions							
Hazard	Type[3]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Feasibility	Impact
All Hazards	Local Planning and Regulations	Assess need for driveway standards to assure adequate emergency access particularly to assure adequate access in winter storms, floods and for wildfire protection	Town Planning Commission, Zoning, and DPW Supervisor.	2021 to 2022	Town general fund	High	High
All Hazards	Local Planning and Regulations	During the review of proposed developments encourage proper construction techniques and use of appropriate materials to address hazards, particularly flooding, winter storms, wind events, earthquakes, landslides, and wildfire	Town Planning Commission; Zoning Administrator	~~Continuous~~ September 2021 to September 2022	Town general fund	High	High
All Hazards	Local Planning and Regulations	Update the Local Emergency Management Plan annually	Emergency Management Director Select Board	Annually	Town general fund	High	High

[3] Follows FEMA 2013 Mitigation ideas; a resource for reducing. Federal Emergency Management Agency, U.S. Department of Homeland Security, Washington, DC

Table 27. Mitigation actions							
Hazard	Type[3]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Feasibility	Impact
All Hazards	Education and Outreach	Provide information on the Town website with links to information for residents on preparing for hazards.	Town Select Board Town Emergency Management Director, Zoning	September 2021 to September 2022~~Continuous~~	Town general fund	High	High
All Hazards	Education and Outreach	Encourage residents to sign up with the Citizens Assistance Registry for Emergencies to provide first responders with contacts of populations vulnerable to potential hazards, particularly drought, extreme temperatures, and infectious diseases, but also those in need of assistance for evacuation and/or sheltering	Town Emergency Management Director	2021	Town general fund	High	High
Floods and Flash Floods	Local Planning and Regulations	Review possible bylaw on fluvial erosion hazard zones	Planning Commission	~~Continuous~~ July 2021 to July 2022	Town general fund	Medium	Medium
Floods and Flash Floods	Local Planning and Regulations	Develop stormwater management regulations and guidelines for subdivision and site plan review and for property owners	As required by State of Vermont in cooperation with Municipal Road General Permit	~~Continuous~~ June 2021 to June 2023	Town general fund State Grants, private funds	High	High

Table 27. Mitigation actions							
Hazard	Type[3]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Feasibility	Impact
Floods and Flash Floods	Education and Outreach	Educate property owners on best stormwater management practices	Planning Commission Zoning Administrator	September 2021 to September 2022~~Continuous~~	Town general fund	High	High
Floods and Flash Floods	Education and Awareness	Educate owners on importance of securing propane tanks and other items that could float or blow away in storms	Zoning Administrator	September 2021 to September 2022~~Continuous~~	Town general fund	High	High
Floods and Flash Floods	Education and Awareness	Provide information on the town web site and town hall for property owners on reducing flood damage	Town Administrator Town Emergency Management Director	September 2021 to September 2022~~Continuous~~	Town general fund	High	High
Floods and flash floods	Natural Systems Protection	Work with conservation organizations to acquire lands subject to frequent flooding or wetlands within or adjacent to flood prone areas to provide flood storage	Town Select Board; Vermont Land Trust	July 2021 to July 2024~~Continuous~~	State of Vermont Watershed Grants, Vermont Clean Water Initiative Program, Nonprofit organizations	Low	Low

Table 27. Mitigation actions							
Hazard	Type[3]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Feasibility	Impact
Floods and flash floods	Structure and Infrastructure Projects	Update culvert inventory	DPW Supervisor BCRC	~~Continuous~~ July 2021 to July 2023	Town general fund	High	High
Floods and flash floods	Structure and Infrastructure Projects	Replace undersize bridges and culverts as necessary, particularly those culverts categorized as in poor condition (Table 23)	DPW Supervisor State of Vermont	~~Continuous~~ July 2021 to July 2025	Town general fund VT AOT	Medium	Medium
Floods and flash floods	Structure and Infrastructure Projects	Complete the following road and culvert projects: 1. Design and complete White Creek sink hole remediation 2. Replace Shaftsbury Hollow culvert and Shaftsbury Hollow/Granger Hollow intersection box culvert and guard rails. 3. Improve drainage on West Mountain Rd. 4, Complete Cider Mill Rd. drainage projects 5. Replace culverts on Laclair Rd., and Granger Hollow	DPW Supervisor State of Vermont	2021 to 2024	Town general fund VT AOT	High	High

Table 27. Mitigation actions							
Hazard	Type[3]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Feasibility	Impact
Floods and flash floods	Structure and Infrastructure Projects	Bring all road segments categorized as "very high" in the town road erosion inventory to AOT standards by 2025	DPW Supervisor	2021 to 2025	Town general fund VT AOT	High	High
Floods and flash floods	Structure and Infrastructure Projects	Complete the following high priority stormwater projects: 1. SW-9 and SW-10: Howard Park infiltration and constructed wetland 2. RD-8 Trumbull Hill Rd. drainage improvement 3. C-6 Murphy Hill Rd. culvert replacement 4. DC-7 Rollin Rd. culver/gully stabilization 5. SW1 Rte. 7A/Daniels Rd. intersection stormwater improvements	DPW Supervisor VT AOT	2021 to 2024	Town general fund VT AOT	High	High

Table 27. Mitigation actions							
Hazard	Type[3]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Feasibility	Impact
Floods and flash floods	Structure and Infrastructure Projects	Develop and implement plans for other high priority stormwater and road erosion projects identified in the 2019 Stormwater Master Plan and road erosion surveys (Fitzgerald Environmental Associates 2019)	DPW Supervisor	2023-3025	Town general fund VT AOT		
Floods and flash floods	Structure and Infrastructure Projects	Evaluate alternatives for drainage. Particularly where the hydrology of wetlands is impacted and may affect flooding and groundwater supplies	DPW Supervisor BCRC ANR	~~Continuous~~ July 2021 to July 2022	Town general fund	Medium	Medium
Floods and flash floods	Structure and infrastructure projects	Encourage property owners in flood or fluvial erosion hazard zones to consider selling their properties (buy out) or implementing flood proofing including elevating structures	Zoning Administrator	July 2021 to July 2022~~Continuous~~	FEMA HMGP, BRIC, FMA	Low	Low
Floods and flash floods	Structure and infrastructure projects	Investigate surface improvements to gravel roads to reduce potential for washouts	DPW Supervisor Town Select Board	July 2021 to July 2024~~Continuous~~	Town general fund	High	High

Table 27. Mitigation actions							
Hazard	Type[3]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Feasibility	Impact
Floods and flash floods	Structure and infrastructure protection	Implement corridor protection, buffer plantings, structure and berm removal and other projects listed in the 2016 Batten Kill Walloomsac Hoosic Tactical Basin Plan (Vermont Agency of Natural Resources 2016) and updates to that plan	Town Select Board; Bennington County Conservation District	Ongoing	FEMA HMGP, FMA, BRIC Vermont Clean Water Initiative, Vermont Watershed Grant		
Winter storms	Education and Outreach	Provide materials and post on website on methods to shelter in place including preparation for long-term power outages or transportation disruptions	Town Emergency Management Director	~~Continuous~~ September 2021 to September 2022	Town general fund FEMA Hazard Mitigation Grant	Medium	Medium
Winter storms	Local Planning and Regulations	Investigate requiring undergrounding of utilities for new subdivisions outside of village centers	Planning Commission	~~2020~~2021-2025	Town general fund	Low	Low
Winter storms	Local Planning and Regulations	Develop agreements with adjacent towns for sharing of highway equipment for both maintenance and for disaster remediation	Town Select Board; Town Road Foreman	2021to 2022	Town general fund	High	High
Winter storms	Structure and Infrastructure Projects	Place utilities underground for critical facilities (town hall, fire house, highway garage)	Town Select Board	~~2020~~2021-2025	FEMA HMGP, BRIC, FMA	Low	Low

Table 27. Mitigation actions							
Hazard	Type[3]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Feasibility	Impact
High wind events	Education and Outreach	Encourage property owners to properly tie down outdoor equipment including boats, propane tanks and other outdoor items	Zoning Administrator Town Emergency Management Director	~~2015~~ 2021 to ~~2020~~ 2025	Town general fund, FEMA, Hazard Mitigation Grant	High	High
High wind events	Education and Outreach	Provide educational materials on sheltering in place and preparation for high wind events, including long-term power outages	Town Emergency Management Director	~~2020~~ 2021 to 2025	Town general fund	High	High
High wind events	Local Planning and Regulation	Encourage appropriate plantings to avoid future damage from downed trees	Town Emergency Management Director Zoning	~~2020~~2021-2025	Town general fund	Low	Low
High wind events	Structure and Infrastructure Projects	Manage rights-of-way to clear vegetation to prevent trees falling on to roadways due to high winds	DPW Supervisor	Annual	Town general fund	High	High
High wind events	Structure and Infrastructure Projects	Retrofit existing buildings to withstand high winds including protection of power lines and other utilities	Town Select Board Private Owners	~~2020~~2021-2025	FEMA HMGP, BRIC	Low	Low
Hail	Structure and Infrastructure Projects	Retrofit existing buildings to minimize hail damage	Town Select Board; Private Owners	~~2020~~2021-2025	FEMA HMGP, BRIC	Low	Low

