

**Town of Warren, VT
Local Hazard Mitigation Plan Update
December, 2011**

Prepared by the Town of Warren and CVRPC

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3. Community Profile

Located in the southwestern corner of Washington County, the Town of Warren is 40.14 square miles and is bounded by the two other Mad River Valley Towns of Fayston and Waitsfield to the north, by Northfield to the east, and by the Addison County towns of Granville and Lincoln to the south and west respectively. The Village of Warren is nestled in a valley between the Green Mountain range to the west and by the Northfield Mountains to the east. The town presided wholly within the upper watershed of the Mad River, which drains in a northerly direction towards the Winooski River Basin.

The Town's primary transportation route is Vermont Route 100, which runs alongside the Mad River from north to south. This highway provides access to Waitsfield, the commercial hub of the Mad River Valley, and to Route 2 and Interstate 89 further north. The historic Village of Warren is located to the east of Route 100 on the other side of the Mad River. The Village is comprised of a cluster of historic buildings, including a general store, inn, post office, church, library, municipal offices and private residences. According to the Town Plan the potential for locating additional development in the Village is limited." A second area of development is located around the base of Sugarbush Ski area, located northwest of the Village and accessed via the Sugarbush Access Road. The Sugarbush Village area/Lincoln Peak Base area is Warren's largest growth area and is the "focal point for the Valley's tourist industry" and additional year round residential housing. It consists of condominium development, lodging facilities, restaurants and retail business. An additional area of concentrated development is Alpine Village; a residential neighborhood, comprised of 290-acres, located in the southeast quadrant of Warren. It was planned in the 1960's for primarily seasonal/recreational/vacation uses, yet many structures have been converted to year-round residences yet environmental constraints will limit future development. According to the Town Plan, approximately 4.1% of the land in Warren is developed as residential, 0.26% is commercial and the majority of the land remains forested (84.9%).

The 2000 Census indicates that the Town of Warren has a population of 1,705 The Town Plan states that "Warren's population, as with other Valley towns, is expected to grow more quickly than Washington County." Between 2000 and 2010, the population increased by 1.5%. Yet the Census population figures do not take in account the large seasonal population. Housing data is one indication of the impact of seasonal residents. Of Warren's 2,232 housing units, 60.3% were reported to be used for seasonal or recreational use and 771 housing units were reported to be occupied at the time the Census was taken.

Warren has adopted zoning and subdivision regulations and participates in the NFIP. Land use regulations include a Flood Hazard Overlay District, designed to prevent or minimize hazards to life or property due to flooding. The Town of Warren is currently in the process of developing a Fluvial Erosion Hazard Overlay with the assistance of the Friends of the Mad River watershed group.

In regards to community facilities and services, Green Mountain Power is the electrical provider to the Town of Warren. Residents and businesses located within the Village rely on a municipal

water and wastewater system. Similarly Sugarbush Resort and Sugarbush Village depend on private water and waste water systems that serves 648 users, according to the 2005 Town Plan. Remaining residents and business not located within these areas rely on individual or small-scale community wells and spring for their water supply and private waste water treatment systems. The Town's Wastewater Ordinance regulated all disposal systems up until July 2007 now the State of Vermont over see's all waste water permitting.

The Warren Volunteer Fire Department is responsible for local fire protection. According to the *Annual Report of the Town and Town School District for the Year Ending December 31, 2010, Town of Warren, Vermont* the fire department responded to 48 calls during 2010. The Vermont State Police provide local law enforcement and the town contracts with the Washington County Sheriffs Department for traffic enforcement. Plus, as stated in the Town Plan "Sugarbush ski resort has an annual agreement with Washington County Sheriffs Department to assist with traffic control during the ski season and special events." The Mad River Valley Ambulance Service is the emergency medical provider for the Mad River Valley and the station is located in the neighboring town of Waitsfield. The Town's Annual Report indicates the Ambulance Service responded to a total of 444 calls during 2010, 140 (39 ski related) in Warren.

The Town of Warren has an approved Rapid Response Plan that was adopted in 2006. The Warren Elementary School and the Fire Station are designated emergency shelters and have back up generators.

The *Town Plan, Warren, Vermont, 2010* includes discussion, planning considerations, goals, objectives and implementation strategies in regards to Transportation, Community Services, Facilities and Utilities, and Land Use. The *Warren Land Use & Development Regulations, As Amended & Adopted by the Warren Select Board August 24, 2010* outline zoning districts and development standards to protect steep slopes, headwaters and drinking water, and encourage development within proximity to public services and facilities. The zoning regulations also include a Flood Hazard Overlay District, established "to promote public health, safety and welfare by preventing or minimizing hazards to life or property due to flooding." The Town is currently in the process of updating its town plan and updated its zoning regulations and flood regulations on August 24, 2010.

