Village of Manchester Hazard Mitigation Plan

May 15, 2017

Village of Manchester, Vermont

Village of Manchester, Vermont
PO Box 482
Manchester, Vermont 05254-0482
(802) 362-1515

September 5, 2017

A Resolution adopting the Village of Manchester Hazard Mitigation Plan

Whereas, the Village of Manchester has worked with the Bennington County Regional Commission to identify hazards, analyze paste and potential future losses due to natural disasters, and identify strategies for mitigation future losses, and

Whereas, the Village of Manchester has developed a hazard mitigation plan that provides a series of potential projects and actions to mitigate damages from disasters that could occur in the Village, and

Whereas, the Village of Manchester has provided an opportunity for members of the public, surrounding towns, and other agencies and organizations to comment on the draft hazard mitigation plan, and

Whereas, both the Vermont Department of Homeland Security and Emergency Management and the Federal Emergency Management Agency reviewed and provided substantive comments on the draft plan, and

Whereas, changes requested by the Vermont Department of Homeland Security and the Federal Emergency Management Agency have been incorporated in the Village of Manchester Hazard Mitigation Plan dated May 15, 2017, and

Whereas, a duly noticed public meeting was held by the Village of Manchester Board of Trustees to formally adopt the Village of Manchester Hazard Mitigation Plan dated September 5, 2017;

NOW, THEREFORE BE IT RESOLVED, that the Village of Manchester hereby adopts the Village of Manchester Hazard Mitigation Plan dated May 15, 2017; and
NOW THEREFORE BE IT FURTHER RESOLVED, that the respective officials identified in the mitigation action section of the Village of Manchester Hazard Mitigation Plan are hereby directed to pursue implementation of the recommended actions assigned to them.

Brian Knight, President

James Lewis,

Tom Deck

Bill Mariano

Andrea Ross

Table of Contents

List of Tables

List of Figures

List of Maps (follow end of document)

I. Introduction

A. Purpose

Hazard mitigation actions are designed 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 (FEMA 2013a).

This plan is intended to identify, describe and prioritize potential natural hazards that could affect the Village of Manchester in Bennington County, Vermont and provide specific measures to reduce or avoid those effects. The Federal Emergency Management Agency, within the U.S. Department of Homeland Security and the Department of Vermont 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 Village, 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
- Landslides and Debris Flow
- Earthquake
- Hazardous Materials Spill
- Infectious Disease Outbreak
- Invasive Species

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

B. Mitigation Goals

The Village 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 so as to minimize impacts to rivers, water bodies and other natural features, historic structures, and neighborhood character.
5. Increase the economic resiliency of the Village of Manchester 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 Village Plan, Capital Improvement Plan, and Local Emergency Operation Plan
7. Ensure that members of the general public continue to be part of the hazard mitigation planning process.

II. Village Profile

A. Regional Context

The Village of Manchester is located in the northern part of Bennington County, Vermont and is surrounded by the Town of Manchester which is bordered by the Towns of Arlington, Dorset, Rupert, Sandgate, Sunderland, Stratton and Winhall (Map 1). Route 7A is the main route through the Village, and a railroad from New York though North Bennington, Arlington and Sunderland also passes along the eastern border on the way to Rutland.

B. Demography and Land Use

The population as of 2010 was 749 people, and the Village population increased 24.4% since 2010 (BCRC 2015). This represents approximately 17.1% of the Town of Manchester population (Village of Manchester Plan of Development (2016)).

The main settled areas are within the Batten Kill valley which also represents the main transportation corridors for US 7 and Route 7A. To the west is Mt. Equinox, which is primarily forested, and to the east are the Green Mountains, also forested. There are some agricultural lands primarily scattered outside of the Village center and intermixed with forested lands (Map 2).

C. Economic and Cultural Resources

Table 1. Number of properties by classification. Source: Village of Manchester 2016	
Residential	276
Commercial	48
Commercial Apartments	4
Seasonal Home	0
Mobile Home	0
Farm	0
Utilities	2
Woodland	132
Miscellaneous and Other	23
Total	485

Economic resources are best summarized by the types of uses, which are described in the Village of Manchester Plan of Development (2016). The property types and the assessed values of different classes of properties total 485 parcels, not including 22 non-tax parcels, for a total value of $319,657,717.00 (Table 1). Map 3 shows the land use designations from the Village Plan of Development (2016) and from the 2012 Manchester Town Plan. Most commercial and industrial uses area located in the areas designated for commercial uses, which are located within the valley areas of the Town and Village.

The Village Plan of Development (2016) identifies the following important historic buildings, locations and institutions:

- The Equinox, a large hotel serving the region,
- Mark Skinner Library, a former library now a residence,
- Bur and Burton Academy, an independent secondary school,
- Hildene, an educational facility serving the region,
- First Congregational Church,
- The Courthouse, which includes the Village offices and the County court system,
- Dellwood Cemetery,
- Southern Vermont Arts Center which houses visual and performing arts,
- Equinox and Ekwanok Golf Courses,
- The Orvis Company, a major manufacturer of fly-fishing gear and
- Johnny Appleseed Bookstore, a historic building adjacent to the Equinox Hotel.

The concentration of development provides for large areas, primarily in higher elevations and steeper slopes, to remain forested, though most of these are beyond the boundaries of the Village and in the Town. At the same time the costs of maintenance of major roads, water and sewer and other services are reduced.

Both the Town of Manchester and the Village of Manchester have historic districts (Map 3) designed to provide protection for important historic buildings.

D. Critical Facilities

Table 2 lists and describes critical facilities including Village facilities, utility substations, schools, sites with hazardous substances, and the areas served by Town water and sewer services. These are labeled and shown on Map 4. The transportation system also represents a set of critical facilities. The Village contains 2.007 miles of Class 1 roads, 3.390 miles of Class 2 roads, and 3.690 miles of Class 3 roads for a total of 9.087 miles of roads maintained by the Village. Route 7A or Main St. is maintained by the Village. US 7, which is outside of the Village, is a main route from Bennington to Manchester and further north (Vermont Agency of Transportation, 2015).

Table 2. Village of Manchester Critical Facilities.
Source: VCGIS and Village of Manchester Planning Team

Label	Name	Description
1	Town of Manchester Water and Sewer Department	Town water and sewer facilities
2	Burr and Burton Academy	Education facility
3	Maple Street School	Education facility
4	Shaw's	Major grocery
5	The Equinox Hotel	Lodging and major business
6	Village of Manchester Office	Village government
7	Village of Manchester Highway Department	Village garage
8	The Golf Club at the Equinox	Public attraction or landmark building
9	Town of Manchester Tank #1	Water storage tank

III. Planning Process

A. Planning Team

The Bennington County Regional Commission began discussions with the Village on developing a hazard mitigation plan in 2014. The Village Board of Trustees decided to initiate planning in 2015. This is the first stand-alone hazard mitigation plan for the Village of Manchester, though the Town of Manchester was part of a multi-jurisdictional plan that expired in 2010. The hazard mitigation planning team consisted of members listed in Table 3 below

Table 3. Planning committee members

Name	Affiliation
Karen Walla	Planning Commission Chair
Tom Deck	Planning Commission and Village Trustee
Donald Brodie	Planning Commission Member

Table 3. Planning committee members	
Name	Affiliation
Al Michaels	Planning Commission Member
Constance West	Planning Commission Member
Nina Mooney	Planning Commission Member
Andrea Ross	Planning Commission Member
Eric Scott	Administrative Officer
Alan Mowrey	Road Foreman
Anthony MacLaurin	BCRC Representative

B. Public Involvement

The Village started the planning process in the fall of 2015 and held several meetings of the planning committee. These meetings were warned according to the Vermont Open Meetings Law, and dates are listed in Table 4.

Table 4. Dates of planning meetings and public and agency review	
Meeting	Date (s)
Board of Trustees initiates planning process	October 5, 2015
Planning committee organizational meeting	December 3, 2015
Planning committee meeting	September 14, 2016
Planning committee meeting	February 02, 2017
Planning committee meeting	March 22, 2017
1st Draft made available for public and agency review by the planning committee	March 24, 2017
Comment period ended	April 30, 2017
Board of Trustees meeting and vote to send to FEMA	May 15, 2017
Board of Trustees adoption of plan	September 5, 2017

All of the above meetings were warned and open to the public. No members of the public attended. The plan was posted on the Village website and on the website of the Bennington County Regional Commission. The plan was also sent to:

The Town of Manchester Town Manager
The Town of Winhall Town Manager and Town Clerk
The Town of Dorset Town Manager
The Town of Rupert Select Board Chair and Town Clerk
The Town Arlington Select Board Chair and Town Clerk
The Town of Sandgate Select Board Chair and Town Clerk
The Town of Peru Select Board Chair

The Town of Stratton Town Clerk
The Chair of LEPC 7
The district manager of the Bennington County Conservation District

All were asked to share the plan with appropriate Town staff and officials. Comments were requested by email, phone or letter and were to be sent to Michael Batcher at the Bennington County Regional Commission. Comments received and responses are in Appendix I. The plan was then sent to FEMA and, following FEMA review and approval pending adoption, was adopted by the Board of Trustees on September 5, 2017.

C. Hazard Assessment

The following sections provide a detailed assessment of each of the hazards based identified by the planning team based on data from the following sources listed in Section VIII References:

a. Local knowledge
b. The National Climate Data Center (NCDC) storm events database (most recent data from their FTP site)
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. Cooperative weather observer data and station normal where available
g. Palmer Hydrologic Drought Index calculated from 1985 to 2014 from the National Oceanographic and Atmospheric Administration (NOAA)
h. Hazardous materials spills from the Vermont Agency of Natural Resources (VT ANR)
i. Infectious disease outbreaks listed from the Vermont Department of Health
j. Observations of invasive species compared to the state and federal lists of noxious species
k. The Vermont Hazard Mitigation Plan (2013)
l. New England Weather, New England Climate (Zielinski and Keim 2003), Vermont Weather Book (Ludlum 1996)
m. FEMA 2010 Flood Insurance Study, Bennington County, Vermont and Incorporated areas, Federal Emergency Management Agency Study Number 5003CV000A
n. 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
o. Spatial Hazard Events and Losses Database (SHELDUS) records which were not as complete as NCDC and, therefore, not used.
p. Fuel types and potential for wildfire from LANDFIRE (http://www.landfire.gov/) and from the Vermont Department of Parks, Forests and Recreation
q. Vermont Agency of Natural Resources and Vermont Agency of Agriculture, Food and Markets on invasive species.

r. 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 NCDC data, there have been numerous changes to that database in just the last few years. While NCDC 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 fewer than from 1996 onward indicating that some events were not recorded. 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 data is available from the North Adams, MA observer. The only stream gauge is in Bennington near the New York border on the Walloomsac River, which is in a different watershed than the Batten Kill, which encompasses the Village of Manchester. There are no weather stations that record or keep long term data records in the Village of Manchester except for the cooperative weather observers listed above who record daily observations, but not the specifics of storm events.

We have communicated with USGS which is working on models of areas impacted by different storm events using Lidar and stream gauge data, but they are not working in Vermont as yet as far as we know. We looked at the USGS high water marks for Irene (Medalie and Olson 2013), but they were located only along the Batten Kill in Arlington and portions of the Roaring Branch and Walloomsac in Bennington with none recorded in the Village of Manchester. Therefore, we relied on the updated special flood hazard maps for potential flooding extent.

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.

IV. Hazard Assessment

A. 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 the Village of Manchester. 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. 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 the Village is located 200-300 feet above the valleys along the Batten Kill. Munson Brook and Spring Brook both flow from Mount Equinox on the west through the Village to the Batten Kill and contain narrow flood hazard areas. Headwaters streams like these 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 three dams located within the Village (Map 5). Equinox Pond is categorized as having significant hazard potential.

b. Fluvial Erosion

In Vermont, most rivers flow through relatively confined valleys, but still meander over time across the floodplain. 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.

Table 5 shows a total of 49 flood events in Bennington County from 1996 to 2015, using NCDC data. These have been primarily minor and affected either specific streams, such as the Batten Kill and the Walloomsac, or specific municipalities.

Table 5. Total number of flood events by type and year for Bennington County. Source: NCDC 2015

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			
Total	22	27	49

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. Manchester 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 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. A category 1 storm has winds of 74-95 miles per hour and could damage roofs, down shallow-rooted trees and damage power lines (http://www.nhc.noaa.gov/aboutsshws.php).

The following describes nine moderate and extreme events that have occurred since 1996, using the National Weather Service (2010) categories, which affected both the Town of Manchester and the Village or nearby areas. These events were described in the National Climate Database records (2014). It should be noted that only the January 1996 event occurred in the winter, with all other events in the spring, summer or fall. Ice jam flooding does occur and one instance of damage is described below.

<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.

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 14-17, 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 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. The swollen river flooded the Batten Kill Canoe Company and adjacent river property. A Cooperative Weather Observer recorded 3.39” of rain in Sunderland.

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 NCDC 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 between March 31st and 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 Manchester Schools were closed due to flooding. The gage on the Batten Kill River in Arlington rose to 6.90 feet, nearly a foot above the 6-foot flood stage during the predawn hours of April 3rd.

April 16-17 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 led 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 led to widespread minor to moderate flooding across southern Vermont. A Cooperative Weather Observer recorded 4.63" of rain between September 5th and 9th.

c. Extent and Location

Within the Village of Manchester, there have been only minor damages from past flooding events. The dam on Munson Brook may need to be replaced and at least two houses in that area are candidates for flood proofing. There have been no NFIP-designated repetitive losses within the Village of Manchester. No damages were recorded within the Village following Tropical Storm Irene. However, just outside the Village, Richville Rd. was flooded. Cell phone service was lost in the area, resulting in poor communications.

In addition to the above events, the Peru, Pownal and Sunderland Cooperative Observer recorded precipitation. Table 6 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 NCDC records or local knowledge, but this does provide additional information on potential flooding extent.

Table 6. 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.