Table 27. Mitigation actions							
Hazard	Type[3]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Feasibility	Impact
Temperature extremes	Education and Awareness	Encourage residents to sign up with the Citizens Assistance Registry for Emergencies to provide first responders with contacts of populations vulnerable to potential hazards, particularly drought, extreme temperatures, and infectious diseases, but also those in need of assistance for evacuation and/or sheltering	Town Emergency Management Director	Continuous	Town general fund	High	High
Temperature extremes	Education and Awareness	Provide information on insulation, protecting pipes and other measures to prevent damage during extreme cold	Town Emergency Management Director	~~2020~~2021-2025	Town general fund FEMA HMGP, BRIC	Medium	Medium
Drought	Local Planning and Regulation	Monitor drought conditions and report conditions on Town web site.	Town Emergency Management Director	~~Continuous~~ July 2021 to July 2025	Town general fund	Medium	Medium
Drought	Education and Awareness	Provide information for residents on preparing for drought	Town Emergency Management Director	~~Continuous~~ 2021 to 2022	Town general fund	Medium	Medium

Table 27. Mitigation actions							
Hazard	Type[3]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Feasibility	Impact
Drought	Natural System Protection	Develop improved assessment of groundwater sources and amend bylaws to assure their protection	Vermont Geological Survey Planning Commission	~~2020~~2021-2025	FEMA HMGP, BRIC State of VT	Medium	Medium
Drought	Local Planning and Regulation	Incorporate planning for droughts in the emergency management plan	Town Emergency Management Director	~~2020~~2021-~~2021~~2022	Town general fund	High	High
Wildfire	Education and Outreach	Acquire materials from Firewise for homeowners and make available for landowners	BCRC Town Emergency Management Director	~~Continuous~~ September 2021 to September 2022	BCRC	High	High
Wildfire	Education and Outreach	Provide information on outdoor burning safety prior to the spring and fall fire seasons	Fire wardens	September 2021 to September 2022~~Continuous~~	Fire wardens	High	High
Wildfire	Education and Outreach	Provide a review of properties where owners request assessment of their properties for wildfire safety and adequate defensible space	BCRC, Shaftsbury Fire Department	~~Continuous~~ July 2021 to September 2022	BCRC, Shaftsbury FD	Medium	Medium
Wildfire	Natural Systems Protection	Implement fuel reduction, particularly in grass fields and in areas of Green Mountain National Forest	Shaftsbury Fire Department/Green Mountain National Forest	July 2021 to September 2022~~Continuous~~	Shaftsbury FD/Green Mountain NF	Medium	Medium

Table 27. Mitigation actions							
Hazard	Type[3]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Feasibility	Impact
Wildfire	Local Planning and Regulations	Encourage defensible space around structures	Town Planning Commission Zoning Administrator	Continuous	Town general fund	Medium	Medium
Wildfire	Structure and Infrastructure Projects	Assure adequate water supplies are available	Town Select Board; Emergency Management Director	~~Continuous~~ June 2021 to June 2022	Town general fund /State of Vermont grants for dry hydrants/ Vermont Department of Parks, Forestry and Recreation	High	High
Landslide and debris flow	Local Planning and Regulations	Following receipt of river corridor maps from VT ANR, consider adopting fluvial erosion hazard bylaws	Town Select Board; Town Planning Commission	~~2020~~2021-2025	Town general fund	Medium	Medium
Landslide and debris flow	Structure and Infrastructure Projects	Identify needed measures to stabilize Northbound lane on 7A between North Rd. and Myers Rd.	VT AOT	2025	State funding	High	High
Landslide and debris flow	Structure and Infrastructure Projects	Evaluate stream bank stabilization projects where needed	Town ANR	~~Continuous~~ September 2021 to September 2022	Town general fund VT ANR	High	High

Table 27. Mitigation actions							
Hazard	Type[3]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Feasibility	Impact
Landslide and debris flow	Education and Outreach	Educate property owners on proper construction techniques to reduce potential for creating or suffering damage from landslides	Town Zoning Administrator	~~Continuous~~ September 2021 to September 2022	Town general fund	Medium	Medium
Earthquake	Education and Awareness	Educate property owners on proper construction techniques to reduce potential damage from earthquakes	Town Zoning Administrator	September 2021 to September 2022~~Continuous~~	Town general fund	Medium	Medium
Hazardous materials spill	Local Planning and Regulation	Identify groundwater source areas and develop ordinances to protect those areas	Vermont Geological Survey Planning Commission	~~2020~~2021-2025	VT Geological Survey funds	Medium	Medium
Hazardous materials spill	Local Planning and Regulation	Enforce Village speed limits	VT State Police / Sheriff	~~Continuous~~ June 2021 to June 2024	State Local	High	High
Infectious disease outbreak	Local Planning and Regulations	Monitor disease occurrences and potential outbreaks	Town Health Officer	June 2021 to June 2024~~Continuous~~	Town general fund	High	High
Infectious disease outbreak	Education and Outreach	Provide educational materials in printed form and on the town web site on potential infectious diseases	Town Health Officer	June 2021 to June 2024~~Continuous~~	Town general fund /State of Vermont Health Department	High	High

Table 27. Mitigation actions							
Hazard	Type[3]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Feasibility	Impact
Invasive species	Local Planning and Regulations	Monitor extent of invasive species, particularly forest invasive species such as Emerald Ash Borer	Town Select Board Town Tree Warden	Continuous	Town general fund	High	High
Invasive species	Local Planning and Regulations	Complete surveys for ash trees vulnerable to Emerald Ash Borer	BCRC; Bennington County Conservation District	2021-2022	FEMA HMGP, BRIC VT Department of Forests, Parks and Recreation	High	High
Invasive species	Local Planning and Regulations	Survey for invasive species (e.g., Japanese knotweed)s along streams to identify potential erosion areas	Bennington County Conservation District	~~2020~~2021-2025	State of Vermont Department of Parks, Forestry and Recreation	Medium	Medium
Invasive species	Local Planning and Regulations	During review of development projects encourage use of native species in plantings for commercial and residential development	Town Planning Commission Zoning Administrator	~~Continuous~~ September 2021 to September 2022	Town general fund	High	Medium

Table 27. Mitigation actions							
Hazard	Type[3]	Actions	Responsible Parties	Time Frame	Funding Source(s)	Feasibility	Impact
Invasive species	Education and Awareness	Provide outreach materials for landowners on using native plants and controlling invasive species	Bennington County Conservation District Zoning Administrator	September 2021 to September 2022~~Continuous~~	Town general fund /State of Vermont Department of Parks, Forestry and Recreation	Medium	Medium

VII. Plan Maintenance

A. Annual Monitoring and Continued Public Involvement

Copies of this plan will be kept at the town office and made available via the town and BCRC website. The Select Board intends to involve the public in the implementation, review, and update of this plan. Tracking of actions will take place during the annual budgeting process, when funds are allocated for various programs to operate the town, including capital improvements. The Select Board is responsible for developing a town budget, which is approved during Town Meeting Day in March.

During future updates to the Town Plan, the planning commission will review this plan and incorporate relevant mitigation actions and goals into the Town Plan. This plan will also be integrated into annual updates to the Town Local Emergency Operations Plan. New data from a variety of studies completed by the Bennington County Regional Commission, the State of Vermont, the U.S. Forest Service, and others will be used in updating the town plan, as they were used to develop this hazard mitigation plan. The process of updating the town plan will incorporate the public involvement, agency review and adjacent town review requirements of Vermont statutes.

B. Plan Evaluation and Update

The Shaftsbury Select Board will be responsible for serving as or appointing a planning team for evaluating and updating the plan.

1. Plan Evaluation

The effectiveness of the plan will be determined by whether or not actions listed in Table 27 are implemented and whether or not the goals listed in VI. A. have been achieved.

a) Prior to town meeting in March, the Select Board, and the Emergency Management Director, will review each of the actions in Table 27 to determine their status. Status categories will include completed, in progress, scheduled, no progress.
b) The evaluation will be presented at a public meeting to allow for a discussion on progress in implementing the plan and the need for applying for funding or to address program and budgeting priorities.
c) The evaluation will be used to update the Local Emergency Operations Plan, which is required annually, and to identify potential changes to other town plans, programs, and policies.

If requested, the Bennington County Regional Commission will provide advice and assistance on the plan evaluation.

2. Plan Update

At least one year before the five-year period covered by this plan, the planning team will initiate a review of the plan by:

a. Updating the descriptions and analyses of events using new information since completion of this 2021hazard mitigation plan.
b. Identification of any new buildings or infrastructure or changes in critical facilities.
c. Estimation of potential probability and extent of hazards based on any new information since completion of this plan.
d. Review of completed hazard mitigation projects.
e. Identification of new projects given the revised hazard evaluation.
f. Review of any changes in priorities since adoption of this plan.
g. Revision of the assessment of risks and vulnerability from identified hazards.
h. Development and use of criteria to assess the potential benefits and costs of identified actions for use in prioritizing those actions.
i. Integration of the updated plan into the any updates to the Shaftsbury Town Plan and other plans and programs.