4. Planning Process and Maintenance

4.1 Planning Process

The Central Vermont Regional Planning Commission (CVRPC) and the Town Administrator coordinated the Warren Local Hazard Mitigation Plan process. The Warren Select Board held a public hearing to provide residents the opportunity to identify hazards at their October 14, 2008 meeting. The following people were in attendance:

Cindi Hartshorn-Jones, Town Administrator
Andy Cunningham, Select Board

Burt Bauchner, Select Board
Erin Russell-Story, Select Board
Kirstin Reilly, Select Board
Rudy Elliott
Chris Kathan
Raemon Weston Jr., Warren Road Crew
Craig Klofach, Planning Commission
Michael Ketchel, Planning Commission
Joshua Schwartz, Mad River Planning District
Jim Sanford, Planning Commission
Andreas Lehner
Bill Oeatmena
Barry Simspon, Warren Road Crew

A meeting was held in Warren on December 18, 2008 in order to review the inventory of the town's vulnerability to hazards and its current and future mitigations programs, projects and activities. Input was received from Cindi Hartshorn-Jones, Town Administrator. The Town Administrator provided copies of the draft Local Hazard Mitigation Plan to the following town boards and departments for additional input: Roads Crew, Department of Public Works, Select Board, Planning Commission and Design Review Board. The Planning Commission reviewed the draft Local Hazard Mitigation Plan at their February 9, 2009 meeting. Planning Commission members included:

Craig Klofach
Michael Ketchel
Jim Sanford
Dan Raddock
Don LeHaye

Due to the recent approval, Jen Mojo and Cindy Jones –Hartshorn worked together to complete an update on the Warren Mitigation Plan on 11/03/11. The meeting indicated that the Town is most vulnerable to Flooding/Flash Flooding/Fluvial Erosion, Hurricanes/Severe Storms and Winter Storms/Ice Storms/Extreme Cold. Warren is focusing mitigation efforts on flooding projects as flooding is the most common and damaging event.

Select Board and Planning Commission meeting are duly warned and open to the public. Agendas are posted on the municipal website providing local residents and businesses the opportunity to review and comment upon the plan. Also, the draft plan was made available for public comment at the Town Clerks office and notice of the plan was posted on the community bulletin board and uploaded onto the Municipal website.

Once the draft was updated, CVRPC placed a notice for public comments of the draft update on the CVRPC blog and newsletter. The draft update was also available was at the Warren Municipal offices and by request from CVRPC for public review and comments from 11/10/2011

to 12/15/2012. The announcement of the draft update in the CVRPC newsletter reached over 150 people and businesses in the Region's 23 towns, including the adjacent towns of Roxbury, Waitsfield, Fayston and Northfield. No comments were received by CVRPC or Warren Staff. Public comments submitted in the future will be reviewed by the Planning Commission Chair (and CVRPC Staff dependant on funding) and attached as an appendix. In the future, the draft plan will be made available during Town Meeting Day and local meetings with State and local officials to allow for more public comment and review. Once the plan is approved pending adoption by FEMA, the plan will go before the Select Board for adoption.

4.2 Plan Update Process

The Warren Local Mitigation Plan was originally adopted by the Town as an Annex to the Central Vermont Regional Pre Disaster Mitigation Plan in June 2009 and received FEMA final approval in October 2009. The 2011 update is intended to be submitted as a single jurisdiction Local Mitigation Plan.

Preparation for the meeting included a review of Warren's planning documents, including the Warren Municipal Plan, Zoning Regulations, the Warren Rapid Response Plan 2006 and the Mad River Fluvial Geomorphology Assessment (2007).

The current plan is an update of the 2009 plan. Below is a list of the revisions that have been made from the past plan and the appropriate sections for reference. New hazards identified include winter storms/ice storms and hurricanes/tropical storms/severe storms.

General Updates

- General reorganization/restructuring of the plan according to future FEMA/VEM checklist
 - New sections added – 4.2 Plan Update Process, 4.3 Plan Maintenance, 5.2 Winter Storm/Ice Storm, 5.2 Hurricane/Sever Storms, 5.3 Moderate Threat Hazards
- Update of all data and statistics using 2010 Town Report and US Census Data (Section 3)
- Revaluation, identification and analysis of all significant hazards (Section 5)
- Acknowledgment of implemented mitigation strategies since 2009 – see matrix below (section 4.2)
- Identification of on-going mitigation projects and strategies – see Existing Mitigation Programs, Projects and Activities section (section 4.2)

Hazard Analysis Updates (Sections 5 and 6)

- New hazards added – winter storm/ice storm, hurricane/severe storms
- Added location/vulnerability/extent/impact/likelihood table for each hazard to summarize hazard description (Section 5.1-5.3 – after each hazard)
- Review of Vermont Hazard Mitigation Plan (Section 5 – hazard analysis table)

Maps

- Review of 2009 Areas of Concern map and Local Hazards Analysis map – identified project locations and hazard areas

The following chart provides an overview of Warren’s proposed 2009 local hazard mitigation actions along with their current status. Additionally since the 2007 plan, the Town is in the process of updating their flood regulations to be compliant with basic NFIP regulations to maintain NFIP compliance.