Sunderland		Pownal	Peru
Month	Year	Year	Year
January	1990, 1998, 1999 (5.98")	1996, 1998, 1999 (4.29")	1990, 1999 (5.79")
February	2002, 2008, 2011 (3.58")	1990, 2008 (3.53")	2000, 2002, 2008 (4.93")
March	2001, 2007, 2008 (5.35")	1999, 2001, 2007 (4.42")	2001, 2008 (6.15")
April	1993, 1996, 2002, 2007, 2011 (4.74")	1990, 1993, 1996 (4.76")	1996, 2007 (5.95")
May	1990, 2000, 2006 (6.31")	1990, 2013 (6.50")	1990, 2012 (7.70")
June	1998, 2002, 2006 (7.67")	1998, 2000, 2002, 2013 (7.27")	1998, 2006, 2011, 2013 (8.94")
July	1996, 2004, 2008 (6.87")	2004, 2010 (6.34")	1996, 2000, 2013 (7.41)"

Table 6. 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.			
Sunderland		Pownal	Peru
Month	Year	Year	Year
August	1990, 2003, 2011 (7.38")	1990, 1991, 2003, 2011 (7.24")	1990, 2003, 2011 (8.65")
September	1999, 2003, 2011 (5.75")	1999, 2004, 2011 (6.13")	1999, 2003, 2011 (7.13")
October	2005, 2007, 2010 (7.05")	1995, 2003, 2010 (5.46")	1995, 2005, 2006, 2010 (8.30")
November	2002, 2004, 2005 (5.28")	2005 (5.36")	2002 (6.37")
December	1996, 2003, 2008 (6.42")	1990, 2003, 2011 (4.62")	1996 (7.18")

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 7 shows the number of structures, by type, in the special flood hazard and river corridors, and the extent of both areas is shown in Map 5. Figure 1 below shows the parts of a typical floodplain.

Figure 1. Typical floodplain

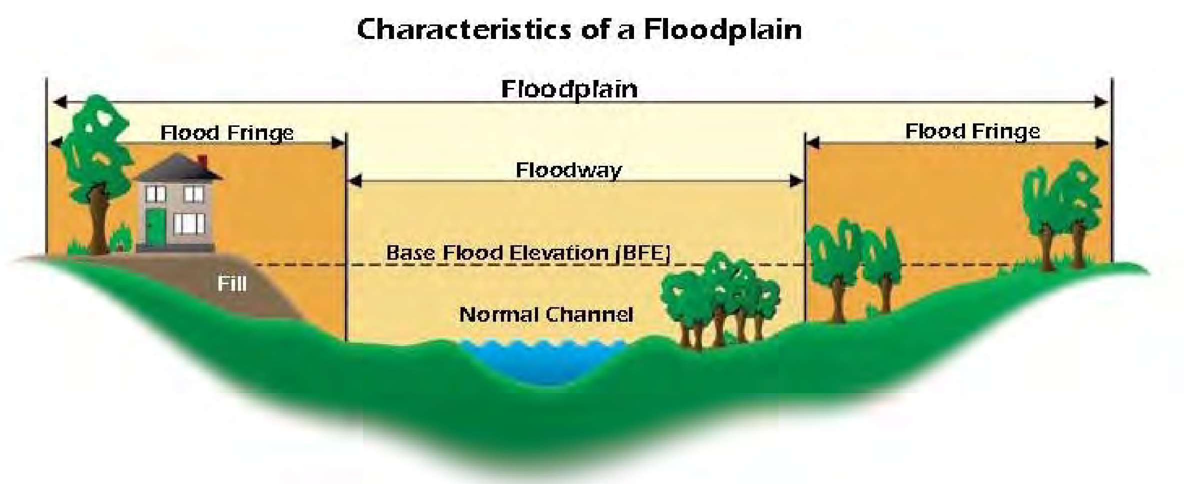
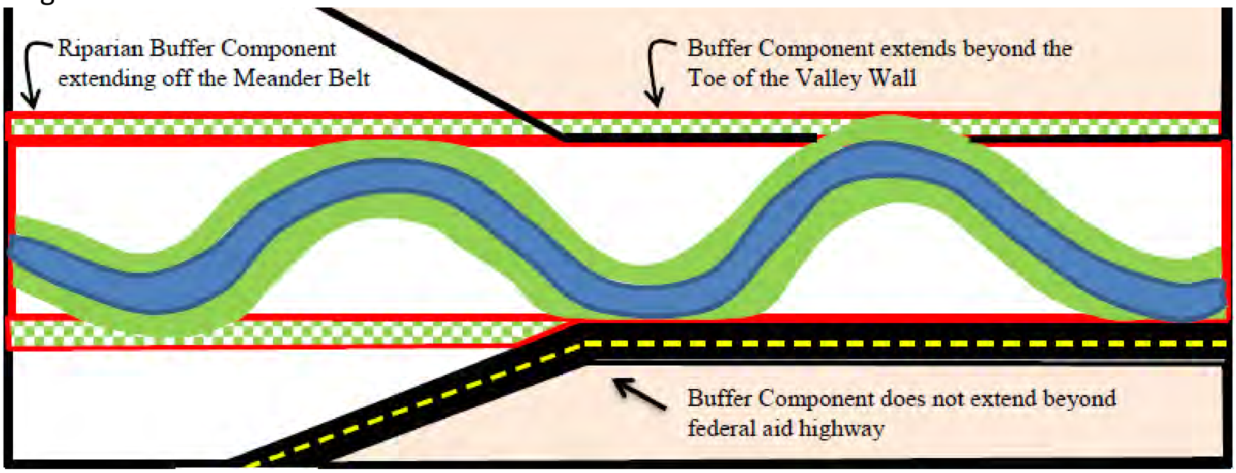


Figure 2. River corridors



River Corridors: River corridors (Figure 2), previously known as "fluvial erosion hazard areas," have been mapped by the Vermont Agency of Natural Resources using geospatial data and will be modified by VT ANR river scientists using available field data. The data were used to calculate the "meander belt width" or area within which a river would move. 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.

Table 7. Structures by type in flood hazard zones in the Village of Manchester, VT.
Source: Vermont Center for Geographic Information www.vcgi.org

Type	Number in special flood hazard zone	River Corridor
Single-Family	7	5
Multi-Family	0	1
Commercial	1	0
Other Commercial	1	0
Total	9	6

The maps developed by VT ANR show the potential extent of fluvial erosion in North Bennington. This is the only information available that shows the amount of fluvial erosion that could occur. Therefore, these maps provide the best data to determine extent of fluvial erosion.

d. Probability, Impact, and Vulnerability

Based on data from 1996 to 2015, nine moderate or major flood events have affected areas within or near the Village of Manchester resulting in a 50-60% chance of such an event occurring in any given year. Table 7 tallies the number of structures by type within the river corridor and special flood hazard area. The Village has a total of 361 single family residences, 27 multi-family dwellings, 64 seasonal homes, 79 commercial/industrial establishments, 87 camps, 13 lodging establishments and 19 government, church, public gathering and school buildings, and 10 other uses. As shown in Table 7, there are 9 structures in the special flood hazard area and 6 in the river corridor recently mapped by VT ANR. Therefore, the potential proportion damaged within the Village 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.

A comparison of E911 structures from 2016 with those of 2005 indicate two new structures in the special flood hazard area. Interestingly, two structures that were in that area, as currently mapped, no longer appear, so overall vulnerability has not increased since the 2005 hazard mitigation plan.

B. 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. The "Blizzard of ’93," one of the worst storms this 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 8. Total number of winter storm events by type and year for Bennington County.
Source: NCDC 2015

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	2	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		1			6	
Totals	1	28	2	64	47	135

2. Previous Occurrences

Table 8 summarizes the 143 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 and 2011. Using NCDC 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 NCDC as producing heavy or record snows or blizzards or significant icing. The Blizzard of 1993 was categorized as “Extreme.” The NCDC 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.

<u>January 2 to 3, 1996 Heavy Snow</u>: 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.

<u>December 7 to 8, 1996 Winter Storm:</u> Heavy wet snow fell across southern Vermont resulting in 20,000 customers losing power. Eleven inches of snow were recorded in Dorset and fourteen inches in Peru. Downed trees caused road closures and some were without power for several days.

<u>March 31 to April 1, 1997 Winter Storm</u>: A nor’easter formed bringing rain that changed to snow with totals of twelve inches in Shaftsbury and thirteen inches in Peru. The wet snow caused power outages and road closures.

<u>December 29 to 30, 1997 Winter Storm</u>: Wet snow and strong wins combined to down trees and power lines. Route 7 was closed for several hours.

<u>January 14 to 15, 1999 Winter Storm</u>: Heavy snow fell across eastern New York and southern New England with 11 inches reported in Dorset. The storm was accompanied by extremely cold conditions with reported temperatures of -9 F.

<u>March 5 to 6, 2001 Winter Storm</u>: An extended period of moderate to heavy snow resulted in 26 inches in Pownal and 27 inches in Peru. This was one of the largest snowfalls in southern Vermont since the Blizzard of 93.

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 from Arlington to the New York State Line.

December 6 to 8, 2003 Winter Storm: The first major snowstorm of the winter resulted in 20.5 inches of snow reported in Pownal.

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.

April 15 to 16, 2007 Winter Storm: Heavy, wet snow, ranging from 8-12 inches, downed trees and power lines causing widespread outages.

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 at 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.
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 1 to 2 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.

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

3. Extent and Location

The average annual snowfall in Bennington County is 64.4 inches, with December, January, February and March as the primary months for snowfall. Extreme snowfall events for one, two and three-day events have ranged from 12 to over 20 inches (NOAA/National Climate Data Center 2014 Cooperative Weather Observer reports).

Increasing temperatures that are predicted to occur will likely reduce total winter snowfall. If precipitation falls as rain in the 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 the Village of Manchester 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. Power outages could be short term or last seven or more days. Some roads may remain impassable for long periods as well. The Village Road Foreman did not identify any specific areas where snow removal was more problematic than others.

C. 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 NCDC recorded 69 thunderstorms with damaging winds in Bennington County since 1996. 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 NCDC recorded three tornadoes in Bennington County since 1990.

2. Previous Occurrences

Table 9 below summarizes the total number of significant wind events including thunderstorms, strong winds, and tornadoes from 1996 to 2015. 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 (NCDC 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 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 of 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 wind events within the Village of Manchester due to the lack of weather stations. NCDC data (2015) 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 the Village of Manchester are described below.

Table 9. Summary of wind events in Bennington County.
Source: NCDC 2015

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

Table 9. Summary of wind events in Bennington County. Source: NCDC 2015						
Year	High Wind	Strong Wind	Thunderstorm Winds	Tornado	Funnel Cloud	Totals
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						
Totals	33	5	67	3	1	109

July 17 and July 18, 1997 Thunderstorm Winds: Severe thunderstorms downed trees in Manchester and Dorset.

May 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.

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.

December 12, 2000 High Wind: Strong winds from the boundary of high and low pressure systems downed trees and powerlines across Bennington County.

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 and a second tornado in Pownal and Bennington, downing trees and causing minor damage.

June 27, 2005 Thunderstorm Winds: A thunderstorm near Manchester Center blew down several trees.

October 29, 2006 High Winds: Strong winds, some reaching 60 mph, blew from the evening of the 28^{th} through parts of the 29^{th}.

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.

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

July 20, 2008 Thunderstorm Winds: A storm brought down trees and wires and blocked Route 7A northeast of Manchester.

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 off shore Tropical Storm Nicole created winds gusting to over 55 mph with power outages reported.

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

August 28-19, 2001 (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.

July 4, 2012 Thunderstorm Winds: Strong storms produced damaging winds in Manchester on Independence Day.

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.

May 21, 2013 Thunderstorm Winds: A broken line of thunderstorms created downed wires and trees in Dorset.

July 19, 2013 Thunderstorm Winds: Thunderstorm winds downed trees in Manchester and Sunderland.

July 3, 2014 Thunderstorm Winds: Thunderstorms again affected Bennington and Dorset.

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). During a December 2009 event, winds were measured at 59 mph at the Morse Airport in Bennington. Higher winds were likely created during the two 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 the Village of Manchester.

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 10-100% in the Village of Manchester.

D. Hail

The National Climate Data Center has 23 reports of hail storms in Bennington County between 1996 and 2015, all associated with thunderstorms. The following were within the Town of Manchester, which surrounds the Village, or adjacent towns.

<u>May 31, 1998 Thunderstorm Winds and Tornado and Hail</u>: 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. Hail was reported in Shaftsbury.

<u>July 18, 2000 Hail</u>: Hail was reported in Bennington and Sunderland

<u>July 4, 2001 Hail</u>: Half-dollar sized hail fell in Sunderland.

<u>June 6, 2005 Hail</u>: Hail was reported in West Rupert, and one-inch hail was reported in Dorset.

<u>August 1, 2005 Hail</u>: One-inch sized hail was reported at Emerald Lake State Park in Dorset.

<u>June 19, 2006 Hail</u>: Penny-sized hail was reported in Sunderland.

<u>May 10, 2007 Hail</u>: Quarter sized hail was reported in Arlington.

<u>June 21, 2007 Hail</u>: Nickel sized hail was reported in Sunderland.

August 3, 2007 Hail: Ping pong ball sized hail was reported in Shaftsbury.

June 10, 2008 Hail: Nickel sized hail was reported in Rupert.

August 6, 2008 Hail: Quarter sized hail was reported in Arlington.

June 1, 2011 Hail: Half dollar sized hail was reported in Arlington and golf ball sized hail reported in Shaftsbury. Reports of hail were widespread.

June 24, 2013 Hail: Quarter sized hail was reported in Manchester.

Hail was also reported by 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 cover wide areas and has the potential for damaging crops, automobiles or glass within structures, as well as causing injury. Generally, however, hail storms affect relatively small areas as they form in thunderstorms, which are localized. Storms with the largest hail stones near the Village of Manchester were the two in 2005 during which one inch hail was reported in Dorset and Rupert.

d. Probability, Impact and Vulnerability

Hail storms 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 the Village of Manchester could range from 10-100%. 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.