The planning team will hold open meetings to solicit opinions and to identify issues and concerns from members of the public and stakeholders. The planning team and the Town of Shaftsbury Select Board will work with the Bennington County Regional Commission and the State Hazard Mitigation Officer (SHMO) to review and update programs, initiatives and projects based on changing local needs and priorities. BCRC will assist in any necessary coordination and communication with neighboring towns to assure that mitigation actions address regional issues of concern. The revised plan will be submitted for review by the State Hazard Mitigation Officer and FEMA and revised based on their comments. Following approval by FEMA, the Select Board will adopt the completed plan.

C. Post Disaster Review and Revision

Should a declared disaster occur, Shaftsbury may undertake special review of this plan and the appropriate updates made. After Action Reports, reviews, and debriefings should be integrated into the update process. The plan should also be updated to reflect completion of projects listed in the basin plan, river corridor plan, culvert surveys and other studies.

VIII. References

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B. Map Data Sources

Data for maps came from the Vermont Open Geodata Portal (http://geodata.vermont.gov/)provides data on transportation systems, the location of structures (E911), critical facilities, jurisdictional boundaries, and other information. The base map was from ArcGIS Online (ESRI). Data from other sources for specific maps (if any) is listed below.

Map 1. Town of Shaftsbury: New York GIS Clearinghouse, https://gis.ny.gov/

Map 2. Town of Shaftsbury Land Cover: National Oceanographic and Atmospheric Administration, https://coast.noaa.gov/digitalcoast/data/nlcd.html

Map 3. Shaftsbury Designated Villages: Data from the Bennington County Regional Commission Town of Shaftsbury Town Plan 2015

Map 4. Shaftsbury Critical Facilities: Shaftsbury Local Emergency Management Plan (LEMP) (2020); Vermont Agency of Transportation provided to BCRC for Batten Kill Resilience Study, and the Planning Committee.

Map 5. Town of Shaftsbury Special Flood Hazard Areas and River Corridors: Vermont Agency of Natural Resources Natural Resources Atlas, http://anrmaps.vermont.gov/websites/anra/

FEMA Flood Map Service Center: https://msc.fema.gov/portal/

Map 6. Town of Shaftsbury Water Resources

Map 7. Shaftsbury Wildfire Potential: LANDFIRE Program, www.landfire.gov
Vermont Forest Resources Plan, http://anrmaps.vermont.gov/websites/sars_data/; BCRC data.

Map 8. Shaftsbury Landslide Potential and Rockfalls: Dale, J. 2015. Landslide potential in Bennington County, Vermont. Report prepared for Majorie Gale, Vermont Geological Survey from Green Mountain College, Poultney, VT.

Map 9. Shaftsbury Invasive Species: Early Detection and Distribution Mapping System 2020 Mary Beth Deller.

Map 10. Town of Shaftsbury Water Resources and Transportation

C. Personal Communication Sources

Mary Beth Deller, Botany Program Coordinator, Green Mountain and Finger Lakes National Forest, Rochester, VT

Veronica Fialkowski, MPH., Infectious Disease Epidemiologist, Vermont Department of Health, Veronica.Fialkowski@vermont.gov

Richard Heims, NOAA regarding drought indices, richard.heim@noaa.gov

Stuart Hinson, NOAA regarding NOAA data, stuart.hinson@noaa.gov

Erik Lars, Vermont Department of Forests, Parks and Recreation. Wildfire data.

Appendix 1. Mitigation actions from 2014 Shaftsbury Hazard Mitigation Plan

Hazard	Type[4]	Actions	Responsible Parties	Time Frame	Status (complete, carried to 2021 plan, deleted	Priority
All Hazards	Local Planning and Regulations	Assess need for driveway standards to assure adequate emergency access particularly to assure adequate access in winter storms, floods and for wildfire protection	Town Planning Commission	2015 to 2017	Carried to 2021 Plan	High
All Hazards	Local Planning and Regulations	Encourage proper construction techniques and use of appropriate materials to address hazards, particularly flooding, winter storms, wind events, earthquakes, landslides, and wildfire	Town Planning Commission; Zoning Administrator	2015 to 2017	Complete	High
All Hazards	Local Planning and Regulations	Update the Local Emergency Operations Plan annually	Emergency Management Director Select Board	2015 to 2016 and annually	Complete	High
All Hazards	Local Planning and Regulations	Install solar panels at Shaftsbury landfill to provide alternate power supply	Select Board	2015 to 2016	Deleted not economically viable	Medium
All Hazards	Education and Outreach	Provide a “be prepared” section of the Town website with links to information for residents	Town Select Board Emergency Management Director	2015 to 2017	Carried to 2021 plan	High
All Hazards	Education and Outreach	Identify and develop methods to communicate with populations vulnerable to potential hazards, particularly drought, extreme temperatures, and infectious diseases, but also those in need of assistance for evacuation and/or sheltering	Town Emergency Management Director	2015 to 2017	Carried to 2021 Plan	High

[4] Follows FEMA 2013 Mitigation ideas; a resource for reducing. Federal Emergency Management Agency, U.S. Department of Homeland Security, Washington, DC

Appendix 1. Mitigation actions from 2014 Shaftsbury Hazard Mitigation Plan

Hazard	Type[4]	Actions	Responsible Parties	Time Frame	Status (complete, carried to 2021 plan, deleted	Priority
Floods and Flash Floods	Local Planning and Regulations	Review possible bylaw fluvial erosion hazard zones	Planning Commission	2018 to 2019	Complete	High
Floods and Flash Floods	Local Planning and Regulations	Develop stormwater management regulations and guidelines for subdivision and site plan review and for property owners	Planning Commission VT Department of Agriculture and Markets BCRC	2018 to 2019	Complete	High
Floods and Flash Floods	Education and Outreach	Educate property owners on best stormwater management practices	Town BCRC	2016 to 2018	Carried to 2021Plan	High
Floods and Flash Floods	Education and Awareness	Educate owners on importance of securing propane tanks and other items that could float or blow away in storms	Town Zoning Administrator	2015 to 2017	Carried to 2021 Plan	Medium
Floods and Flash Floods	Education and Awareness	Provide information on the town web site and town hall for property owners on reducing flood damage	Town Administrator	2015 to 2017	Carried to 2021 Plan	Medium
Floods and flash floods	Natural Systems Protection	Acquire lands or work with conservation organizations to acquire lands subject to frequent flooding or wetlands within or adjacent to flood prone areas to provide flood storage	Town Select Board; Vermont Land Trust	2015 to 2020	Delete	Medium
Floods and flash floods	Structure and Infrastructure Projects	Update culvert inventory	Road Foreman BCRC	2015 to 2017	Complete	High
Floods and flash floods	Structure and Infrastructure Projects	Replace undersize bridges and culverts e.g., Bouplon Hollow Rd., Cider Mill Rd.	Road Foreman	2015 to 2020	As funds available	High
Floods and flash floods	Structure and Infrastructure Projects	Evaluate alternatives for drainage at Old Depot Rd., near Sugarhouse, particularly hydrology of wetlands that may affect flooding and groundwater supplies	Select Board	2015 to 2020	Complete	Low

Appendix 1. Mitigation actions from 2014 Shaftsbury Hazard Mitigation Plan

Hazard	Type[4]	Actions	Responsible Parties	Time Frame	Status (complete, carried to 2021 plan, deleted	Priority
Floods and flash floods	Structure and Infrastructure Projects	Inventory ditches and related drainage structures	Road Foreman BCRC	2015 to 2017	Complete	High
Floods and flash floods	Structure and infrastructure projects	Encourage property owners in flood or fluvial erosion hazard zones to consider selling their properties (buy out) or implementing flood proofing including elevating structures	Select Board	2015 to 2020	Carried to 2021 Plan	Low
Floods and flash floods	Structure and infrastructure projects	Investigate surface improvements to gravel roads to reduce potential for washouts	Road Foreman Select Board	2017 to 2018	Complete	High
Winter storms	Education and Outreach	Provide materials and post on website on methods to shelter in place including preparation for long-term power outages or transportation disruptions	Town Emergency Management Director	2017 to 2018	Carried to 2021 Plan	High
Winter storms	Local Planning and Regulations	Investigate requiring undergrounding of utilities for new subdivisions outside of village centers	Planning Commission	2017 to 2019	Complete	Medium
Winter storms	Local Planning and Regulations	Develop agreements with adjacent towns for sharing of highway equipment	Town Select Board; Town Road Foreman	2015 to 2017	Carried to 2021 Plan	High
Winter storms	Structure and Infrastructure Projects	Acquire generator for town shelter	Town	2015 to 2018	Complete	High
Winter storms	Structure and Infrastructure Projects	Place utilities underground for critical facilities (town hall, fire house, highway garage)	Town Select Board	2015 to 2018	Carried to 2021 Plan	Medium
High wind events	Education and Outreach	Encourage property owners to properly tie down outdoor equipment including boats, propane tanks and other outdoor items	Town Select Board	2015 to 2020 and ongoing	Carried to 2021 Plan	Medium