2009 Mitigation Action	2011 Status
Relocate a section of West Hill Road away from eroding stream bank	Needs additional engineering studies; was brought up during a roads meeting on 11/2/11; construction will not be started until 2012
Reface or replace the Covered Bridge abutment	Department of public works applied for a transportation enhancement grant; engineering study was performed in 2011; no construction funding available until 2014/15; bridge has been reopened since Irene damage.
Identify and become knowledgeable of non-compliant NFIP structures	Town is still interested

Existing Hazard Mitigation Programs, Projects & Activities

The ongoing or recently completed programs, projects and activities are listed by mitigation strategy.

Community Preparedness Activities

- Rapid Response Plan
- Capital Equipment Plan

Insurance Programs

- Participation in NFIP

Land use Planning/Management

- Warren Town Plan, 2010
- Town of Warren Land Use Regulation, 2010

- Fluvial Geomorphology Assessment, 2007
- Upper River Corridor Plan, January 2008

Hazard Control & Protective Works of Infrastructure and Critical Facilities

- Maintenance Programs (Culvert and Bridge Survey)
- AOT Codes and Standards for Roads
- 2002 Bridge Study
- Dry Hydrants
- Red Cross Certified emergency Shelters

Public Awareness, Training & Education

- CPR Trainings
- School Fire Safety Program
- Public awareness road safety signs

4.3 Plan Maintenance Process

The Warren Local Hazard Mitigation Plan will be updated and evaluated annually at a March Select Board meeting along with the review of the Basic Emergency Operations Plan. Updates and evaluation by the Select Board will also occur within three months after every federal disaster declaration and as updates to town plan/zoning and river corridor plans come into effect. The plan will be reviewed by the Select Board, Zoning Admin, Town Manager and public at the abovementioned September select board meeting. CVRPC will help with updates or if no funding is available, the Town Administrator will update the plan.

The process of evaluating and updating the plan will include continued public participation through public notices posted on the municipal website, notice in the municipal building, Valley Reporter and CVRPC newsletter and blog inviting the public to the scheduled Select Board (or specially scheduled) meeting. Additional stakeholders invited to the meeting will be Sugarbush and business owners in the Village. Also invited in the future will be the VT Agency of Natural Resources (VT ANR), as they are able to provide assistance with NFIP outreach activities, models for stricter floodplain zoning regulations, delineation of fluvial erosion hazard areas, and other applicable initiatives. These efforts will be coordinated by the Town Administrator.

Monitoring of plan progress and implementation will be undertaken by the Town Administrator and Select Board. Monitoring updates may include changes in community mitigation strategies; new town bylaws, zoning and planning strategies; progress of implementation of initiatives and projects; effectiveness of implemented projects or initiatives; and evaluation of challenges and opportunities. The plan is to be a “living document” to allow for new actions to be identified in the five year interim period and amended without formal re-adoption during regularly scheduled Select Board meetings. Prior to the end of the five year period, the plan will be

undergo a formal update and submitted to FEMA for re-adoption following the process outlined the schematic found in the Attachments section.

Warren shall also incorporate mitigation planning into their long term land use and development planning documents. It is recommended the Town review and incorporate elements of the Local Hazard Mitigation Plan when updating the municipal plan, zoning regulations, and flood hazard/FEH bylaws. The incorporation of the Local Hazard Mitigation Plan into the municipal plan, zoning regulations and flood hazard/FEH bylaws will also be considered after declared or local disasters. The Town shall also consider reviewing future Mad River Corridor planning documents for ideas on future mitigation projects and hazard areas.

5. Community Vulnerability by Hazard

5.1 Hazard Identification and Risk Analysis

The following natural disasters were discussed and the worst threat hazards were identified based upon the likelihood of the event and the community’s vulnerability to the event. Hazards not identified as a “worst threat” may still occur. Greater explanations and mitigation strategies of moderate hazards can be found in the State of Vermont’s Hazard Mitigation Plan.

Hazard	Likelihood ₁	Community Vulnerability ²	Worst Threat
Avalanche/ Landslide	Low	No	
Dam Failures	Low	No	
Drought	Low	No	
Earthquake	Low	No	
Flash Flood/Flood/Fluvial Erosion	Med	Yes	X
High Wind	Low	No	
Hurricane/Severe Storms	Med	Yes	X
Structure Fire	Med	No	
Tornado	Low	No	
Water Supply Contamination	Low	No	
Wildfire/Forest Fire	Med	No	
Winter Storm / Ice Storm/Extreme Cold	High	Yes	X

¹ High likelihood of happening: Near 100% probability in the next year.

Medium likelihood of happening: 10% to 100% probability in the next year or at least once in the next 10 years.