E. 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 Manchester (Table 10). 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 108 times between 1980 and 2010 or about three 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 10. Sunderland normal temperatures and precipitation for 1981 to 2010.
Source: National Climate Data Center: http://www.ncdc.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)
January	28.5	9.5	19.0	3.44
February	33.7	11.2	22.5	2.82
March	40.9	19.5	30.2	3.55
April	54.3	31.0	42.7	3.47
May	65.8	41.3	53.5	4.33
June	75.3	49.6	62.5	4.66
July	78.5	54.5	66.5	4.55
August	77.1	53.0	65.0	4.40
September	69.6	44.2	56.9	3.83
October	57.3	34.4	45.8	4.28
November	45.9	27.9	36.9	3.98
December	34.4	17.2	25.8	3.95
Annual	55.1 (Avg.)	32.8 (Avg.)	43.9	47.26

The station normal report for the Cooperative Weather Observer in Sunderland indicates an average of one day per year when the maximum temperature would equal 90 degrees, 55 days when the maximum temperature would be less than 32 degrees and 172 days when the minimum temperature would be less than 32 degrees.

2. Extent and Location

Extreme temperature is a widespread phenomenon. The populations affected could range widely if one is considering outdoor workers or the entire Village in a power outage. Temperatures exceeding 90^0F occur one or two days per year. The highest recorded temperature at the Sunderland Cooperative Weather Observer station was 94^0F on June 1, 2011, which occurred 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.

Average temperatures in Vermont have risen 2.7^{0}F since 1941 with an increase of 1.5^{0}F since 1990. Winter temperatures have risen more than summer temperatures. If these trends continue, the number of days above 90^{0}F 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.

F. 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 11 shows periods when the index showed severe and extreme droughts using data from 1985 to 2014. No drought conditions were recorded from 2003 through 2014.

Table 11. Number of months by year of occurrences of severe or extreme droughts 1985 to 2015
Source: National Climate Data Center. *Source: ftp://ftpncdd.noaa.gov/pub/data/cirs/climdiv/ (Richard Heims, personal communication)*

Year	Extreme	Severe
1907		1
1908	2	1
1909	1	2

Table 11. Number of months by year of occurrences of severe or extreme droughts 1985 to 2015 Source: National Climate Data Center. *Source:* ftp://ftpncdd.noaa.gov/pub/data/cirs/climdiv/ *(Richard Heims, personal communication)*		
Year	Extreme	Severe
1910		2
1911	5	4
1912		2
1913		5
1914		5
1915	3	1
1921		2
1922		1
1930		1
1931		4
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
2002	1	1
Total	23 months; 8 years	58 months; 26 years

3. Extent and Location

The National Climate Data Center calculates this index back to 1895. Since then, severe droughts occurred in 26 years or 21.5% while extreme drought occurred in 8 years or 6.6%. 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 are likely to affect those properties with shallow wells. Based on well data from VT ANR, there are 94 wells in the Village of Manchester with nine with depths less than or equal to 100 feet. There are three public wells, serving the Southern Vermont Art Exchange, the Garden Café and Equinox.

Map 6 shows recharge potential from bedrock and shallow aquifer sources for the Manchester Quadrangle, which covers all of the Village. The valley areas have the highest recharge potential. The Village receives water from the Town of Manchester's water system, which depends on wells located adjacent to the Batten Kill River.

4. Probability, Impact and Vulnerability

Based on the Palmer Drought Severity data, there is a 21.5% chance of a severe or extreme drought occurring in any one year. As can be seen, most existing wells are within areas of unconfined, overburdened aquifers. 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.

G. 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: NWCG 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 Manchester 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).

The Village of Manchester likely has some structures within the "wildland urban interface," which represents areas where structures directly abut wildland fuels (Federal Register 2001). These areas have not been mapped.

2. Past Occurrences

According to records from the Vermont Department of Forests, Parks and Recreation, from 1992 to 2015, 179 wildfires occurred in Bennington County, seven of which occurred in Manchester. Information for the Village was not available. However, these records have been questioned as ten fires were recorded in both 2014 and 2015 by the Manchester Fire Department within the Town of Manchester. All were less than one acre. Burn permits were not issued by the forest fire warden during the dry periods of 2015.

3. Extent and Location

Reported fires in 2014 and 2015 were Class A or B. Low intensity fires with slow rates of spread could occur in the forested areas which comprise most of Village of Manchester's land cover. Throughout the Village 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

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 valleys. Overall the wildfire risk is low or nonexistent, especially in developed areas where there is little or no fuel.

The area's 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 greater than 50 years (Malamud et al. 2005) and greater as shown in Map 7. 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 very limited due to the fuel characteristics. However, large roadless areas and steep topography can make suppressing wildland fires that do occur very difficult. Settled areas have a low vulnerability to wildland fire except in areas where cured grasses and herbaceous vegetation may burn in the spring.

H. Earthquake

1. Description

Vermont has no active faults, but has experienced minor earthquakes. 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

Table 13 below shows the most recent occurring within the state, though there have been others, located outside the state, that have been felt in Vermont (Springston and Gale 1998).

Table 13. 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.

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

Table 13. 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.			
Location	Date	Magnitude	Mercalli Intensity
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

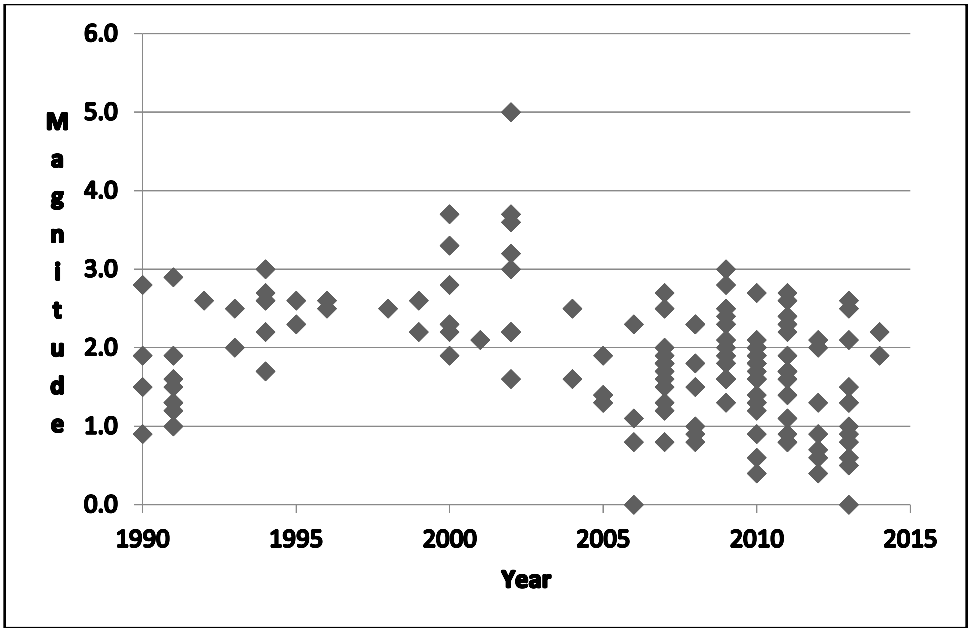
Data from the Weston Observatory at Boston College (Northeast Earthquake Maps and Catalog) was used to identify earthquakes occurring within 100 miles of the Village of Manchester since 1990. No earthquakes occurred in either the Village of Manchester or Bennington County during that period. Figure 3 below plots the number of earthquakes by year by magnitude (Table 14).

Table 14. Earthquake magnitude and intensity scale descriptions. Source: 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.

Table 14. Earthquake magnitude and intensity scale descriptions.
Source: http://earthquake.usgs.gov/learn/topics/mag_vs_int.php.

Magnitude	Modified Mercalli Intensity	Description
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.
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. Earthquakes and magnitude for occurrences within 100 miles of Manchester, Vermont. Source: Northeast Earthquake Maps and Catalog 2015



3. Extent and Location

No earthquakes have been recorded in the Village of Manchester 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 the Village of Manchester. 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 the Village of Manchester (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.

I. 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
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 and none have been reported from previous or subsequent events. A landslide occurred on Mount Equinox in 2000 (Rick Ladue, personal communication), but did not threaten any settled areas or roads. No rockfall areas were identified by the Vermont Agency of Transportation (Eliason and Springston 2007).

3. Extent and Location

There have been no reported landslides within the Village. 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 nearly the entire Village has a low potential for landslide. Outside of the Village, there are areas of medium and high potential for landslides on the steeper slopes of Mount Equinox on the west and Green Mountain National Forest on the east. These are located distant from settled areas, the road system and other infrastructure. There are some areas located along River Road and along the Batten Kill, but no landslides have been reported in those locations. One of the latter represents a mass failure near the Town sewage treatment plant.

4. Probability, Impact and Vulnerability

The probability is low and therefore the potential impact and vulnerability are both low.

J. 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 2016).

Vermont has two invasive species lists: Class A species are on the Federal Noxious Weed List but are not known to occur in Vermont. 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 16).

Table 16. Designated Class B noxious weeds in Vermont. Source: Vermont Agency of Agriculture, Food and Markets*:* *http://agriculture.vermont.gov/plant_pest/plant_weed/invasive_noxious_weeds/noxious_weeds_list* Those with a * have been identified in Bennington County. Source: Early Detection and Mapping System: http://www.eddmaps.org/tools/query/ Those marked with ** have been identified within the Village of Manchester. Sources: Mary Beth Deller, USFS, provided data; Michael S. Batcher observations Those marked with an (A) are also on the aquatic invasives list (Table 17)	
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 (A)	Flowering rush
Celastrus orbiculatus **	Oriental bittersweet
*Euonymus alatus**	Burning bush
Fallopia japonica **	Japanese knotweed
Hydrocharis morsus-ranae (A)	Frogbit
*Iris pseudacorus** (A)	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 ** (A)	Purple loosestrife
*Myriophyllum spicatum** (A)	Eurasian watermilfoil
Najas minor (A)	European naiad
Nymphoides peltata (A)	Yellow floating heart
*Phragmites australis** (A)	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

Table 17 shows aquatic invasive species listed by the Agency for Natural Resources.

Table 17. Aquatic invasive species in Vermont. Source: Watershed Management Division, Department of Environmental Conservation*:* *http://dec.vermont.gov/watershed/lakes-ponds/aquatic-invasives/gallery*	
Scientific Name	Common Name
Dreissena polymorpha	Zebra mussel
Alosa pseudoharengus	Alewife
Orconectes rusticus	Rusty crayfish
Bythotrephes longimanus	Spiny Waterflea
Corbicula fluminea	Asian clam
Didymosphenia geminata	Didymo[1]
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 and animals in the Village of Manchester and in Bennington County has not been fully mapped. However, the Bennington County Regional Commission completed a survey of ash trees within the Village to identify areas of potential hazard from emerald ash borer (Quant 2016). Map 9 shows that areas along Prospect and West Roads have concentrations of ash greater than 12" in diameter. If these are killed off by emerald ash borer, they could damage powerlines and properties and block roads. It is likely that buckthorn (*Rhamnus cathartica*) and barberry (*Berberis thunbergii*) have invaded forests and wetland edges and that Japanese knotweed (*Fallopia japonica*) has invaded stream banks and other disturbed areas.

In addition to the species listed above, the following are potential 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. The bush honeysuckles (*Lonicera* spp.) have also been observed along roadsides. Multiflora rose (*Rosa multiflora*) often is found along roads and wetland edges.

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*

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

tsugae) has dramatically reduced hemlock trees south of Vermont and was recently 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 movement of firewood.

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.

K. 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 116 spills reported in Manchester since 1973. Of these ten occurred within the Village, and all occurred as oil spills in a few residences, some spillage at the Equinox Hotel and at Burr and Burton. There were no major spills.

3 Extent and Location

US Route 7 and VT Route 7A carry substantial traffic, and a spill on these roads could affect a large portion of the Village. Of particular concern in any hazardous materials spill would be the impact on water resources. Map 7 shows the transportation system in relation to surface waters including streams and wetlands. 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. However, increased truck traffic also increases the possibility of a major spill, and 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 and VT Route 7A. 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. Injuries, except in the case of direct injuries from a traffic accident, are likely to be low. However, the long-term impacts of a spill could be extensive if aquatic resources and/or water supplies were affected.

Table 18 Hazardous materials spills in the Village of Manchester, VT. Source: Vermont Agency of Natural Resources: https://anrweb.vt.gov/DEC/ERT/Spills.aspx								
Report #	Year	Facility Name	Address	Nature of Incident	Product Released	Quantity	Unit	Responsible Party
WMD198	2015	Jones Property	2694 Main Street	Leaking UST	#2 Fuel Oil		--	Peoples United Bank
WMD296	2015	Shchemelev Property	3952 Main St	1,000-gal & 500-gal USTs	#2 Fuel Oil	unknown	--	Tecom Group
WMD214	2013	Skinner Library	Rt 7A & Cemetery Ave	PCS and heavy sheen on water in excavation for foundation	#2 Fuel Oil		--	
WMD432	2006	Equinox Resort		leaking AST	Gasoline			Equinox Resort
WMD492	2006	Friedman Residence	2837 Main St	UST line leak	Heating Oil	10	Gallons	Anne Friedman
WMD404	2005	The Reluctant Panther Inn	128 Shepard Lane	oil in stream				N/A
WMD438	2004	Steve Maeder Residence	147 Outpost Farms Lane	AST failure		100	Gallons	unknown at this time
WMD202	2003	Stewarts Ice Cream	4455 Main St	gasoline overfill	Gasoline	2	Gallons	Stewarts
WMD434	2000	Burr and Burton High School	Seminary Ave	leaking line to underground tank				Burr and Burton High School
WMD463	2000	Swinarton Residence	Equinox Pond Rd	delivery to wrong fill pipe		9	Gallons	N/A
WMD104	1995	N/A	Seminary,west,franklin,	Fuel Tank Leak	diesel	20	Gallons	Miles Defalo; Joe Miles
WMD126	1995	N/A	Batten Kill River	Sheen on River. Also, tires and drums in River.				N/A
190	1990	Orlando Property	West Road	Contaminated H2o In Basement		50		Denise Orlando
240	1989	Burr & Burton Seminary		Oil Leak				Burr & Burton / Agway
133	1988	N/A	Powderhorn Road	Ground Water Contamination				Hinnes Michielson
249	1988	N/A	Burr & Burton	Oil Spill		20		Sears Oil Co.
120	1987	N/A	West Rd	Truck Rollover	diesel	200		Heathslip Oil
25	1973	N/A	Equinox House	Spill During Tank Removal		100	Gallons	N/A