Appendix 1. Mitigation actions from 2014 Shaftsbury Hazard Mitigation Plan

Hazard	Type[4]	Actions	Responsible Parties	Time Frame	Status (complete, carried to 2021 plan, deleted	Priority
High wind events	Education and Outreach	Provide educational materials on sheltering in place and preparation for high wind events, including long-term power outages	Town Emergency Management Director	2015 to 2016	Carried to 2021 Plan	High
High wind events	Local Planning and Regulation	Encourage appropriate plantings to avoid future damage from downed trees	Town Emergency Management Director Planning Commission	2015 to 2017	Carried to 2021 Plan	Medium
High wind events	Structure and Infrastructure Projects	Manage rights-of-way to clear vegetation to prevent trees falling on to roadways due to high winds	Road Foreman	Annual	Complete	
High wind events	Structure and Infrastructure Projects	Retrofit existing buildings to withstand high winds including protection of power lines and other utilities	Town Select Board Private Owners	2016 to 2017	Carried to 2021 Plan	Medium
Hail	Structure and Infrastructure Projects	Retrofit existing buildings to minimize hail damage	Town Select Board; Private Owners	2017 to 2019	Carried to 2021 Plan	Low
Temperature extremes	Education and Awareness	Identify vulnerable populations through a survey and outreach	Town Administrator Fire Department Road Foreman Listers	Annual	Carried to 2021 Plan	High
Temperature extremes	Education and Awareness	Provide information on insulation, protecting pipes and other measures to prevent damage during extreme cold	Town Emergency Management Director	2015 to 2017	Carried to 2021 Plan	High
Drought	Local Planning and Regulation	Monitor drought conditions	Town Emergency Management Director	2015 to 2020	Complete	High
Drought	Education and Awareness	Provide information for residents on preparing for drought	Town	2015 to 2017	Carried to 2021 Plan	Low
Drought	Natural System Protection	Develop improved assessment of groundwater sources and amend bylaws to assure their protection	Vermont Geological Survey Town Planning Commission	2017 to 2019	Carried to 2021 Plan	Medium

Appendix 1. Mitigation actions from 2014 Shaftsbury Hazard Mitigation Plan

Hazard	Type[4]	Actions	Responsible Parties	Time Frame	Status (complete, carried to 2021 plan, deleted	Priority
Drought	Local Planning and Regulation	Incorporate planning for droughts in the emergency management plan	Town Emergency Management Director	6-18 months	Carried to 2021 Plan	High
Wildfire	Education and Outreach	Acquire materials from Firewise for homeowners and make available for landowners	BCRC Town Emergency Management Director	2015 to 2016	Carried to 2021 Plan	High
Wildfire	Education and Outreach	Provide information on outdoor burning safety prior to the spring and fall fire seasons	Fire wardens	2015 to 2020	Carried to 2021 Plan	High
Wildfire	Education and Outreach	Provide a review of properties where owners request assessment of their properties for wildfire safety and adequate defensible space	BCRC, Shaftsbury Fire Department	2015 to 2020	Carried to 2021 Plan	Medium
Wildfire	Natural Systems Protection	Implement fuel reduction, particularly in grass fields and in areas of Green Mountain National Forest	Shaftsbury Fire Department/Green Mountain National Forest	2015 to 2020	Carried to 2021 plan	Medium
Wildfire	Local Planning and Regulations	Encourage defensible space around structures	Town Planning Commission	2015 to 2020	Carried to 2021 Plan	High
Wildfire	Structure and Infrastructure Projects	Assure adequate water supplies are available	Town Select Board; Emergency Management Director	2015 to 2020	Complete	High
Wildfire	Natural Systems Protection				Delete	
Landslide and debris flow	Local Planning and Regulations	Following receipt of river corridor maps from VT ANR, consider adopting fluvial erosion hazard bylaws	Town Select Board; Town Planning Commission	2015 to 2019	Complete	High
Landslide and debris flow	Structure and Infrastructure Projects	Identify needed measures to stabilize Northbound lane on 7A between North Rd. and Myers Rd.	VT AOT	2015 to 2019	Complete	Medium

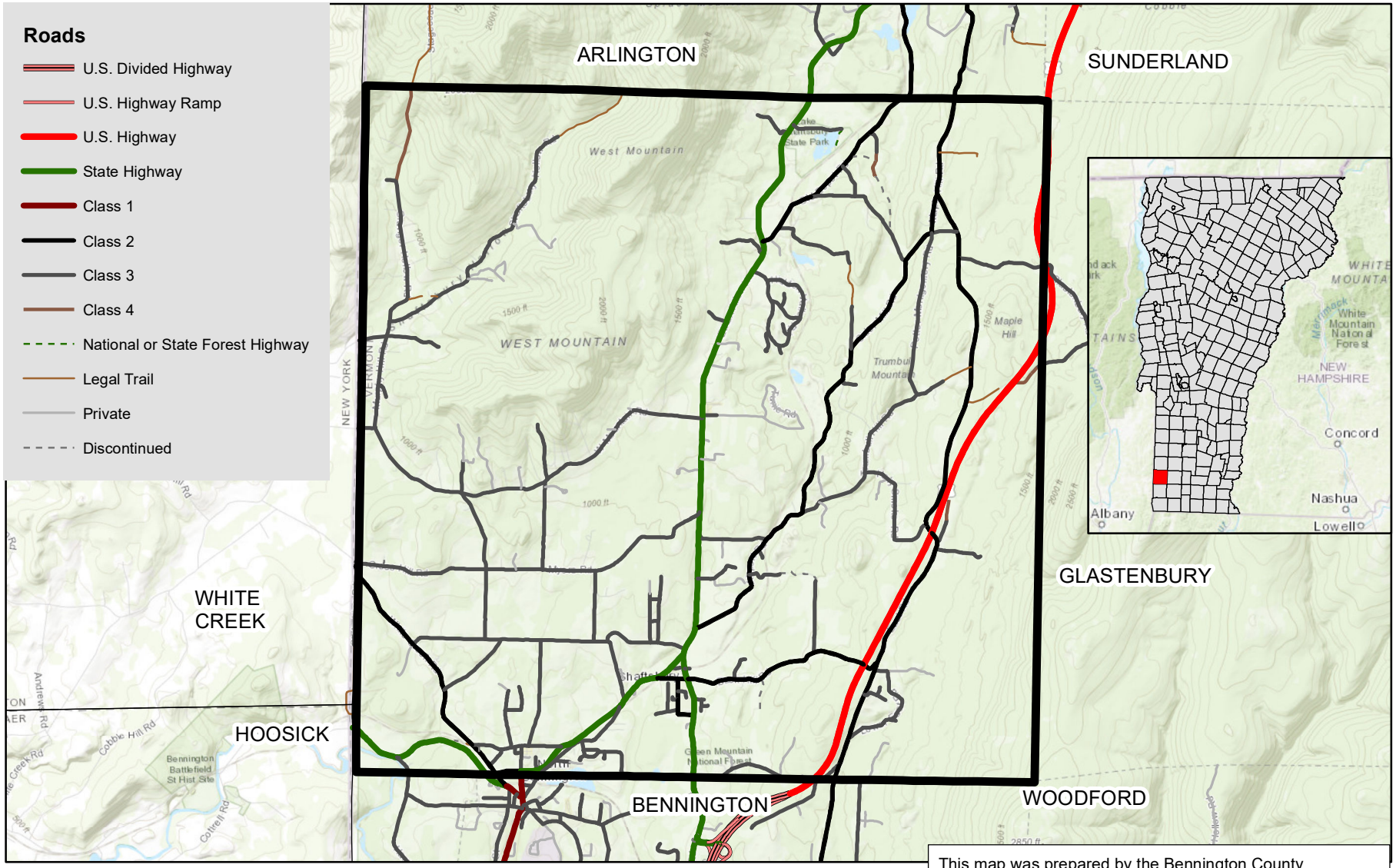
Appendix 1. Mitigation actions from 2014 Shaftsbury Hazard Mitigation Plan

Hazard	Type[4]	Actions	Responsible Parties	Time Frame	Status (complete, carried to 2021 plan, deleted	Priority
Landslide and debris flow	Structure and Infrastructure Projects	Evaluate stream bank stabilization projects where needed	Town ANR	2015 to 2019	Complete	Medium
Landslide and debris flow	Education and Outreach	Educate property owners on proper construction techniques to reduce potential for creating or suffering damage from landslides	Town Zoning Administrator	2015 to 2018	Carried to 2021 plan	Medium
Earthquake	Education and Awareness	Educate property owners on proper construction techniques to reduce potential damage from earthquakes	Town Zoning Administrator	2015 to 2018	Carried to 2021 plan	Medium
Hazardous materials spill	Local Planning and Regulation	Identify groundwater source areas and develop ordinances to protect those areas	Vermont Geological Survey	2015 to 2020	Carried to 2021 plan	Medium
Hazardous materials spill	Local Planning and Regulation	Enforce Village speed limits	VT State Police	2015 to 2020	Complete	High
Infectious disease outbreak	Local Planning and Regulations	Monitor disease occurrences and potential outbreaks	Town Health Officer	2015 to 2020	Complete	High
Infectious disease outbreak	Education and Outreach	Provide educational materials in printed form and on the town web site on potential infectious diseases	Town Health Officer	2015 to 2018	Complete	High
Invasive species	Local Planning and Regulations	Monitor extent of invasive species, particularly forest invasive species such as Emerald Ash Borer	Town Select Board	2015 to 2020	Complete	High
Invasive species	Local Planning and Regulations	Complete surveys for ash trees vulnerable to Emerald Ash Borer	BCRC; Bennington County Conservation District	2015 to 2017	Complete	Medium
Invasive species	Local Planning and Regulations	Survey for invasive species (e.g., Japanese knotweed)s along streams to identify potential erosion areas	Batten Kill Watershed Alliance	2016 to 2017	Carried to 2021 Plan	Medium