Low likelihood of happening: 1% to 10% probability in the next year or at least once in the next 100 years.

² Does the hazard present the threat of disaster (Yes)? Or is it just a routine emergency (No)?

The following hazards were found to be most significant in the Town of Warren:

- Flash Flood/Flood/Fluvial Erosion
- Hurricane /Severe Storms
- Winter Storm/Ice Storm/Extreme Cold

Moderate Threat Hazards Include:

- Structure Fire
- Wildfire/Forest Fire

A discussion of each worst and moderate threat hazard is included in the proceeding subsections and a map identifying the location of each hazard is attached (See map titled *Areas of Local Concern*.) Each subsection includes a list of past occurrences based upon County-wide FEMA Disaster Declarations (DR-#) plus information from local records, a narrative description of the hazard and a hazard matrix containing the following overview information:

Hazard	Location	Vulnerability	Extent	Impact	Likelihood
Type of hazard	General areas within municipality which are vulnerable to the identified hazard.	Types of structures impacted	Magnitude of event: scale dependent on hazard	Dollar value or percentage of damages.	<u>High</u> : 10% to 100% probability within the next year or at least once in the next 10 years. <u>Medium</u> : less than 10% to 100% probability within the next year or less than once in the next 10 years.

5.2 Worst Threat Hazards

Flooding/Flash Flooding/Fluvial Erosion

History of Occurrences: (Mad River Valley encompasses the towns of Waitsfield, Warren, Moretown and Fayston. The Mad River flood gauge is located in Moretown approximately 14 miles downstream. Information from NCDC website)

Date	Event	Location	Extent
8/28/2011	Flash Flood (TS Irene)	Warren; Washington County	Mad River flood gauge at 19.07 feet; 10.07 feet above flood stage (flood stage is 9 feet) DR 4022
5/20/2011	Flash Flood	Washington County, Warren	4" of rain, not a historical crest - DR 1995

3/6/2011	Flood; ice jams	Warren; Washington County	1-2" of rain followed by ~15" of snow
10/1/2010	Flood	Warren, Washington County	4-5" of rain, Mad river gauge at 10.39 ft
8/2/2008	Flash Flood	Washington County (Mad River Valley)	Mad River gauge at 7.89 feet – DR 1790
3/15/2007	Flood; ice jams	Mad River Valley	Mad River Gauge at 13.5 ft
12/24/2003	Flood	Mad River Valley	Mad River flood gauge at 14.17 feet DR 1448
12/17/2000	Flood	Mad River Valley	3" of rain; no data for Mad River gauge
6/27/1998	Flash Flood	Mad River Valley	3-6" of rain over 2 day period – Mad River flood gauge at 14.13 feet, DR1228
8/6/1995	Flood	Mad River Valley	Mad River flood gauge at 8.12 feet
3/31/1987	Flood	Mad River Valley	Mad River flood gauge at 11.97 feet
3/13/1977	Flood; ice jams	Mad River Valley	Mad River flood gauge at 13.72 feet
8/5/1976	Flood	County Wide	Mad River flood gauge at 13.47 feet DR 518
9/22/1938	Flood	County Wide	Mad River flood gauge at 16.34 feet
11/03/1927	Flood	County Wide	Mad River flood gauge at 19.40 feet

Flooding/flash flooding/fluvial erosion is Warren’s most commonly recurring hazard. Flooding is the overflowing of rivers, streams, drains and lakes due to excessive rain, rapid snow melt or ice. Flash flooding is a rapidly occurring flood event usually from excessive rain. Fluvial erosion is the process of natural stream channel adjustments. Fluvial erosion causes erosion of sediment in some areas, while causing aggradation of sediment in other. Fluvial erosion processes occur more quickly and severely during flood events.

The worst anticipated flooding is unknown in the low lying areas in Town of Warren. Due to Warren’s hilly topography, most flooding is of the flash flooding nature. The worst flooding event in Warren’s recorded history occurred in 1927, followed closely by T.S. Irene in 2011. The Mad River flood gauge readings during these events were 19.4 and 19.07, respectively. Detailed historical records relating to the extent of the 1927 flood in Warren are not available, but were believed to be 2-3 feet higher than Irene; during T.S. Irene up to 4 feet of flooding occurred in basements in Warren Village. Lesser but more regular flooding occurs in Warren, with generally 1 foot of flooding in low lying areas every two or three years. In the future, Warren can better gather data for flooding extent by having individuals call in flood levels in areas around the Town.