L. Infectious Disease Outbreak

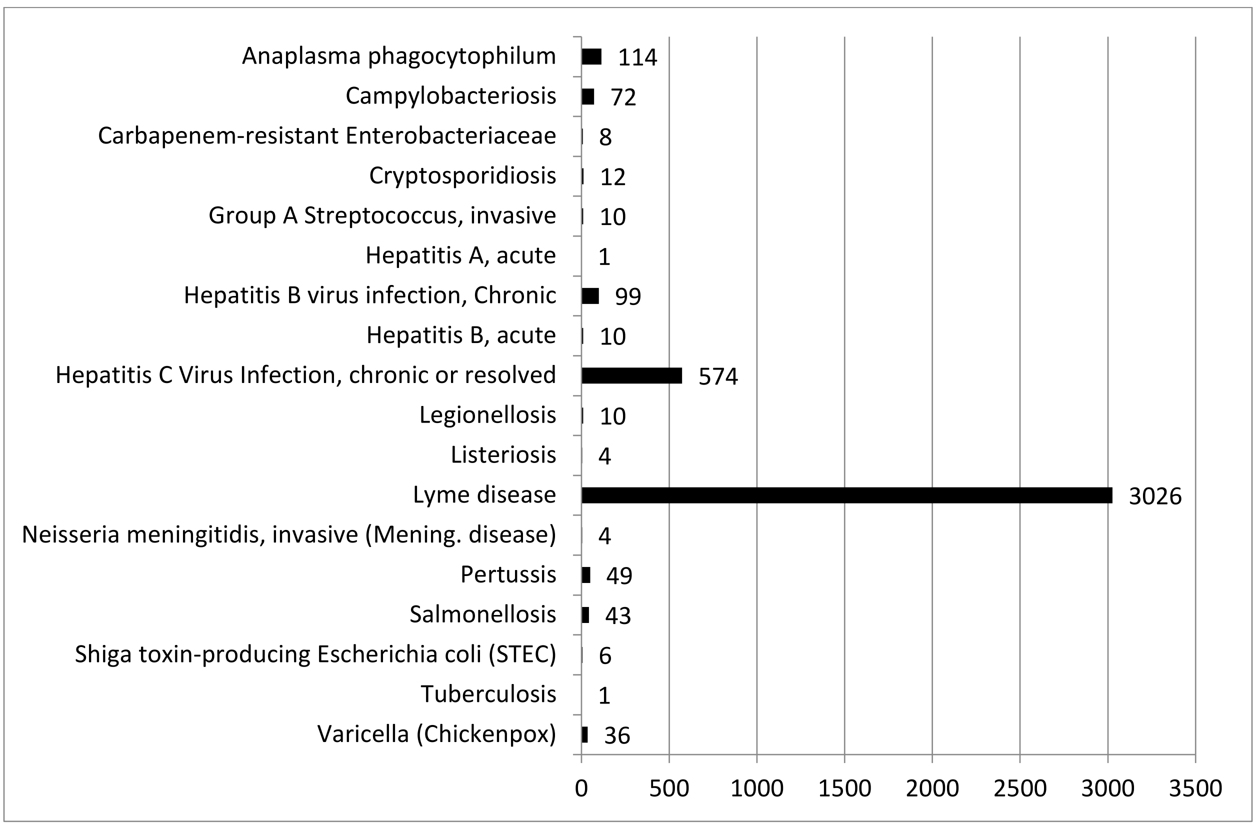
1. Descriptions

Infectious diseases are caused by bacterial infections, viruses, fungi and other organisms that can spread through the human 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 Village.

Figure 4. Disease cases in Bennington County from 2006 to 2015. Source: Chelsea Dubie, Vermont Department of Health



3. Extent and Location

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

4. Probability, Impact and Vulnerability

Given past history, there is a low probability of a disease affecting a large portion of the Village, but high probability of continued, isolated occurrences.

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 19 below.

Table 19. Vulnerability assessment factors (Vermont Hazard Mitigation Plan 2014)
Frequency of Occurrence: Probability
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 <100% probability per year, at least 1 chance in next 10 years
4 = Highly Likely 100% probability in a year
Warning Time: Amount of time generally given to alert people to hazard
1 = More than 12 hours
2 = 6–12 hours
3 = 3–6 hours
4 = None–Minimal
Geographic Area Affected: How large an area would likely be affected?
1 = Community-wide
2 = State-wide
3 = Region-wide
Potential Impact: Severity and extent of damage and disruption
1 = Negligible Isolated occurrences of minor property damage, minor disruption of critical facilities and infrastructure, and potential for minor injuries
2 = Minor Isolated occurrences of moderate to severe property damage, brief disruption of critical facilities and infrastructure, and potential for injuries
3 = Moderate Severe property damage on a neighborhood scale, temporary shutdown of critical facilities, and/or injuries or fatalities
4 = Major Severe property damage on a metropolitan or regional scale, shutdown of critical facilities, and/or multiple injuries or fatalities

B. Priority Hazards

As can be seen in Section IV, the planning team undertook an exhaustive assessment of hazards that could affect the Village of Manchester. They then scored those hazards based on the criteria in Table 19 to determine for which hazards actions would be needed. Table 20 shows the results of the scoring, with <u>Flood and Flash Floods, Winter Storms, High Wind Events, Drought, Hazardous Materials Spills, Infectious Diseases and Invasive Species</u> ranked highest. Geographic area affected and potential impacts were key criteria in determining whether or not 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 20. Vulnerability assessment

Hazard	Number of Events	Frequency of Occurrence	Geographic Area Affected	Warning Time	Potential Impacts	Total Score
Floods and Flash Floods	49 events from 1996 to 2014	3	3	2	3	11
Winter Storms	135 events from 1996 to 2014	4	3	1	3	11
High Wind Events	109 events from 1996 to 2014	3	1	3	3	10
Hail	20 events from 1996 to 2015	2	1	4	1	8
Temperature Extremes	Annual >90 F – 1 day on average Annual maximum <32 F – 55 days Annual minimum < 32 F – 172 days	1 (>90 F) 4(<32 F)	2	1	1	5 (>90 F) 8 (<32 F)
Drought	Severe droughts have occurred in 25 years from 1895 to 2014	3	3	1	2	9
Wildfire	Nearly all of the Village has a low potential for wildfire	1	1	4	1	7
Landslides and Debris Flows	No records	1	1	4	1	7
Earthquake	No events causing damage	1	3	4	2	10
Hazardous Materials Spills	Ten minor spills within the Village	1	1	4	2	8

Table 20. Vulnerability assessment						
Hazard	Number of Events	Frequency of Occurrence	Geographic Area Affected	Warning Time	Potential Impacts	Total Score
Infectious Disease Outbreak	Annual	3	3	1	3	10
Invasive Species	Ongoing	3	3	1	2	9

Map 10 is a composite map showing special flood hazard areas, river corridors, roads with medium or high erosion potential, damages documented during Tropical Storm Irene, and areas identified by the planning team as vulnerable to hazards. Other priority hazards such as invasive species or infectious diseases could not be mapped, because adequate surveys have not been completed, or they could affect the entire towns.

VI. Mitigation Measures

A. Hazard Mitigation Goals

As part of the planning process, the Village 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 so as to minimize impacts to rivers, water bodies and other natural features, historic structures, and neighborhood character.
5. Increase the economic resiliency of Manchester 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 Village Plan, Capital Improvement Plan, and Village Basic Emergency Operation Plan
7. Ensure that members of the general public continue to be part of the hazard mitigation planning process.

B. 2005 Hazard Mitigation Plan

The Village of Manchester did not adopt the 2005 Bennington County multi-jurisdictional plan. However, the Town of Manchester was one of 13 jurisdictions in the county that adopted the plan, and the Town includes the Village with respect to many services. Manchester identified hazardous materials, power shortage/failure, winter storm/ice storm, high wind, earthquake, highway transport accidents, school safety issues and tornadoes as their worst threats. Table 21 below lists actions identified in that plan.

Table 21. Mitigation actions listed in the 2005 Bennington County Multijurisdictional Hazard Mitigation Plan Annex for Manchester

Priority Score	Mitigation Action	Who Is Responsible	Approximate Time Frame & Potential Funding Sources	Initial Implementation Steps
33	Update Rapid Response Plan at least annually	Select Board & Emergency Management Director	• Short Term • Local Resources	Technical assistance from BCRC
29	Upgrade flood drainage structures	Select Board w/ support from Road Foreman	• Short to Long Term • Local & State Resources • PDM-c Funds	Conduct "needs assessment"; Technical assistance from BCRC & VEM
28	Flood-proof structures located in Flood Hazard Areas	Select Board, Other Agencies, Community	• Med. to Long Term • Local & State Resources • PDM-c Funds	Conduct assessment & explore options

While the Village did not formally adopt the 2005 plan, the Town of Manchester did, and the above table lists priorities that could conceivably have covered the Village as well. The Village priorities remain the same with respect to the Local Emergency Operations Plan and flooding. Additional actions have been developed for other natural hazards.

The Town annually updates their Local Emergency Operations Plan which covers the Village. Since 2005, the Village and the Town have been actively improving culverts and bridges as well as addressing stormwater management areas. The vulnerability assessment in this plan addresses the same impacts from the priority natural hazards as the 2005 plan. The main change has been a low ranking for earthquakes as a hazard, based on information assessed in this plan. The actions to upgrade flood drainage structures and to work with landowners to flood proof structures are retained as actions in this plan.

The Village of Manchester joined the National Flood Insurance Program (NFIP) on June 5, 2013. There are three polices in effect. There are no repetitive loss properties in Manchester. The Town and the Village will continue to support flood proofing, and this action will be retained if structures needing flood proofing are identified. As discussed above and shown in Map 3, most of the historic development in the Village of Manchester is located so very limited areas are subject to periodic flooding.

C. Village Plan of Development

The Village's Plan of Development (2016) includes goals for the prohibition of developments that would adversely affect special resource areas or unique natural features, not including lands with development limitations for density calculations, protecting prime agricultural lands and ridges and mountaintops, focusing land protection on the Batten Kill, and protecting ground and surface water resources. As shown in Map 3, development should be concentrated in the current core, along Main Street (Route 7A) with reduced density in areas beyond and finally a forested area where only forest, hunting and recreational uses are permitted.

D. State and Regional Plans and Programs

1. Vermont Hazard Mitigation Plan (2013)

The Vermont Hazard Mitigation Plan (2013) identified a series of hazards shown in Table 22 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. The Village plan tracks the state plan except some hazards are combined and a few, including nuclear plant accident, were not considered.

Table 22. Comparison of hazards considered in the Vermont State Hazard Mitigation Plan vs. the Village of Manchester Hazard Mitigation Plans

VT Hazard Mitigation Plan	Village of Manchester Hazard Mitigation Plan
Atmospheric Hazards	**Natural Hazards**
Drought	Drought
Earthquake	Earthquake
Flooding	Flooding and Fluvial Erosion
Fluvial Erosion	See Flooding and Fluvial Erosion
Hail	Hail
High Winds	High Winds
Hurricane/Tropical Storm	See High Winds and Flooding and Fluvial Erosion
Ice Storm	See Severe Winter Weather/Ice Storm
Ice Jams	See Flooding and Fluvial Erosion
Infectious Disease Outbreak	Infectious Disease Outbreak
Landslide/Debris Flow	Landslide/Debris Flow
Severe Thunderstorm	See High Winds and See Flooding and Fluvial Erosion
Severe Winter Weather	Severe Winter Storms
Temperature Extremes	Temperature Extremes
Tornado	See High Winds
Wildfire	Wildfire
Technological Hazards	**Technological Hazards**
Dam Failure	See Flooding and Fluvial Erosion
Hazardous Materials Spill	Hazardous Materials Spill
Invasive Species	Invasive Species

Table 22. Comparison of hazards considered in the Vermont State Hazard Mitigation Plan vs. the Village of Manchester Hazard Mitigation Plans	
VT Hazard Mitigation Plan	Village of Manchester Hazard Mitigation Plan
Nuclear Power Plant Accident	Not addressed
Rock Cuts	See Landslide
Terrorism	Not addressed

The Vermont Hazard Mitigation Plan identified flooding and fluvial erosion, winter storms, high winds and severe thunderstorms as high risk for Bennington County and radiological accident risk and hazardous materials spills as moderate risk.

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

The Bennington Regional Plan lists a series of policies and actions supporting hazard mitigation including several policy recommendations emphasizing protecting natural resources, maintaining village and urban centers and avoiding development on sensitive lands including areas of steep slope and wetlands along with the protection of surface and groundwater resources and forested lands (Sections VII and VIII). The regional plan also includes a flood resilience section (IX) as required by Vermont statute that identifies 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 has worked with Manchester 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 permit applications for development within the special flood hazard area. VT ANR also reviews permit applications for stream alterations or regulated activities within wetlands as well as permitting for transporting hazardous materials.

4. 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.

5. Other Organizations

Phase I and II geomorphic assessments and a river corridor plan (Field 2007) have been completed for the Batten Kill listing restoration actions. These were integrated into the Batten Kill Walloomsac Hoosic Tactical Basin Plan (Vermont Agency of Natural Resources 2016). The Bennington County Regional Commission, Bennington County Conservation District, The Batten Kill Watershed Alliance and Vermont Agency of Natural Resources have been working to implement the actions in the river corridor plan.

E. Current Programs Supporting Mitigation

The Village of Manchester joined the National Flood Insurance Program in 2013. The community report (available via floodready.vermont.gov/) indicates there are nine buildings in the Special Flood Hazard Area and three flood insurance policies. The Village of Manchester adopted a revised zoning ordinance in 2015 which:

- prohibits new primary structures and selected other uses in the floodway
- permits development outside of the floodway, including within other areas of the special flood hazard area or river corridor by conditional use permit
- prohibits development within 70 feet of the top of bank of any stream, except by conditional use permit
- prohibits development that might negatively impact groundwater within the Aquifer Protection Area
- limits uses in the Forest District to silvicultural uses and hunting camps to maintain forested lands

F. Village Capabilities

The Village receives a number of services from the Town of Manchester, including fire and police protection and water and sewer systems. The Town has a large staff compared to most towns in Bennington County, with a Town manager, zoning administrator, economic development director, public works department, and water and sewer boards. The Village has a Board of Trustees, a Planning Commission, a Development Review Board, and a staff consisting of the Road Foreman/Road Commissioner, Administrative Officer, Village Clerk and an Assistant Clerk/Secretary to the Board of Trustees.