Appendix 1. Mitigation actions from 2014 Shaftsbury Hazard Mitigation Plan

Hazard	Type[4]	Actions	Responsible Parties	Time Frame	Status (complete, carried to 2021 plan, deleted	Priority
Invasive species	Local Planning and Regulations	Encourage use of native species in plantings for commercial and residential development	Town Planning Commission	2015 to 2020	Carried to 2021 Plan	Medium
Invasive species	Education and Awareness	Provide outreach materials for landowners on using native plants and controlling invasive species	Bennington County Conservation District	2015 to 2017	Carried to 2021 plan	High

Map 1. Town of Shaftsbury



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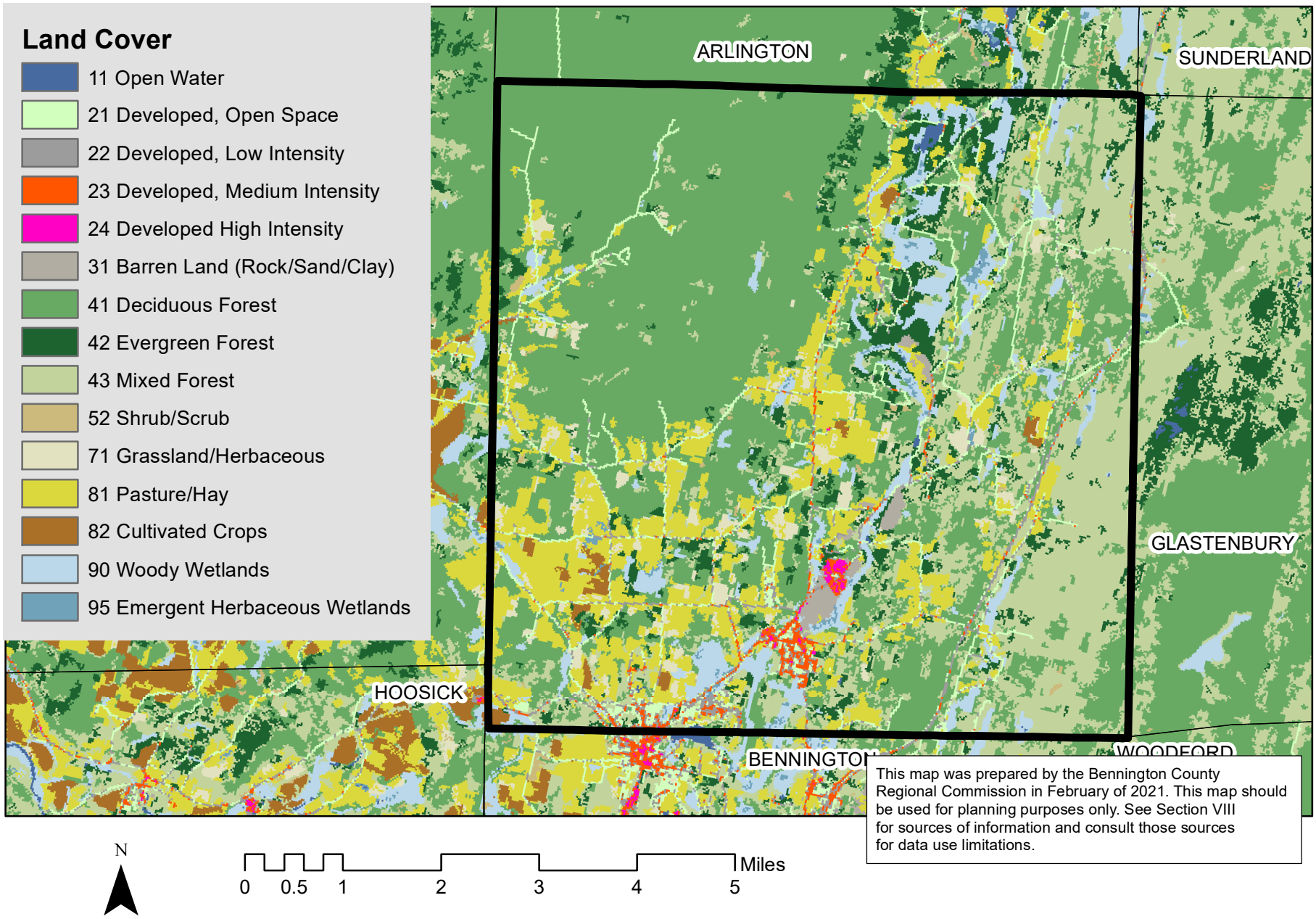
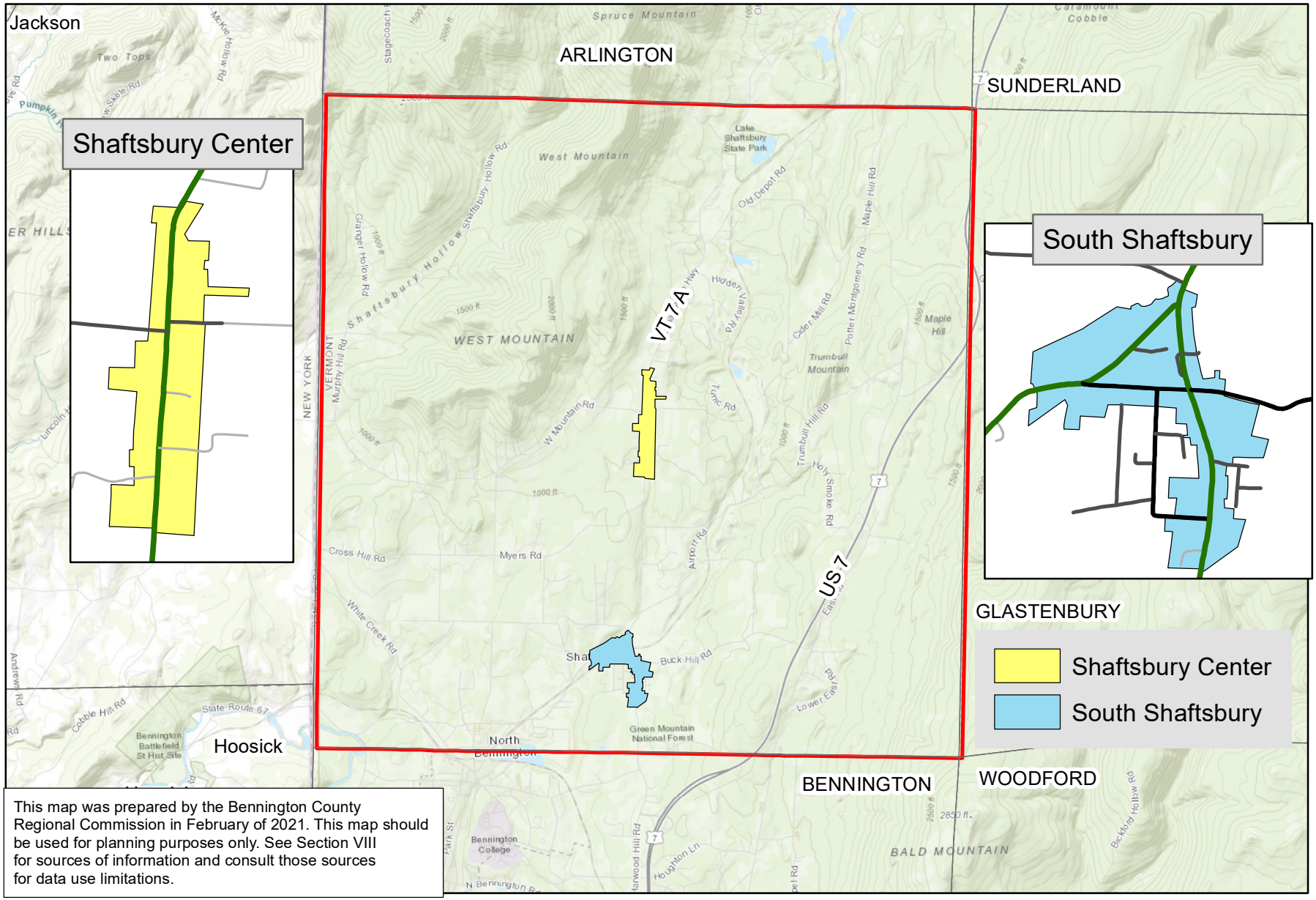
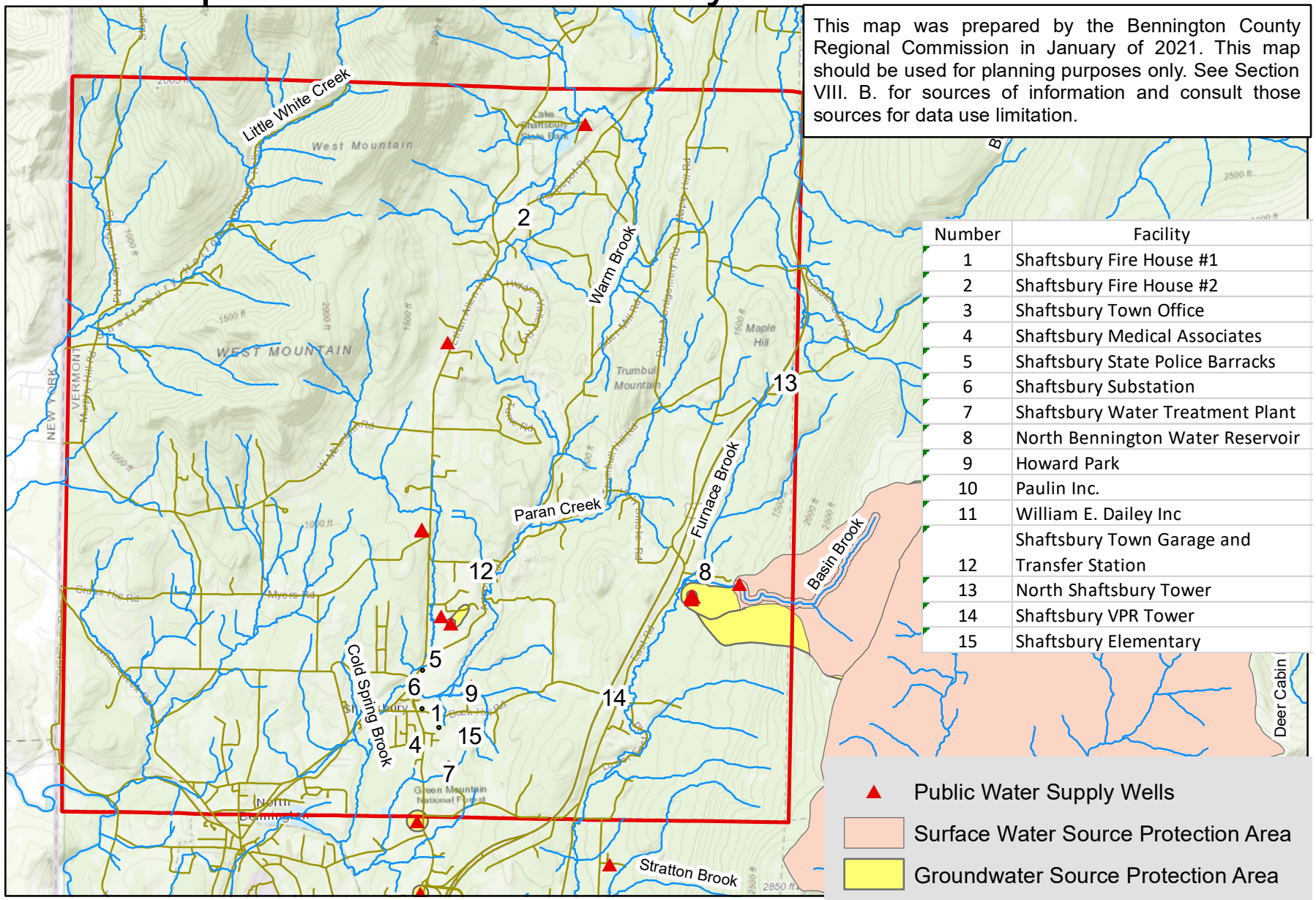
Map 2. Town of Shaftsbury Land Cover