Warren is located in the upper watershed of the Mad River. The village is located on the valley floor and flanked by the rugged steep slopes of the Green Mountains to the west and the Northfield range to the east. Many river and stream tributaries drain into the Mad River from the adjacent mountains. As in many New England towns, roads were built along side mountain tributaries. Rain events and spring snow melt attribute to the gradual bank fluvial erosion which impacts the municipal transportation and infrastructure system. Past occurrences of fluvial erosion are documented in the River Corridor Plan for the Mad River. The Corridor Plan only identifies areas along the main stem of the Mad River and not erosion areas along Warren's tributaries. The plan does not identify the dates of past occurrences but does identify two areas in Warren (one area just upstream of the Covered Bridge and one area downstream of the Covered Bridge, totaling a length less than 200 feet) where the river banks are being affected by erosion. The Town is currently in the process of reviewing and considering the adoption of a Fluvial Erosion Hazard Overlay Zone which would prohibit future development within areas susceptible to fluvial erosion.

Warren has 117 properties and 13 structures in the NFIP 100 year floodplain. The total of these properties is \$26,716,800 based on the average grand list value. There are no repetitive loss properties in Warren. Warren has 20 active NFIP policies which has a coverage of \$5,778,100. The effective date of Warren's FIRM is 9/1/1977. Enforcement of Warren's flood hazard regulations is performed by the Zoning Administrator.

In the fluvial erosion hazard zone, Warren has 171 properties, totaling \$34,610,400 based on the average grand list value.

West Hill Road runs parallel to Bradley Brook and provides local access to rural residential development, the Sugarbush Golf Course and Sugarbush Ski Resort. Gradual bank erosion of the brook is impacting the stability of West Hill Road. In 2006 the road was closed for repairs and required local traffic to use alternative routes. One particular resident of West Hill Road requires frequent medical attention and the road closure extends the response time of emergency medical services. The Town of Warren has made previous attempts at bank stabilization yet the natural hydrological processes require additional repairs to ensure road stability.

Fluvial erosion is also undermining the west abutment of the Village Covered Bridge. As stated in the Warren Town Plan the bridge is listed in the National Register and was built following the 1927 flood. The 2002 Bridge Study indicates replacement of the western abutment is required and the River Corridor Plan recommends replacing and/or resizing the Covered Bridge Abutments.

The Kingsbury Bridge abutments continue to suffer degradation as a result of fluvial erosion and flooding. The Town and VTrans are working together to replace the bridge in 2014.

In 2011, the Sugarbush access road needed to be replaced due to a snow making line rupture. The Town is concerned about slow leaks and major ruptures which could cause weak spots in roads. The cost to repair the Access Road was over \$1 million. 18 culverts were replaced and the faulty section of the snowmaking line.

Over the long term, improved storm water management and managing land use can help improve the health of the Mad River and reduce the flooding impacts of rain events.

Hazard	Location	Vulnerability	Extent	Impact	Likelihood
Flooding/ Flash Flooding/ Fluvial Erosion	West Hill Road, Covered Bridge, Sugarbush Access Rd, Volkstown Rd, Kingsbury Bridge	Transportation Infrastructure, private property, culverts	TS Irene - 5.75” of rain, Mad River flood gauge at 19.07 feet; 9 ft is flood stage	\$1 million for Access Rd repairs, \$350,000 from Irene damages,	Medium

Hurricanes/Severe Storms Hurricane/Tropical/Severe Storms

History of Occurrence: (Mad River Valley encompasses the towns of Waitsfield, Warren and Fayston)

Date	Event	Location	Extent
8/28/2011	Tropical Storm, Flash Flood (TS Irene)	Warren; Washington County	Mad River flood gauge at 19.07 feet; 10.07 feet above flood stage (flood stage is 9 feet) – DR 4022
7/06/2011	Thunderstorm	Washington County	50 knot winds; 15,000 people in VT lost power
5/26/2011	Hail/Thunderstorms/Flash Flooding	Warren; Washington County	1” hail, 25,000 customers lost power in VT, 3-5” of rain, not a historical Mad river crest DR 4001
8/9/2010	Thunderstorm/Wind/Hail	Warren	50 knot winds
7/21/2010	Hail	Washington County (Mad River Valley)	1” Hail
7/18/2008	Hail	Mad River Valley	1” Hail, 30 knot winds
7/9/2007	Hail, thunderstorms	Mad River Valley	Baseball sized hail DR 1715
7/1/2006	Hail, thunderstorms	Mad River Valley	1” Hail, severe t-storms

9/29/2005	Severe thunderstorms	Mad River Valley	Downed trees and power lines, 35 knot winds
9/16/1999	Tropical Storm Floyd	Statewide	Tropical storm winds and flooding
7/22/1999	Hail, Thunderstorms	Mad River Valley	1.5" hail, severe t-storms
6/27/1998	Severe Storms	County Wide	Mad River gauge 14.13 ft DR 1228
7/15/1997	Severe Storms	County Wide	3-5" of rain, Not a historical crest
5/19/1982	Thunderstorm winds	County Wide	56 knot winds
7/3/1964	Hail	County Wide	1.5" hail
9/22/1938	Hurricane	Statewide	Category 1 force winds

Hurricanes and tropical storms are violent rain storms with strong winds that have large amounts of rainfall and can reach speeds up to 200 mph. Hurricane season is between the months of June and November. These types of storms originate in the warm waters of the Caribbean and move up the Eastern seaboard where they lose speed in the cooler waters of the North Atlantic. A severe thunderstorm is a thunderstorm that contains any one or more of the following three weather conditions: hail that is 3/4 of an inch or greater in diameter, winds 58 miles per hour or greater, and/or tornadoes. Severe storm events can occur late spring and early summer as temperatures increase in the summer season. The frequency and intensity of hurricanes, tropical storms, and severe storms is expected to increase with climate change.