Table 23 below summarizes Village capabilities and areas needing improvement to enhance those capabilities.

Table 23. Capabilities of the Village of Manchester			
Plans, Policies, Ordinances	Description/Responsible Agent	Effectiveness	Improvements Needed
Village Plan of Development	Planning Commission; Board of Trustees	High effectiveness; Updated Village Plan addresses Emergency Management	Update and improve Plan of Development as required.
Local Emergency Operations Plan (LEOP)	Town of Manchester Emergency Manager Director; Village Road Foreman; Board of Trustees	Needs some improvements and updates	Update and improve LEOP annually,
Flood Hazard Ordinance	Administrative Officer; (permitting); Board of Trustees	High effectiveness; flood hazard regulations adopted (2014)	Continue to monitor FEMA regulations and new local flood hazards.
Zoning/Subdivision Regulations	Planning Commission; Development Review Board; Administrative Officer(permitting); Board of Trustees (approval of bylaws)	Effective	Review Bylaws due to recently adopted Plan; continued training of volunteer board members and Administrative Officer to ensure effective permitting
Wetlands/Rivers and Streams/Waterbodies/Steep Slopes/Groundwater Protection Regulations	Planning Commission; Development Review Board; Administrative Officer (permitting); Board of Trustees (approval of bylaws)	Effective; Village requires 70-foot setback from stream bank	Review Bylaws due to recently adopted Plan; continued training of volunteer board members and Administrative Officer to ensure effective permitting
Building Codes	State of Vermont (commercial only); Administrative Officer (certain building codes in flood hazard zones)	Commercial building codes overseen by State of Vermont, Department of Public Safety	Village does not oversee building codes for residential structures.
Water/Sewer Facilities (Town)	Town Water and Sewer Superintendent; Town engineer; Town Manager; Sewer Board and Water Board	Effective	New Town Water and Sewer Ordinance was expected to be enacted in 2016, but is pending; Town to purchase back-up portable generator for water well and sewer lagoon pumps; update water 4" mains to increase fire protection.
Road Maintenance Programs and Standards	Road Foreman; Road Foreman/Commissioner, Board of Trustees	Effective; Village adopted most recent State of Vermont (AOT) road and bridge standards	
Events Management	Administrative Officer (permitting) Emergency Management; Town Police Department	Village special events applicants address emergency planning	Special Events Ordinance was enacted in 2016

Table 23. Capabilities of the Village of Manchester			
Plans, Policies, Ordinances	Description/Responsible Agent	Effectiveness	Improvements Needed
School Emergency Response	School administrators; Town Emergency Management Director and Emergency Management Coordinator; Fire Chief; Police Chief	Varies from school to school; needs some improvements	Update and review school emergency plans
Vulnerable Populations	Town Emergency Management Director and Emergency Management Coordinator; Health Officer	Needs some improvements and updates	Map and catalog vulnerable populations; review Emergency Management plans for school, medical facilities, senior housing facilities; train emergency personnel on response to vulnerable populations; continuing training of Town Health Officer
Mobile Homes	The Village has no mobile homes		

G. Mitigation Actions

Table 25 below lists mitigation actions for each of the priority hazards: floods and flash floods, winter storms, high wind events, drought, hazardous materials spills, infectious disease outbreaks and invasive species. Some will be implemented by the Village of Manchester and others by agencies such as the Vermont Agency of Transportation. Mitigation actions are listed by the type of hazard. Table 24 lists the criteria 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. Prior to the implementation of any action, a benefit-cost analysis would be completed to assure the action would be feasible and cost-effective.

Table 24. Ranking of mitigation actions

Criteria	Ranking (score in parentheses)
Potential vulnerability from hazard	High (3): risk assessment score Medium (2): risk assessment score Low (1): risk assessment score
Potential protection of life and degree of reduction in damage by action	High (3): greater than 50% reduction in estimated damage, loss of life or injury Medium (2): 25-50% reduction in estimated damage, loss of life, or injury Low (1): less than 25% reduction in estimated damage, loss of life or injury
Consistency of the action with Village goals and plans	High (3): goals are consistent with existing Village plans Low (1): goals are inconsistent with existing Village plans
Degree of technical feasibility of the proposed action	High (3): project is technically feasible Low (1): feasibility is low
Implementation costs	High (3): project could be implemented for less than $25,000 Medium (2): project would cost between $25,000 and $100,000 Low (1): project costs would exceed $100,000
Ability of the Village to implement the proposed action in terms of administrative capability and legal authority	High (3): Village has current capability to implement the action Medium (2): Village would need to expand capability while implementing action through contractors or additional staffing Low (1): Village would need extensive assistance to implement action
Degree of local support for the action	High (3): the community supports the proposed action Low (1): the project is opposed in the community
Potential costs to natural systems of implementing the action	High (3): natural systems would not be affected, would be enhanced by the action or be affected to a minimal degree Medium (2): natural systems would be affected by impacts that could be mitigated or reduced Low (1): natural systems would be negatively impacted and those impacts could not be mitigated or reduced

Table 24. Ranking of mitigation actions	
Criteria	Ranking (score in parentheses)
Potential costs to cultural resources of implementing the action	High (3): cultural resources would not be affected Medium (2): cultural resources would be affected by impacts could be mitigated or reduced Low (1): cultural resources systems would be negatively impacted and those impacts could not be mitigated or reduced
Potential costs to social and economic resources of implementing the action	High (3): social and economic resources would either be unaffected or enhanced by the project Medium (2): economic and social resources would be affected by impacts could be mitigated or reduced Low (1): economic and social resources would be negatively impacted and those impacts could not be mitigated or reduced

Table 25. Mitigation Actions. Type is based on categories in FEMA 2013						
Hazard	Type	Action	Responsible Party	Time Frame	Funding Source(s)	Priority
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	Village Development Review Board	2017 to 2022	Village General Fund	High
All Hazards	Local Planning and Regulations	Build economic development capacity as recommended in the Northshire Economic Development Strategy	Village Board of Trustees	2017-2019	Village General Fund	Medium
All Hazards	Local Planning and Regulations	Integrate this Hazard Mitigation Plan into the Village Plan of Development, the Local Emergency Operations Plan and Budgeting and Capital Improvements Plans	Village Planning Commission	2017-2019		Medium
Floods and Flash Floods	Local Planning and Regulations	Adopt and enforce updated flood hazard and river corridor protection zone bylaws	Village Administrative Officer	2017-2019		High
Floods and Flash Floods	Local Planning and Regulations	Participate in the Community Rating System to help reduce flood insurance premiums for residents and businesses	Village Board of Trustees	2017 to 2019	Village General Fund	High
Floods and Flash Floods	Local Planning and Regulations	Encourage appropriate stormwater and erosion control measures in new developments	Village Development Review Board	2017-2019		
Floods and flash floods	Local Planning and Regulations	Adopt the latest Vermont Town Road and Bridge Standards	Village Board of Trustees	2017 to 2022 and as updated	Village General Fund	High
Floods and Flash Floods	Local Planning and Regulations	Inventory roads for stormwater mapping as part of the Vermont Stormwater program	Village Road Foreman BCRC	2017 to 2020	VT Better Roads Village General Fund	High
Floods and Flash Floods	Local Planning and Regulations	Complete village-wide stormwater management plan in accordance with the Vermont Stormwater Manual	Village Road Foreman BCRC	2017 to 2020	VT Better Roads Village Highway Fund	High
Floods and Flash Floods	Local Planning and Regulations	Map stormwater system	Vermont DEC	2017 to 2018	State funding	High

Table 25. Mitigation Actions. Type is based on categories in FEMA 2013						
Hazard	Type	Action	Responsible Party	Time Frame	Funding Source(s)	Priority
Floods and Flash Floods	Local Planning and Regulations	Update culvert inventory	Village Road Foreman BCRC	2017 to 2018	Village Highway Fund VT Better Roads funding	High
Floods and flash floods	Natural Systems Protection	Identify possible acquisition of wetlands and special flood hazard areas to assure natural systems protection	Village Board of Trustees BCRC	2018 to2021	Village General Fund Municipal Planning Grant	Low
Floods and flash floods	Natural Systems Protection	Complete inventory of road network to assess whether road segments connected to surface waters through ditches, culverts or other drainage structures meet the new stormwater standards currently under development by the DEC Municipal Roads Program	Village Road Foreman	2017 to 2018	Village Highway Fund VT Better Roads	High
Floods and flash floods	Natural Systems Protection	Develop a long-term plan to bring all sections of connected roads to revised standards as part of the Municipal General Permit.	Village Road Foreman	2017 to 2019	Village Highway Fund VT Better Roads	High
Floods and Flash Floods	Natural Systems Protection	Implement stormwater management projects identified as part of the Municipal General Permit planning	Village Road Foreman Bennington County Conservation District, BCRC	2018 to 2021 and beyond	Village Highway Fund State funding FEMA HMGP, PDM, FMA	High
Floods and flash floods	Structure and Infrastructure projects	Road crew should regularly survey culverts for blockages including photographs and records of damages and costs	Village Road Foreman	2017 to 2022 (ongoing)	Village Highway Fund	High
Floods and flash floods	Structure and infrastructure protection	Encourage property owners in flood or fluvial erosion hazard zones to consider selling their properties (buy out) or implementing flood proofing including elevating structures	Village Board of Trustees	2017 to 2022 (ongoing)	FEMA HMGP, PDM, FMA	High

Table 25. Mitigation Actions. Type is based on categories in FEMA 2013						
Hazard	Type	Action	Responsible Party	Time Frame	Funding Source(s)	Priority
Floods and flash floods	Structure and infrastructure protection	Implement corridor protection, buffer plantings, structure and berm removal and other projects listed in the Batten Kill-Walloomsac-Hoosic Tactical Basin Plan and, where applicable, in the 2007 Batten Kill corridor plan (Field 2007) and in the	Village Board of Trustees; Batten Kill Watershed Alliance Basin Planning Team	2017 to 2022 (ongoing)	FEMA HMGP, FMA, PDM Vermont Ecosystem Restoration Program, Vermont Watershed Grant	High
Floods and flash floods	Structure and infrastructure projects	Identify and replace culverts and bridges that do not meet current Vermont Town Road and Bridge Standards	Village Road Foreman	2017 to 2022 (ongoing)	Village Highway Fund State of Vermont AOT FEMA HMGP, PDM, FMA	High
Winter storms	Education and Outreach	Provide educational materials on sheltering in place and preparation for winter storms, including long-term power outages	Town Emergency Management Director	2017 to 2018	Town General Fund	Low
Winter storms	Education and Awareness	Provide educational materials for residents on methods to protect property from wind events	Town Emergency Management Director	2017 to 2018	Town General Fund FEMA HMGP, PDM, FMA	Low
Winter storms	Structure and Infrastructure Projects	Place utilities underground for critical facilities	Village Board of Trustees	2017 to 2019	FEMA HMGP, PDM, FMA	Medium
High wind events	Education and Outreach	Provide educational materials on sheltering in place and preparation for winter storms, including long-term power outages	Town Emergency Management Director	2017 to 2018	Town General Fund	High

Table 25. Mitigation Actions. Type is based on categories in FEMA 2013						
Hazard	Type	Action	Responsible Party	Time Frame	Funding Source(s)	Priority
High wind events	Local Planning and Regulation	Encourage protection and planting of wind breaks in new developments	Village Development Review Board; Village Administrative Officer	2017 to 2019	Village General Fund	Medium
High wind events	Structure and Infrastructure Projects	Retrofit existing buildings to withstand high winds including protection of power lines and other utilities	Village Board of Trustees; Private Owners	2017 to 2022 (ongoing)	FEMA HMGP, PDM	Low
High wind events	Structure and Infrastructure Projects	Place utilities underground for critical facilities	Village Board of Trustees Private Owners	2017 to 2019	FEMA HMGP, PDM	Low
Drought	Local Planning and Regulation	Monitor drought conditions	Town Emergency Management Director	2017 to 2022 (ongoing)	Town General Fund	Medium
Drought	Natural System Protection	Develop improved assessment of groundwater sources and amend bylaws to ensure their protection	Vermont Geological Survey Village Planning Commission	2018 to 2020	FEMA HMGP, PDM State of VT	Medium
Drought	Local Planning and Regulation	Incorporate planning for droughts in the Local Emergency Management Plan	Town Emergency Management Director	2017 to 2019	Town General Fund	Medium
Hazardous materials spill	Local Planning and Regulation	Update 2012 assessment of hazardous materials and potential accident locations.	LEPC 7	2019 to 2021	VT DEC funds	High
Hazardous materials spill	Natural Systems Protection	Identify groundwater source areas and develop ordinances to protect those areas	Vermont Geological Survey	2017 to 2019	VT Geological Survey funds	Medium
Infectious disease outbreak	Local Planning and Regulations	Monitor disease occurrences and potential outbreaks, partnering with the VT Dept. of Health	Town Health Officer	2017 to 2022 (ongoing)	VT Dept. of Health	High

Table 25. Mitigation Actions. Type is based on categories in FEMA 2013						
Hazard	Type	Action	Responsible Party	Time Frame	Funding Source(s)	Priority
Infectious disease outbreak	Education and Outreach	Provide educational materials on potential infectious diseases	Emergency Management Director and Coordinator	2017 to 2020	Town General Fund /VT Dept. of Health	Medium
Invasive species	Local Planning and Regulations	Monitor extent of invasive species, particularly forest invasive species such as Emerald Ash Borer	BCRC Bennington County Conservation District	2017 to 2022 (ongoing)	FEMA HMGP, PDM, VFPR	Medium
Invasive species	Local Planning and Regulations	Complete surveys for ash trees vulnerable to Emerald Ash Borer in Village highway ROW	BCRC; Bennington County Conservation District	2016 to 2018	FEMA HMGP, PDM VT Dept. of Forests, Parks and Recreation	Medium
Invasive species	Local Planning and Regulations	Survey for invasive species (e.g., Japanese knotweed) along streams to identify potential erosion areas	Batten Kill Watershed Alliance; Conservation Commission, BCCD	2017 to 2019	VT Dept. of Parks, Forestry and Recreation	Medium
Invasive species	Local Planning and Regulations	Encourage use of native species in plantings for commercial and residential development	Village Development Review Board	2017 to 2022 (ongoing)	Village General Fund	Medium
Invasive species	Education and Awareness	Provide outreach materials for landowners on using native plants and controlling invasive species	Bennington County Conservation District	2017 to 2018	Village General Fund /VT Dept. of Parks, Forestry and Recreation	High

VII. Plan Maintenance

A. Annual Monitoring and Continued Public Involvement

Copies of this plan will be kept at the Village office and made available via the Village and BCRC website. The Board of Trustees 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 Village, including capital improvements. The Board of Trustees is responsible for developing a Village budget, which is approved during Village's Annual Meeting in July.