Map 3. Town of Shaftsbury Designated Villages



Map 4. Town of Shaftsbury Critical Facilities



Number	Facility
1	Shaftsbury Fire House #1
2	Shaftsbury Fire House #2
3	Shaftsbury Town Office
4	Shaftsbury Medical Associates
5	Shaftsbury State Police Barracks
6	Shaftsbury Substation
7	Shaftsbury Water Treatment Plant
8	North Bennington Water Reservoir
9	Howard Park
10	Paulin Inc.
11	William E. Dailey Inc
12	Shaftsbury Town Garage and Transfer Station
13	North Shaftsbury Tower
14	Shaftsbury VPR Tower
15	Shaftsbury Elementary

Map 5. Special Flood Hazard Areas and River Corridors

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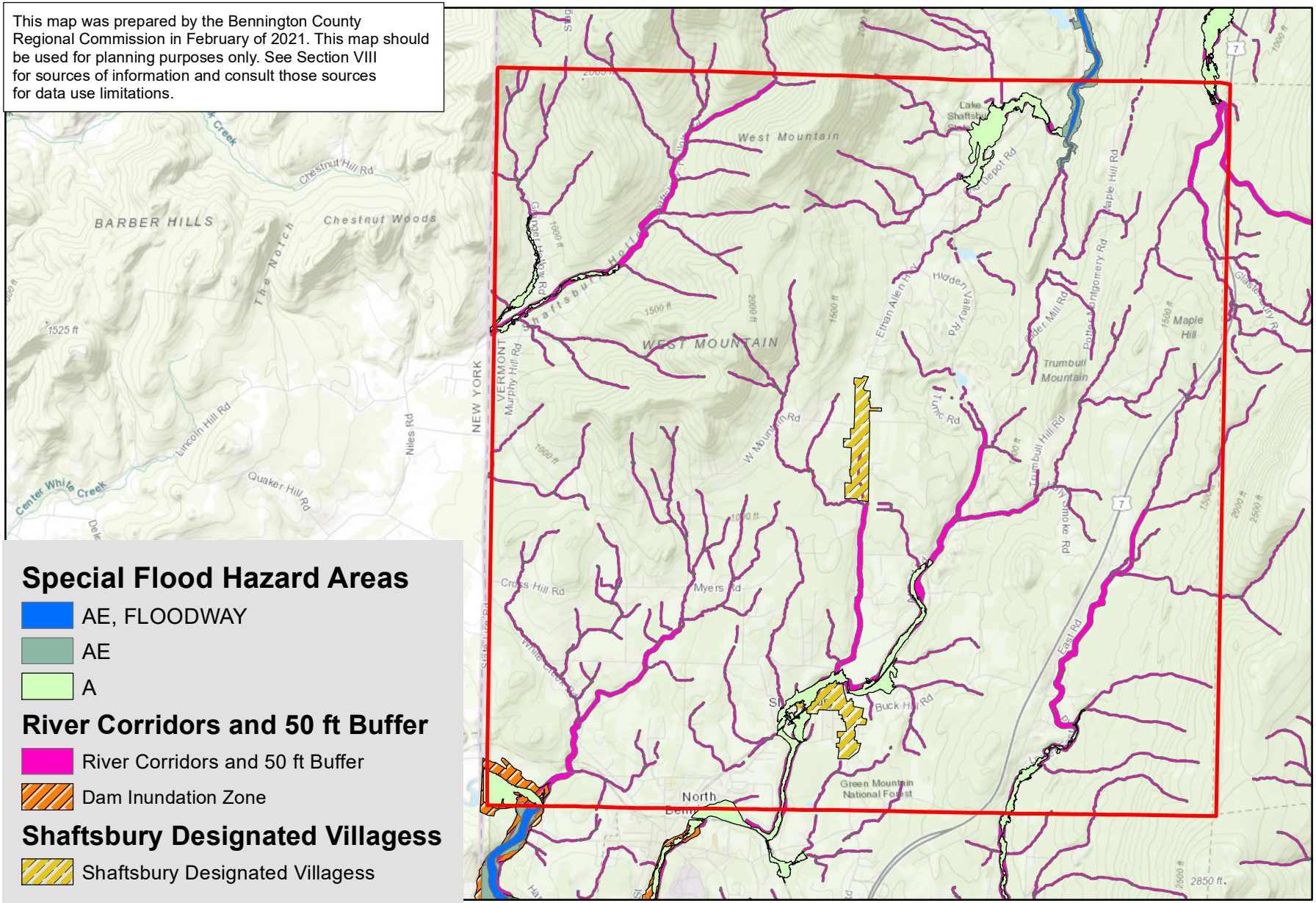