On Aug 28, 2011, Tropical Storm Irene hit Vermont and proceeded to deposit 5.75" of rain over Warren. Total damages from the storm have not yet been calculated. Roads that received the greatest damage were:

- Flat Iron Rd
- Plunkton Rd – Thayers & Plunkton bridges, 3 culverts
- Iron Mountain Road
- Cider Hill Rd
- Bridge Rd – Covered bridge
- Brook Rd – 1 culvert in poor condition
- Fuller Hill Rd – 10 Culverts – 5 in poor condition
- Airport Rd – 2 culverts

Damage was primarily a result of flooding of the Mad River and extreme amounts of rain falling in a short period. Areas which still need engineering and hydraulic studies are Flat Iron Rd, bridges on Plunkton Rd, and the Covered Bridge.

In 1999, Hurricane Floyd passed through Vermont. The primary impact from Floyd was downed trees and power lines due to high winds. 5-8" of rain fell over the Central Vermont Region; however, flood impacts were offset by drought conditions from earlier in the year.

Hazard	Location	Vulnerability	Extent	Impact	Likelihood
Hurricane/ Tropical/ Severe Storms	Flat Iron Rd, Plunkton Rd, Cider Hill Rd, Bridge Rd, Brook Rd, Fuller Hill Rd, Airport Rd	Culverts, bridges, private property, power lines, trees	Irene - 5.75" of rain in 24 hrs, Mad River flood gauge at 19.07 feet; 9 ft is flood stage Floyd - 5-7" of rain, winds 31 mph	\$350,000 from Irene – final amount TBD	Medium

Winter Storm/Ice Storm/Extreme Cold

History of Occurrences (from NCDC website and FEMA DR List.)

Snow and/or ice events occur on a regular basis. Recent significant events have included:

Date	Event	Location	Extent
3/6/2011	Winter storm	County wide, Warren	12-18" of snow, 10,000 customers lost power statewide
2/23/2010	Winter Storm	County wide, Warren	20" of snow and 50,000 customers lost power statewide
2/22/2009	Winter Storm	County Wide, Warren	16" of snow, 30 mph wind gusts
2/1/2008	Winter storm	County wide, Warren	3-7" of snow and ice ¼-1/2" thick, 50 mph wind gusts
2/14/2007	Winter storm	County wide, Warren	22" of snow
2/14/2006	Winter storm	Warren, County Wide	30" of snow
1/4/2003	Winter storm	County wide	19" of snow
3/5/2001	Winter storm	County wide, Warren	15-30" of snow
12/31/2000	Winter storm	County wide	10" of snow
1/15/1998	Winter storm	County wide, Warren	10-12" snow (not a DR in Washington County)
12/29/1997	Winter storm	County wide, Warren	21" of snow
12/7/1996	Winter Storm	County wide	12" of snow
3/21/1994	Winter storm	County Wide,	5-11" of snow

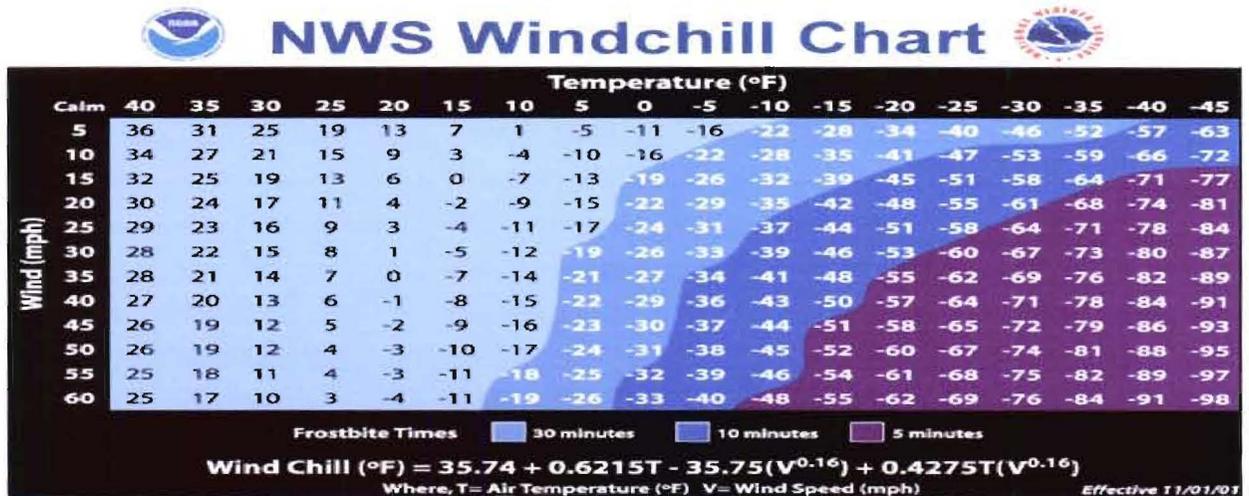
		Warren	
11/1/1993	Winter storm	County wide, Warren	15" of snow
1/3/1993	Freezing Rain	Statewide	