This plan will be integrated into existing planning efforts including any updates or revisions to the Village Plan as well as the annual 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 Village Plan, as they were used to develop this Hazard Mitigation Plan. The process of updating the Village Plan will incorporate the public involvement, agency review and adjacent town review requirements of Vermont statutes.

B. Plan Evaluation and Update

The Village of Manchester Board of Trustees will be responsible for serving as or creating 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 25 are implemented. In addition, the Village Trustees will annually evaluate the plan to assess if the goals are being achieved.

a) Prior to the Village Annual Meeting that occurs in the summer, the Village Board of Trustees will review each of the actions in Table 25 to determine their status. Status categories will include completed, in progress, scheduled, no progress.
b) The evaluation will be presented at the Annual 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 recommend updates to the Local Emergency Operations Plan, which is required annually, and which is completed by the Town of Manchester as well as to identify potential changes to other Village 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 the 2017 hazard 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 the 2017 hazard mitigation plan and the updated Village 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 the 2017 hazard mitigation 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 hazard mitigation plan into the Village of Manchester Village Plan of Development 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 Board of Trustees will work with the Bennington County Regional Commission and the State Hazard Mitigation Officer (SHMO) to review and update their 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, the Village of Manchester 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 findings of the river corridor plan, culvert study and other studies.

VIII. References

A. Literature and Reports

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B. Map Data Sources

The Vermont Center of Geographic Information provides data on transportation systems, the location of structures (E911), critical facilities, jurisdictional boundaries, and other information.

That data was used in all maps. Data from other sources were used in specific maps as noted below.

Map 1. Vermont Center for Geographic Information, http://geodata.vermont.gov
U.S. Department of Agriculture Geospatial Data Gateway for NAIP orthoimagery and topography, http://datagateway.nrcs.usda.gov/

Map 2. Vermont Center for Geographic Information, http://geodata.vermont.gov
National Land Cover Data originally from USGS.

Map 3. Vermont Center for Geographic Information, http://geodata.vermont.gov
U.S. Department of Agriculture Geospatial Data Gateway for NAIP orthoimagery and topography, http://datagateway.nrcs.usda.gov/
Data from the Bennington County Regional Commission

Map 4. Vermont Center for Geographic Information, http://geodata.vermont.gov
U.S. Department of Agriculture Geospatial Data Gateway for NAIP orthoimagery and topography, http://datagateway.nrcs.usda.gov/
Vermont Agency of Natural Resources Natural Resources Atlas, http://anrmaps.vermont.gov/websites/anra/

Map 5 Vermont Center for Geographic Information, http://geodata.vermont.gov
U.S. Department of Agriculture Geospatial Data Gateway for NAIP orthoimagery and topography, http://datagateway.nrcs.usda.gov/
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. Vermont Center for Geographic Information, http://geodata.vermont.gov
U.S. Department of Agriculture Geospatial Data Gateway for NAIP orthoimagery and topography, http://datagateway.nrcs.usda.gov/
Vermont Agency of Natural Resources Natural Resources Atlas, http://anrmaps.vermont.gov/websites/anra/
De Simone 2004, http://www.anr.state.vt.us/dec/geo/GwaterTownIndex.htm

Map 7. Vermont Center for Geographic Information, http://geodata.vermont.gov
U.S. Department of Agriculture Geospatial Data Gateway for NAIP orthoimagery and topography, http://datagateway.nrcs.usda.gov/
LANDFIRE Program, www.landfire.gov
Vermont Forest Resources Plan, http://anrmaps.vermont.gov/websites/sars_data/

Map 8. 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. Vermont Center for Geographic Information, http://geodata.vermont.gov, ESRI, and field data collected by the Bennington County Regional Commission (Quant 2016).

Map 10. Vermont Center for Geographic Information, http://geodata.vermont.gov
U.S. Department of Agriculture Geospatial Data Gateway for NAIP orthoimagery and topography, http://datagateway.nrcs.usda.gov/
Manchester Hazard Mitigation Planning Team, Village of Manchester Hazard Mitigation Planning Team, BCRC Data

C. Personal Communication Sources

Chelsea Dubie, M.Ed., Infectious Disease Epidemiologist, Vermont Department of Health, Chelsea.dubie@vermont.gov

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

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

George Springston, Norwich University, Northfield, VT, gsprings@norwich.edu

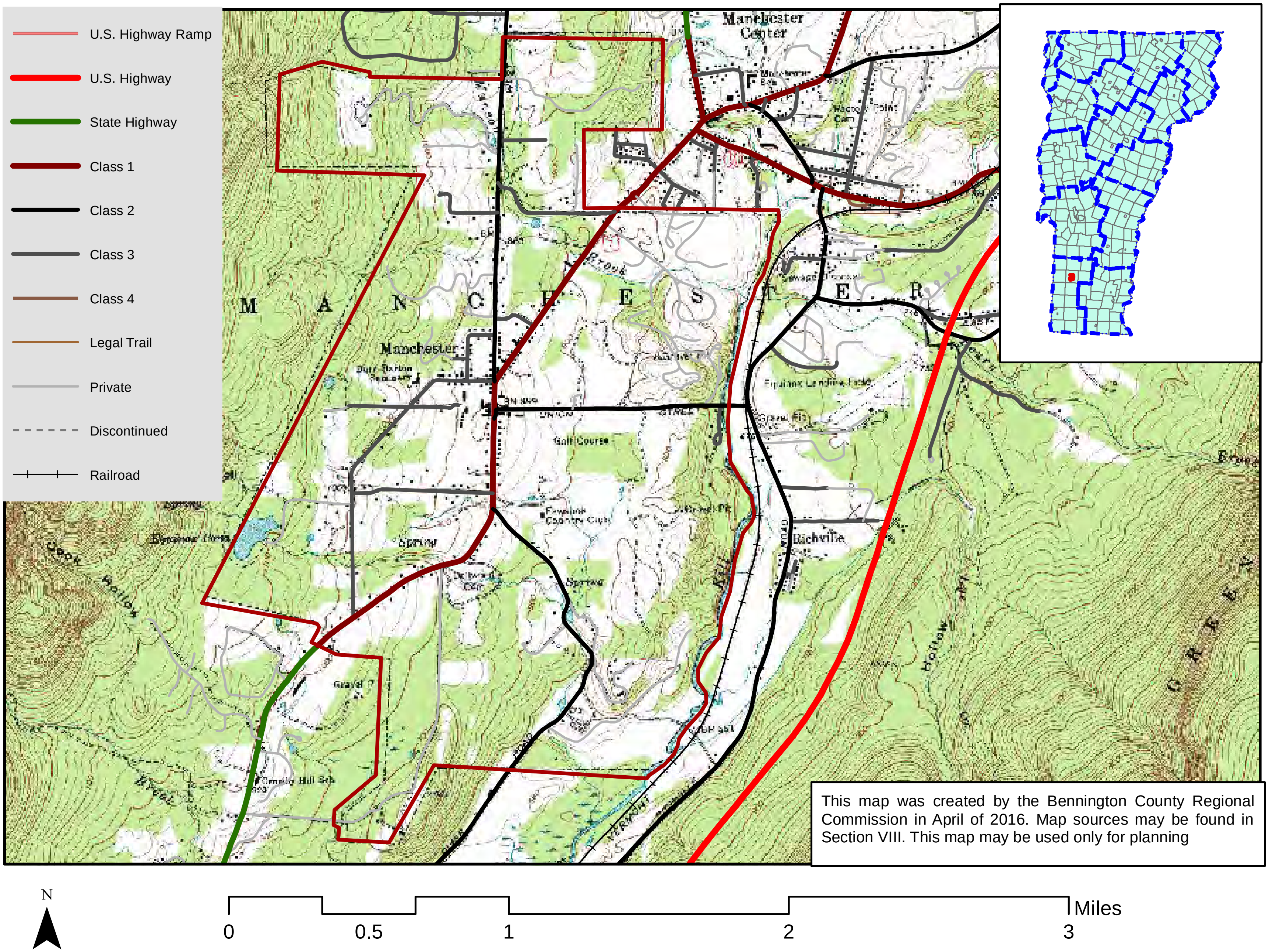
Rick Ladue, Equinox Preservation Trust Steward, rick@equinoxpreservationtrust.org

Appendix I. Comments Received

Comment: The Bennington County Conservation District noted an historic landslide on Mt. Equinox. ,.

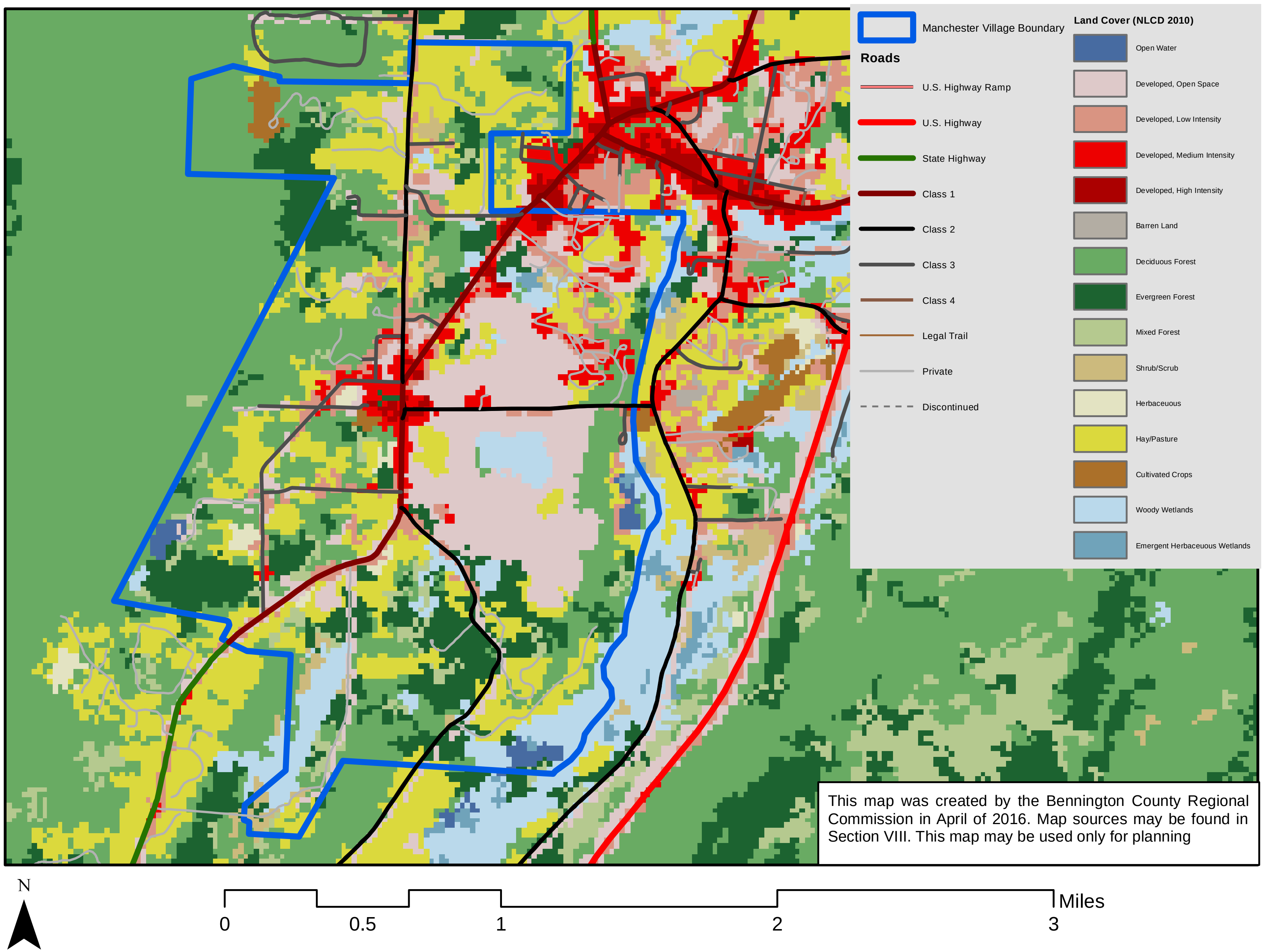
Response: This event was added to the discussion on past occurrences
There were some editorial and spelling suggestions. Otherwise, no other comments were received.