Special Flood Hazard Areas

- AE, FLOODWAY
- AE
- A

River Corridors and 50 ft Buffer

- River Corridors and 50 ft Buffer
- Dam Inundation Zone

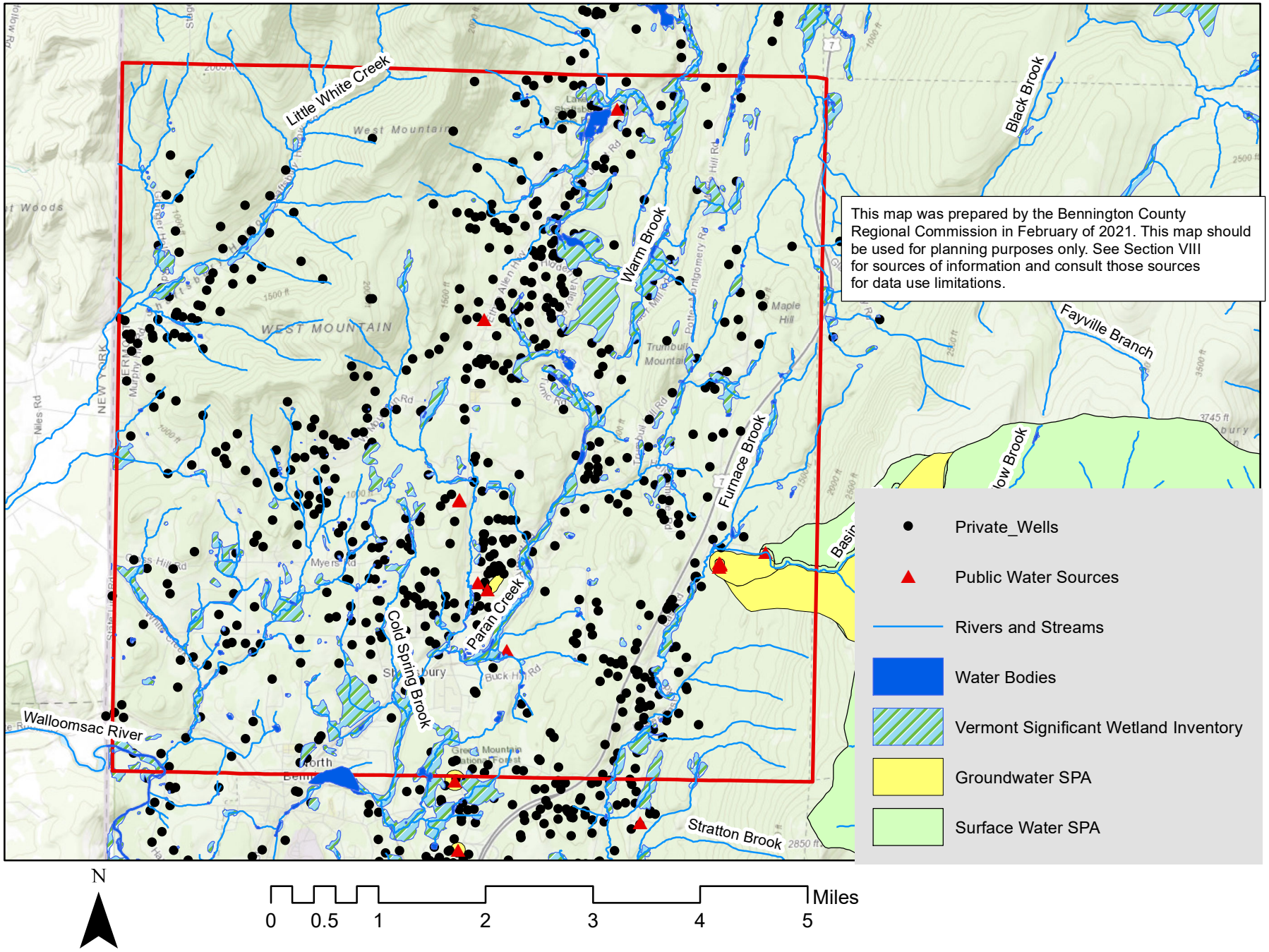
Shaftsbury Designated Villagess

- Shaftsbury Designated Villagess

N

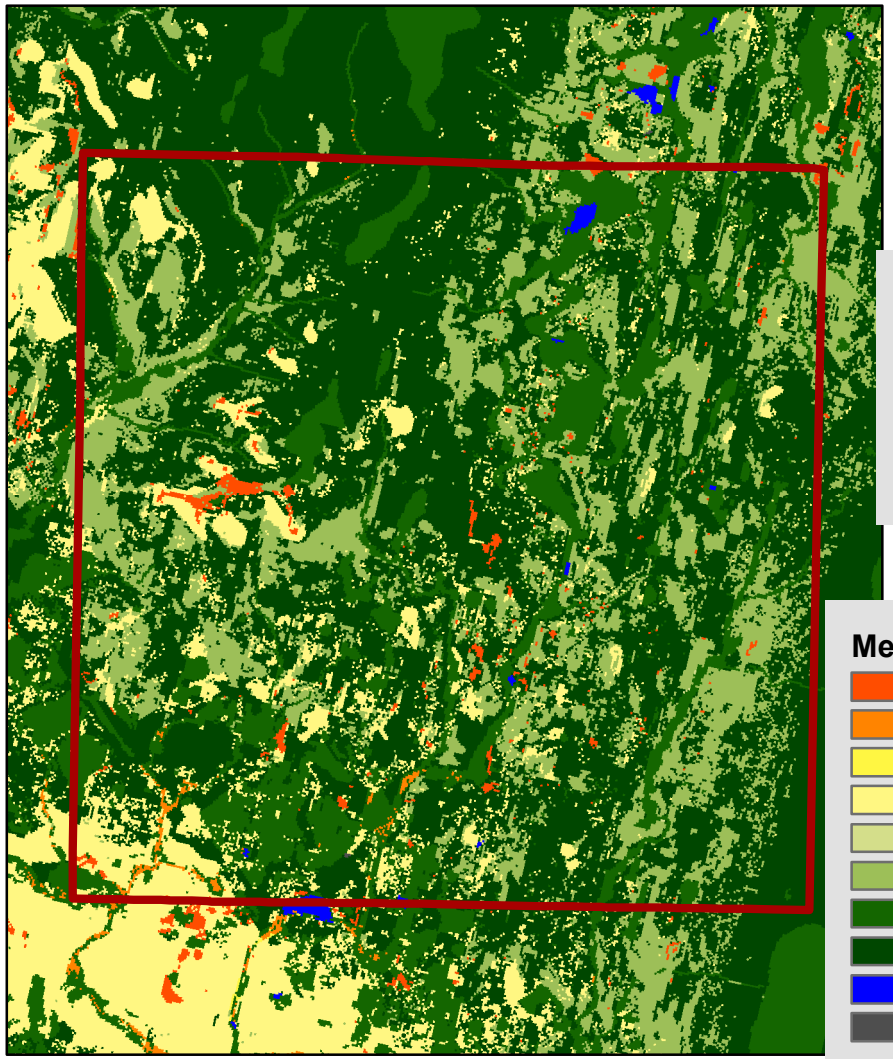
0 0.5 1 2 3 4 5 Miles

Map 6. Town of Shaftsbury Water Resources

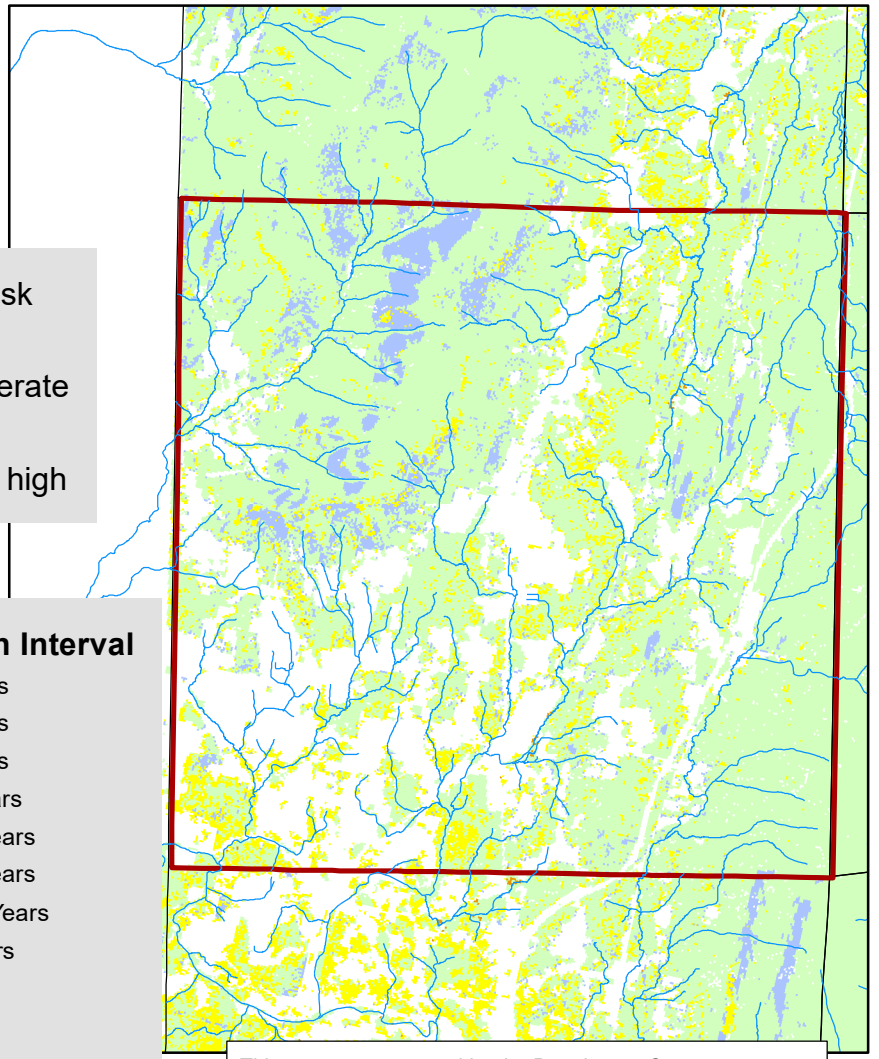


Map 7. Town of Shaftsbury Wildfire Potential

Mean Fire Return Interval



Wildfire Risk



No risk
Low
Moderate
High
Very high

Mean Return Interval

46-50 Years
51-60 Years
81-90 Years
91-100 Years
126-150 Years
151-200 Years
501-1000 Years
>1000 Years
Water
Barren