A winter storm is defined as a storm that generates sufficient quantities of snow, ice or sleet to result in hazardous conditions and/or property damage. Ice storms are sometimes incorrectly referred to as sleet storms. Sleet is similar to hail only smaller and can be easily identified as frozen rain drops (ice pellets) that bounce when hitting the ground or other objects. Sleet does not stick to wires or trees, but in sufficient depth, can cause hazardous driving conditions. Ice storms are the result of cold rain that freezes on contact with the surfaces coating the ground, tress, buildings, overhead wires and other exposed objects with ice, sometimes causing extensive damage. Periods of extreme cold tend to occur with these events. There is no set definition of extreme cold; however, a period of extreme cold is often characterized by temperatures at or below freezing for an extended period of time.

The physical impacts of winter storms are town wide due to the expansive nature of winter storms. For the next plan update, Warren will more closely monitor winter storms to determine the worst impacts possible on the Town. Based on past occurrences, the worst anticipated winter weather Warren could experience would be 2-3' in 24 hrs of snow with more at higher elevations and several days of power outages. The worst recent storm was in March 2011 and after that the Blizzard of 1888. Scales to measure the extent of winter storms are:

- Heavy snowfall** – Warren is significantly affected when they experience an accumulation of 7 inches or more of snow in a 12-hour period or 13 inches or more in a 24-hour period.
- Blizzard** – Warren is significantly affected when they experience sustained wind speeds in excess of 40 mph accompanied by heavy snowfall or large amounts of blowing or drifting snow.
- Ice storm** – Warren is significantly affected when they experience ice accumulations of ¼" or greater.

Wind Chill Extent Scale



One of the major problems associated with ice storms is the loss of electrical power. Major electric utility companies have active, ongoing programs to improve system reliability and protect facilities from damage by ice, severe winds and other hazards. Typically, these programs focus on trimming trees to prevent encroachment of overhead lines, strengthening vulnerable system components, protecting equipment from lightning strikes and placing new distribution lines underground.

Other major problems include closed roads and restricted transportation.

By observing winter storm watches and warnings, adequate preparations can usually be made to lessen the impact of snow, ice and sleet, and below freezing temperature conditions on the Town of Warren. Providing for the mass care and sheltering of residents left without heat or electricity for an extended time and mobilizing sufficient resources to clear broken tree limbs from roads, are the primary challenges facing community officials. Warren should plan and prepare for these emergencies. That planning and preparedness effort should include the identification of mass care facilities and necessary resources such as cots, blankets, food supplies and generators, as well as debris removal equipment and services. The Town shelter locations are the Warren School and Fire Department.

Hazard	Location	Vulnerability	Extent	Impact	Likelihood
Winter Storm/Ice Storm	Town Wide	Elderly & handicapped populations, remote structures, old/under insulated structures, utilities, trees	18+” of snow in 24 hrs on March 2011 event	5-10% damages – routine emergencies	High

5.3 Moderate Threat hazards

Structure Fire

About one sixth of the calls received in 2010 by Warren’s fire department were fire related incidents – chimney fires, dumpster fires, smoke alarms, and carbon monoxide alarms. Although many structures in Warren are less than 100 years old, many residents heat their homes with wood or pellet burning stoves. The remoteness and distance from fire and emergency services of many homes also increases the likelihood of a home being completely, opposed to partially, destroyed by a fire. Large, vacant condo complexes, which are not regularly checked upon also pose threats. To date, there have been no large structure fires.

Hazard	Location	Vulnerability	Extent	Impact	Likelihood
Structure Fires	Town Wide	Wood structures, especially older than 100 yrs, homes that use wood burning stoves for heat, vacant condo/ vacation homes	Data gap	\$150, 000 per home based on median grand list value	Medium

Wild Fire/Forest Fire

FEMA indicates there are three classes of wild land fires – surface fires, ground fires and crown fires, with the most common type indicated as a surface fire. Surface fires burn slowly along the forest floor, killing and damaging trees. Ground fires burn on or below the forest floor and are usually caused by lightning. Crown fires move quickly by jumping along the tops of trees. Crown fires can spread quickly during windy conditions. In Warren, there have been no known occurrences of wildfires; however, changing land use patterns and weather conditions may increase Warren’s vulnerability. The rural nature and vast tracts of forested land can make Warren susceptible to forest fires. During rare drought occurrences, fire danger may be high.