Map 1. Village of Manchester

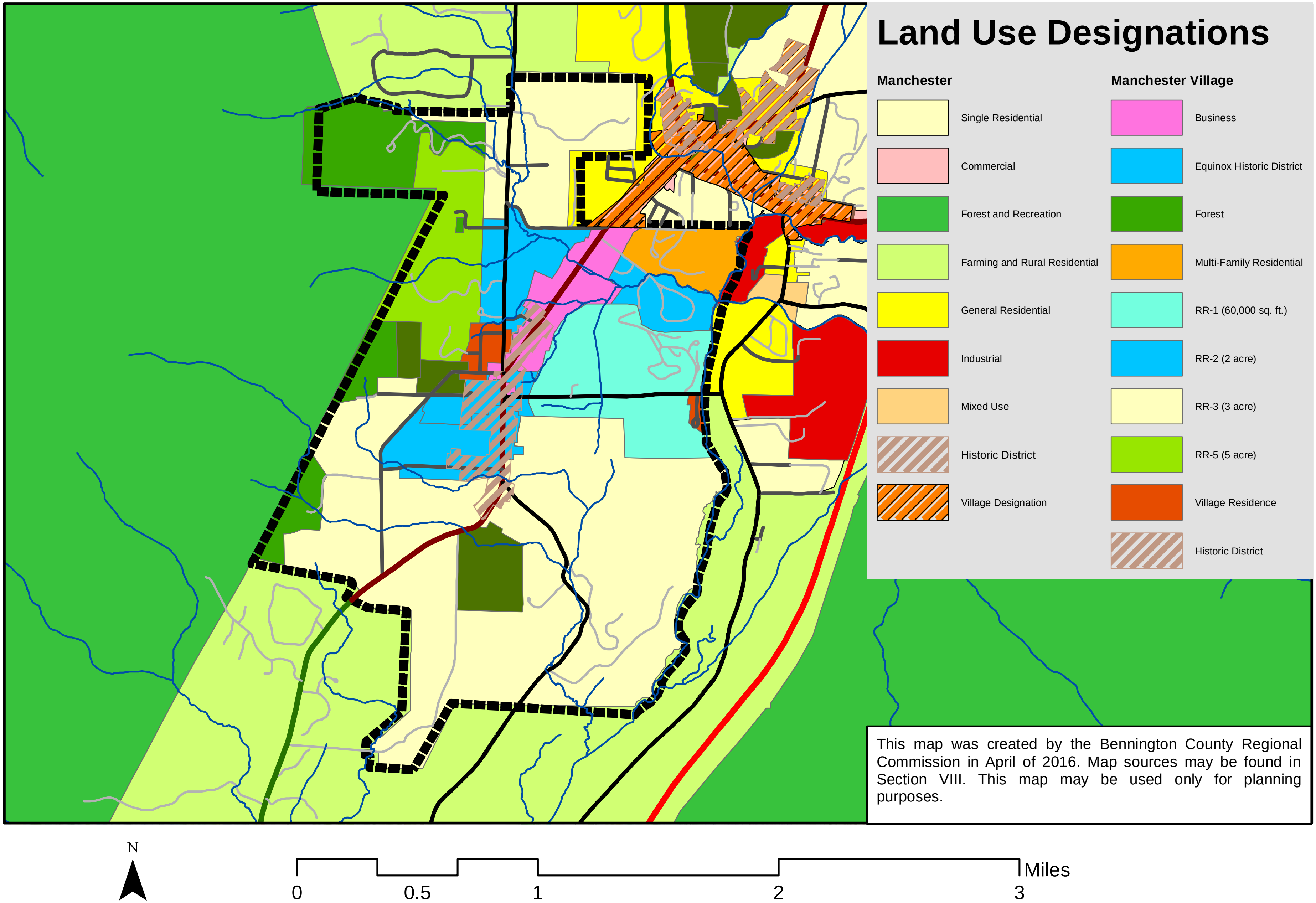


This map was created by the Bennington County Regional Commission in April of 2016. Map sources may be found in Section VIII. This map may be used only for planning

Map 2 Village of Manchester Land Cover

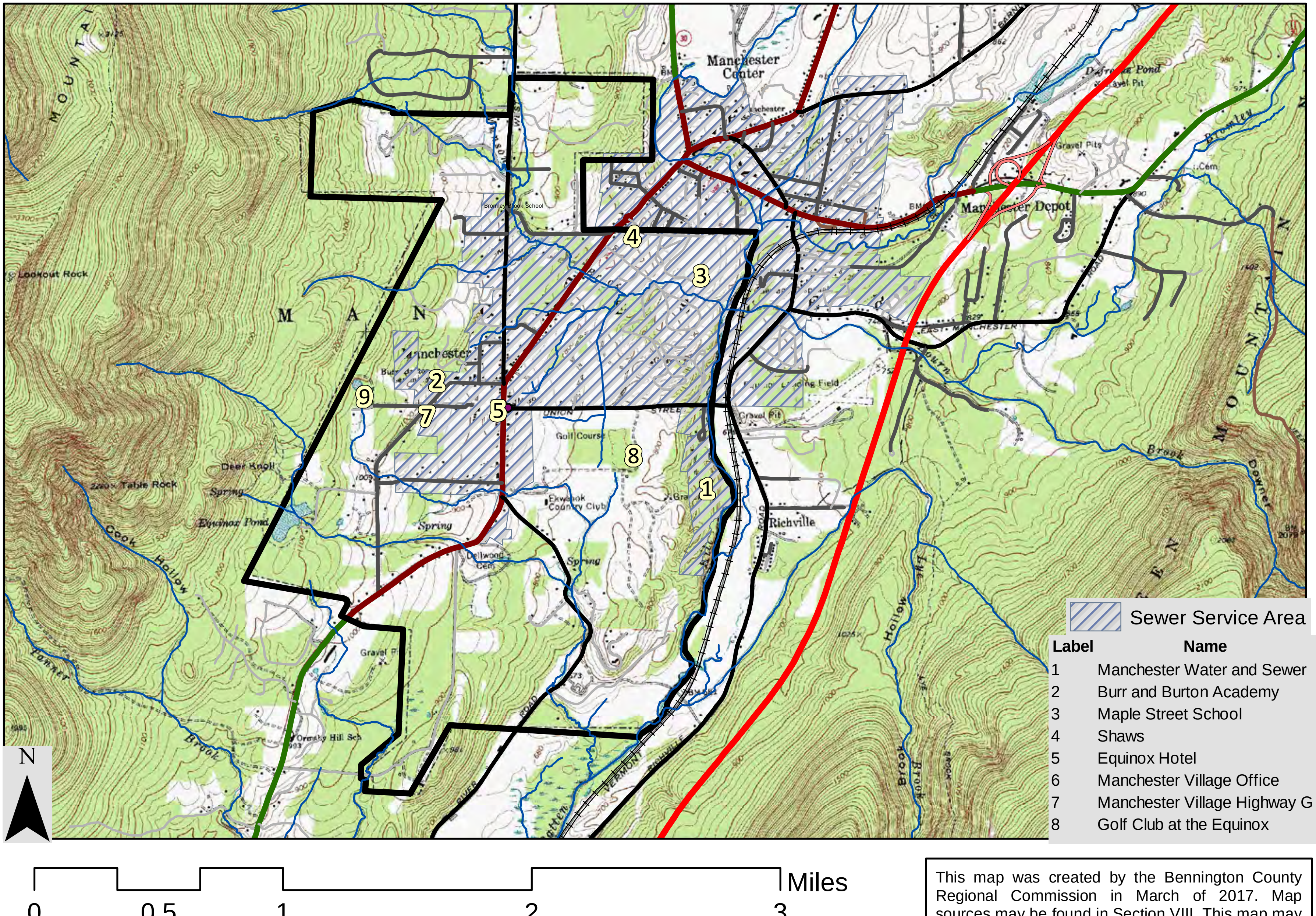


Map 3. Village of Manchester Land Use Designations



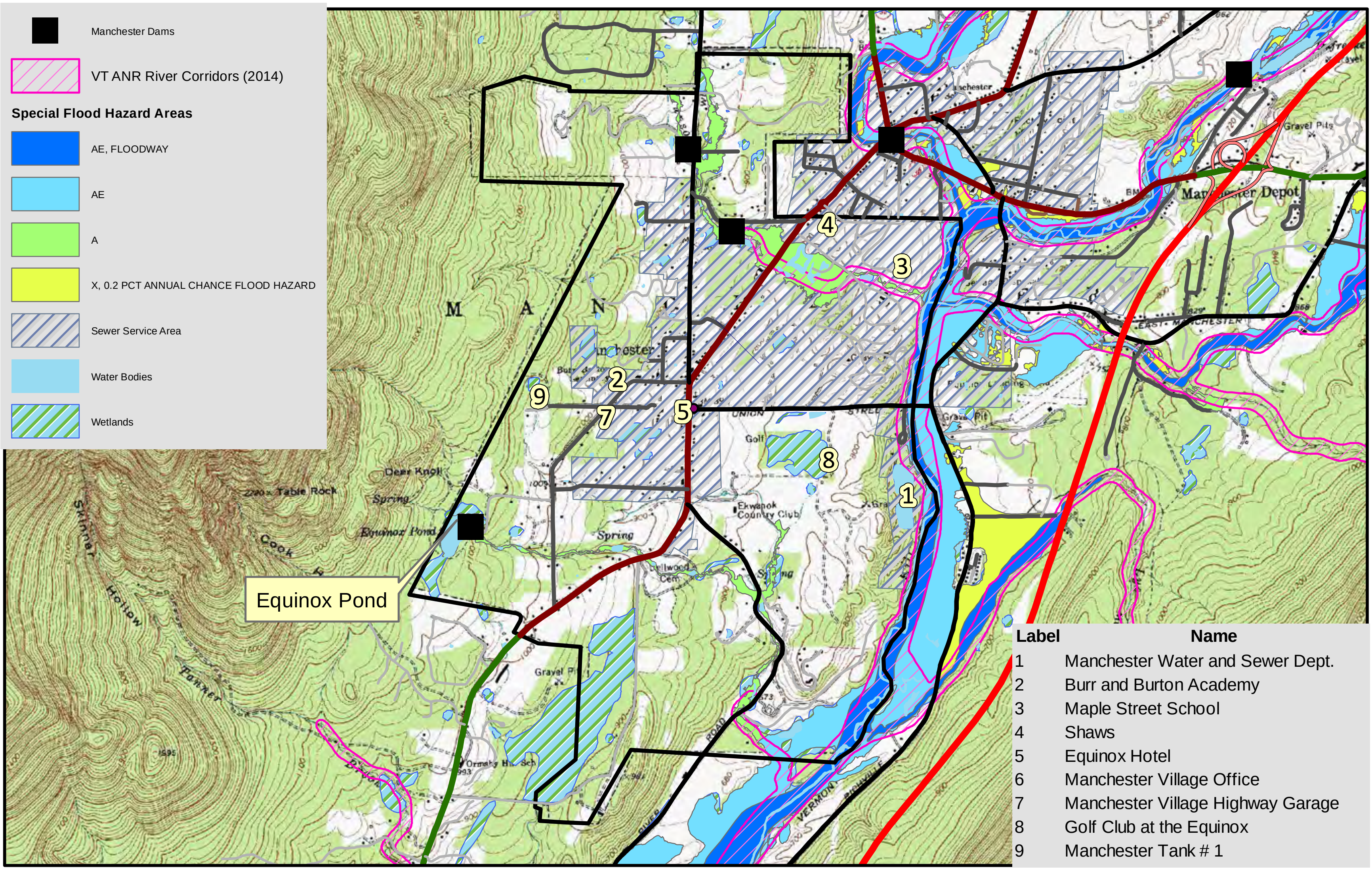
This map was created by the Bennington County Regional Commission in April of 2016. Map sources may be found in Section VIII. This map may be used only for planning purposes.

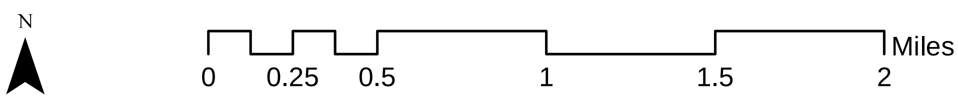
Map 4. Village of Manchester Critical Facilities



This map was created by the Bennington County Regional Commission in March of 2017. Map sources may be found in Section VIII. This map may be used only for planning purposes.

Map 5. Village of Manchester
Special Flood Hazard Areas and River Corridors



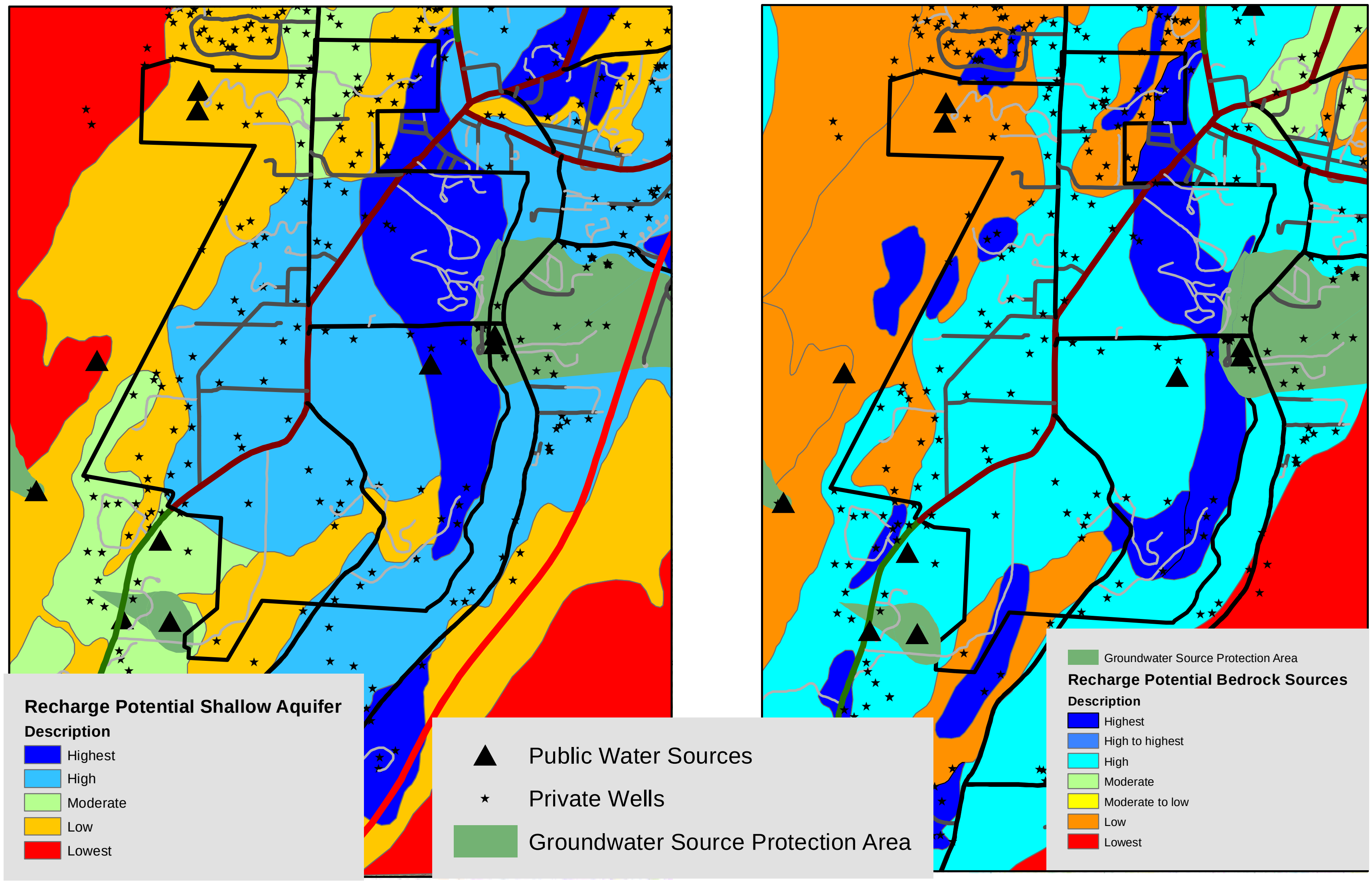


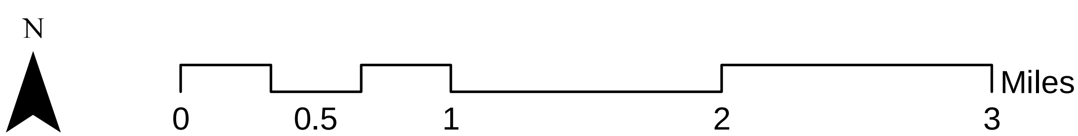
This map was created by the Bennington County Regional Commission in March of 2017. Map sources may be found in Section VIII. This map may be used only for planning