N

0 0.5 1 2 3 4 5 Miles

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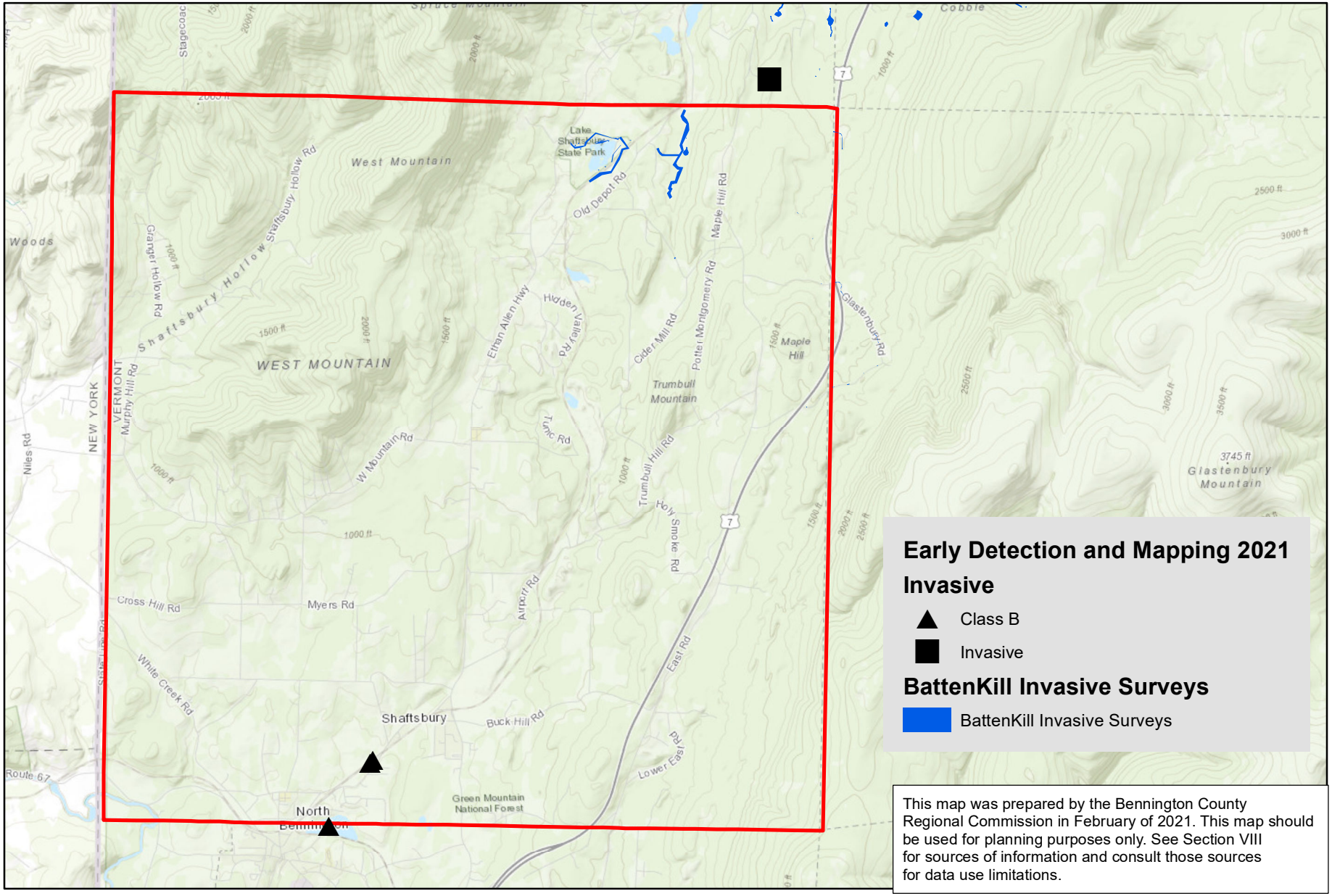
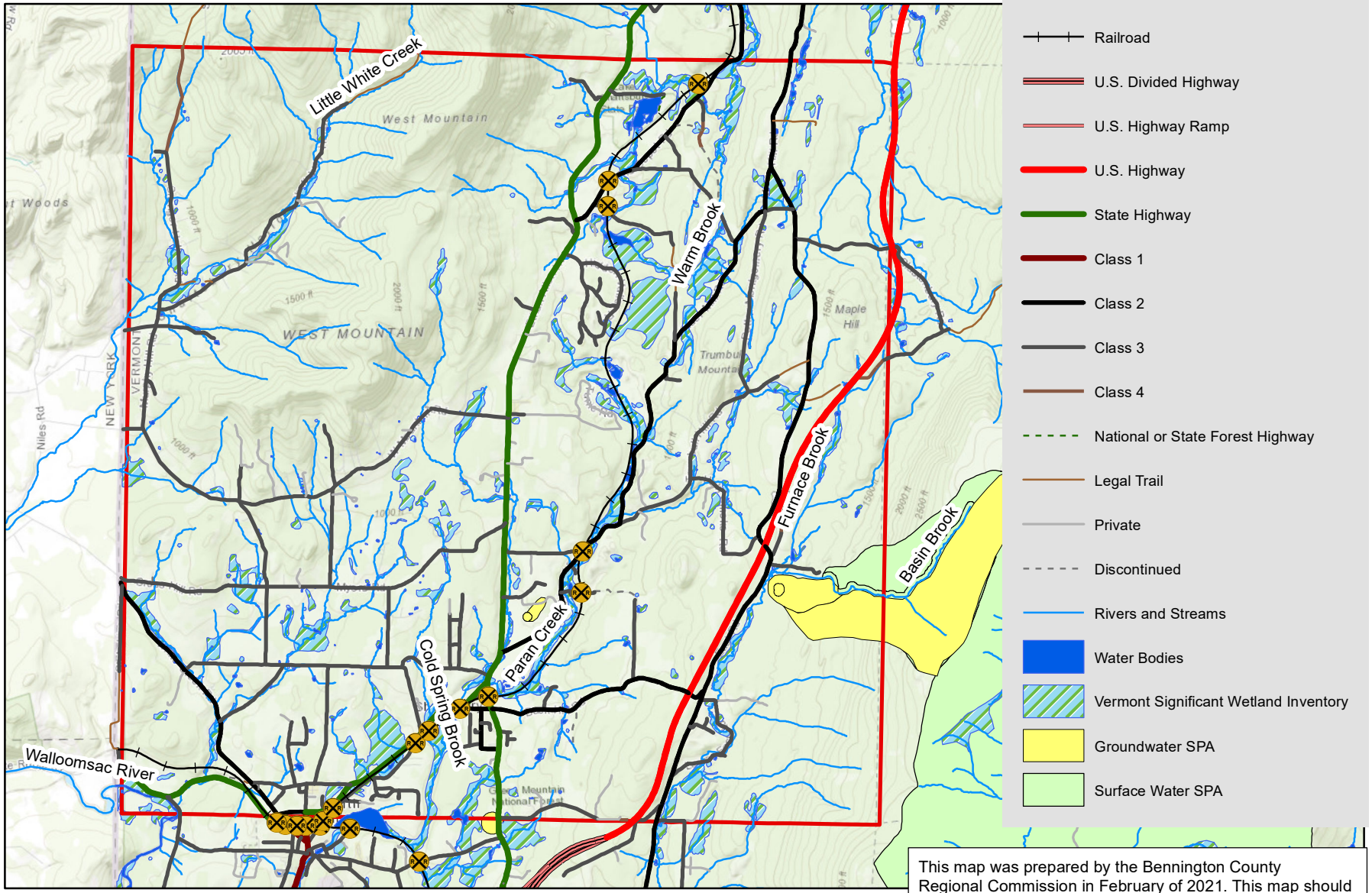
Map 9. Town of Shaftsbury Invasive Species



Map 10. Shaftsbury Water Resources and Transportation



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