Map 6. Village of Manchester Groundwater Resources

Recharge Potential Shallow Aquifer

Recharge Potential Bedrock Aquifer



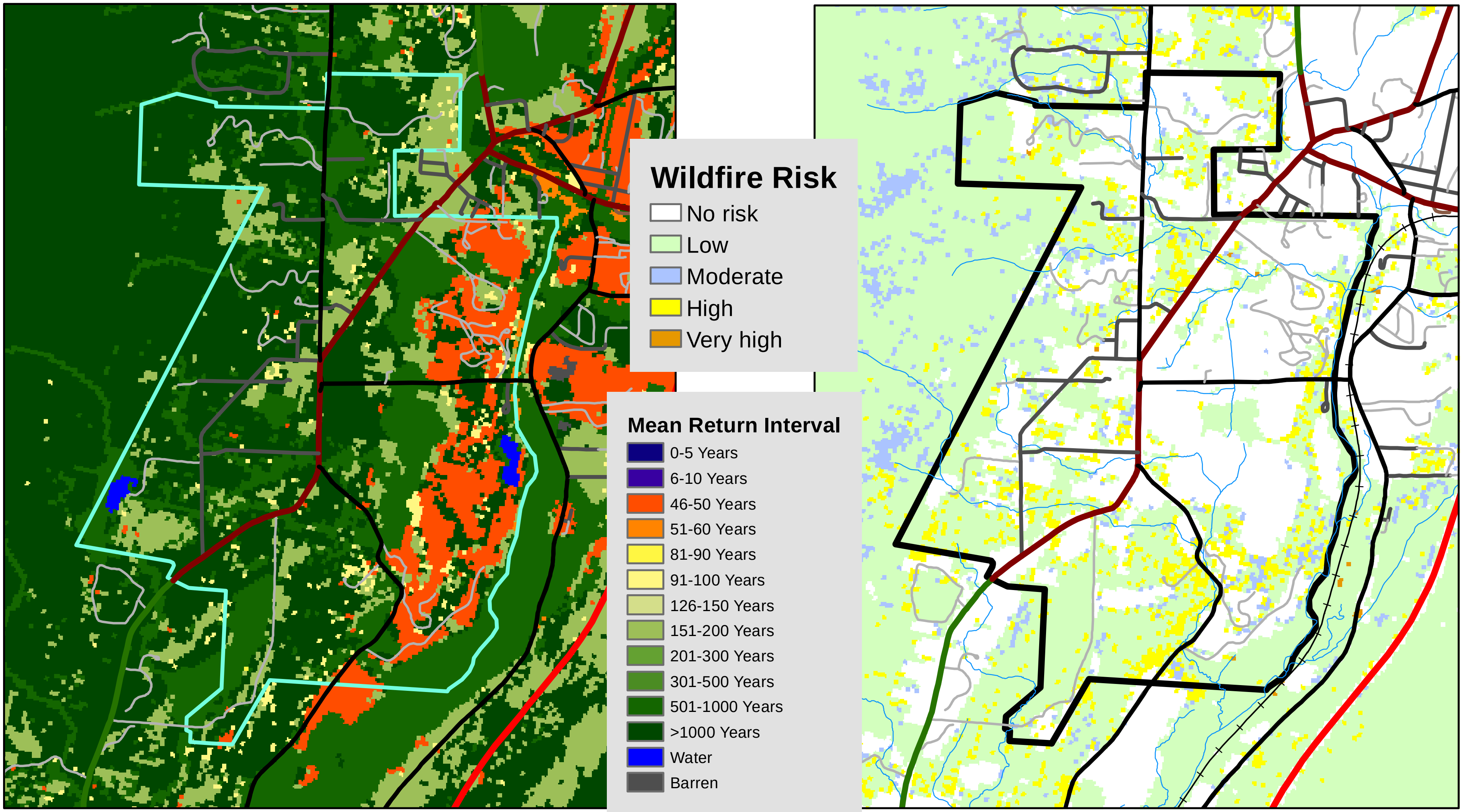


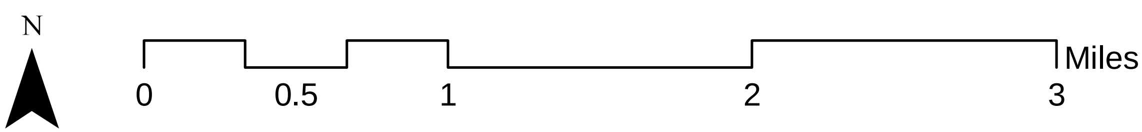
This map was created by the Bennington County Regional Commission in April of 2016. Map sources may be found in Section VIII. This map may be used only for planning

Map 7. Village of Manchester Wildfire Potential

Mean Fire Return Interval

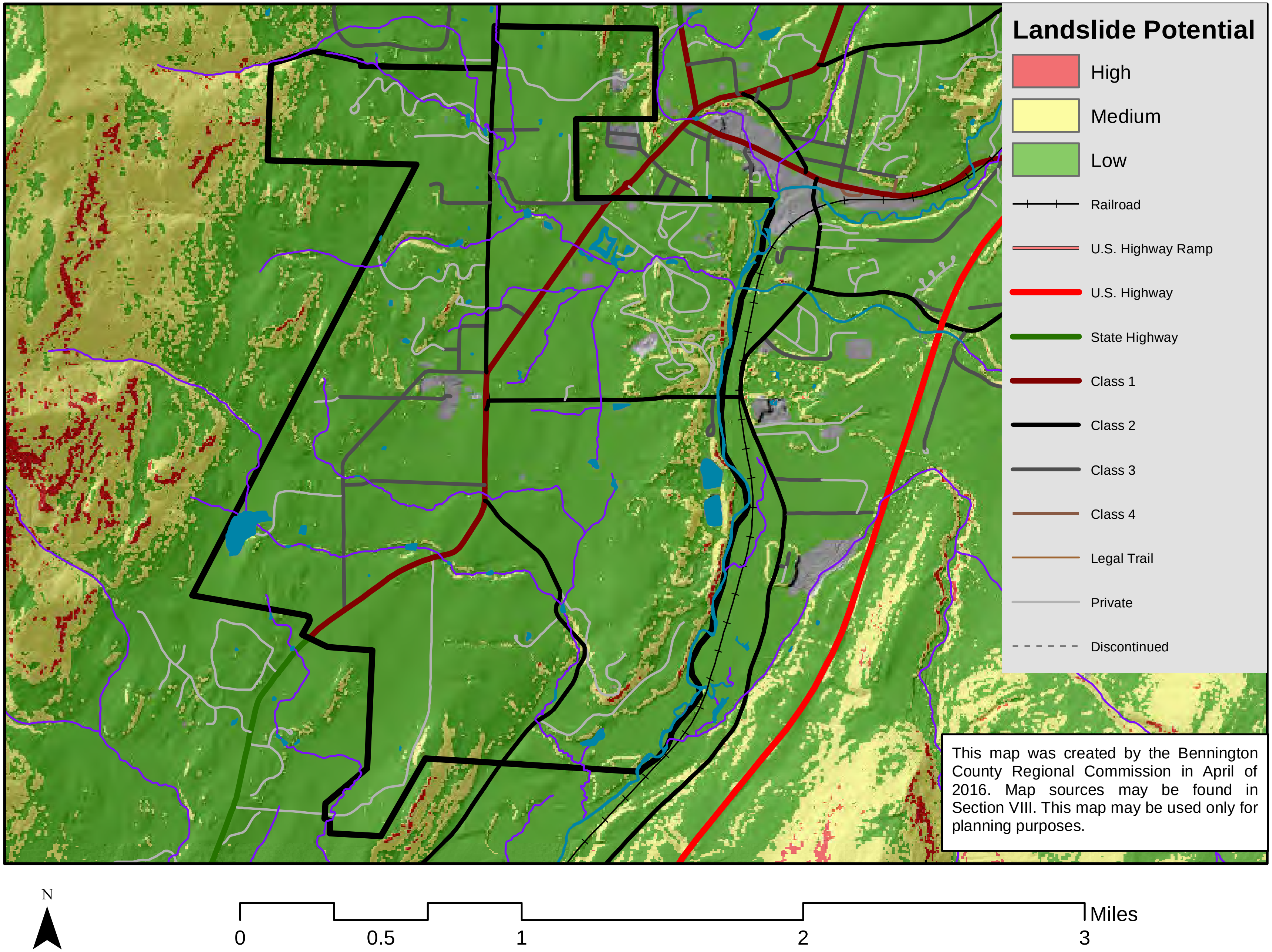
Wildfire Risk



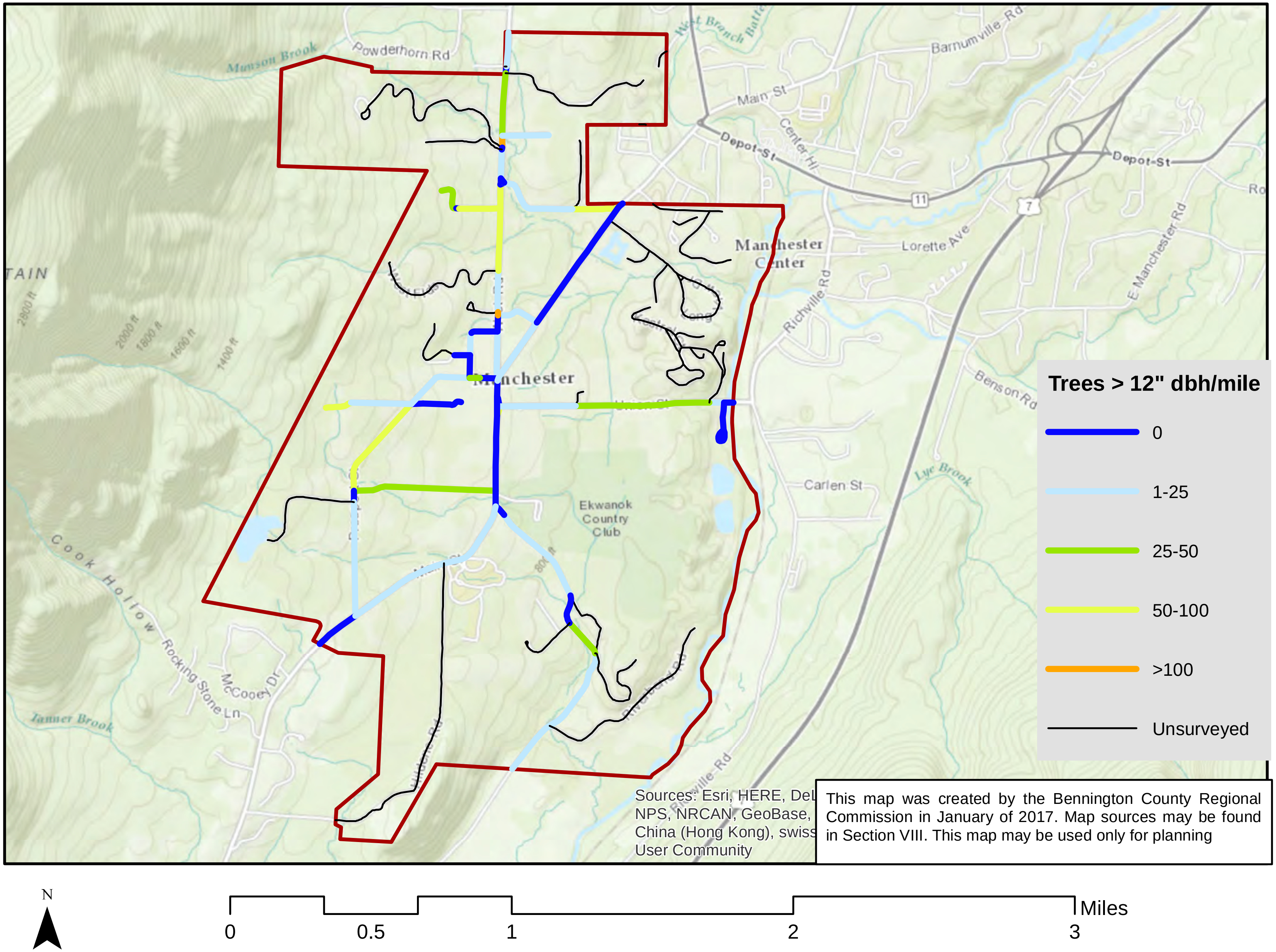


This map was created by the Bennington County Regional Commission in March of 2016. Map sources may be found in Section VIII. This map may be used only for planning purposes.

Map 8. Village of Manchester Landslide Potential



Map 9. Village of Manchester Ash Surveys



Map 10. Identified Vulnerable Areas in the Village of Manchester and Surrounds