Approximately 85% of Warren is wooded. Despite the absence of recent forest fires of significant size, the volume of the Town’s forested landscape in conjunction with dry and windy weather has the potential to rapidly spread fire and create a hazardous situation. Portions of Warren are unreachable by road and an extensive dry hydrant system does not exist, limiting firefighting ability. Properties around the Green Mountain National Forest on the urban forest interface are at the greatest risk. Using Warren’s average grand list property value, the Town in the future can calculate the impact that a major forest fire would have on homes within the Town.

The State of Vermont does have a Forest Management plan in place which addresses forest fire concerns. The 2010 State Forest Management Plan includes several goals regarding forest fire prevention. The Plan states that although the risk of forest fire is low in the State of Vermont, that the State still performs controlled burns on a small during the spring season. To help prevent local forest fires, the State works with local planning commissions to develop Community Wildlife Protection Plans. These plans help towns to identify and mitigate wildfire risk. A common mitigation measure prescribed in the plan is through controlled burns with onsite State support.

The Forest Division also runs the Town Forest Fire Warden program. This program requires towns to have appointed fire wardens. The forest fire program focuses on prevention, fire awareness and fire fighter safety.

Hazard	Location	Vulnerability	Extent	Impact	Likelihood
Wildfire	Town Wide – areas outside Village development	Large Parcels of forested land, homes near urban forest interface, power lines	Green Mountain Forest land – 30% of Warren; 84.9% of Warren is forested	Data gap	Medium

6. Mitigation

6.1 Town Plan (2010) Goals & Objectives that Support Local Hazard Mitigation

- Maintain and improve a transportation system that is safe and efficient. (Transportation Goal)
- The regulation of land development in a manner which protects important natural and community resources including farm land, forest resources, important wildlife habitat and water quality while allowing for diverse land uses in an appropriate locations. (Land Use Goal)
- The provision of an environmentally sound and cost efficient system of community services, facilities and utilities to meet present and future demands of Warren citizens and visitors. (Community Services, Facilities and Utilities Goal)

The next time the Town of Warren updates its Town Plan, it may consider adding additional mitigation goals.

The goal of this local hazard mitigation plan is:

- To take actions to reduce or eliminate the long-term risk to human life and property from natural hazards.

Specific hazard mitigation strategies related to the goals of the plan include:

- Ensure existing and future drainage systems are adequate and functioning properly
- Ensure that all residents and business owners are aware of the hazards that exist within Warren and ways they can protect themselves and insure their property
- Ensure that emergency response services and critical facilities functions are not interrupted by natural hazards
- Provide adequate communication systems for emergency personnel and response units
- Provide residents with adequate warning of potential hazards

6.2. Proposed Hazard Mitigation Programs, Projects & Activities

Hazard mitigation programs, projects and activities that were identified for implementation at the Warren Local Hazard Mitigation meeting:

Hazard	Action	Local Leadership	Prioritization	Possible Resources	Time Frame
Flooding/Fluvial Erosion , Severe Storms/Hurricane	Relocate a section of West Hill Road away from eroding stream bank	Road Foreman Town Admin. Dept. of Public Works	High	HMGP	1-2 yrs
Flooding/Fluvial Erosion, Severe Storms/Hurricane	Reface and replace the Covered Bridge abutment	Dept. of Public Works	Medium	HMGP	2-3 years
NFIP	Identify and become knowledgeable of non-compliant NFIP structures	Zoning Administrator	Medium	Vermont Floodplain Management Coordinator (VT DEC)	3 years
Flooding/Fluvial Erosion, Severe Storms/Hurricane	Replacement and upgrade of Kingsbury Bridge	Road Foreman, VTrans, SB	High	VTrans, Highway Funds, HMGP	3 years
Flooding/Fluvial Erosion, Severe Storms/Hurricane	Obtain temporary bridges for Plunkton Road and perform engineering studies for upgraded replacements	Road Foreman, Town Administrator	Med	HMGP VTrans General Fund	2-3 years
Flooding/Fluvial Erosion, Severe Storms/Hurricane	Expansion and upgrade of culverts on Golf Course Rd, Airport Rd, Fuller Hill Rd, and Plunkton Rd	Road Foreman Town Admin. Dept. of Public Works	High	HMGP	2 years
Flooding/Fluvial Erosion, Severe Storms/Hurricane	Selected projects from Mad River Corridor Plan – see appendix	Select Board, Residents, Town Administrator, Road Crew, ANR	Medium	ANR, Vtrans, HMGP, General Fund	3-4 years
Severe storms/ Hurricane, Winter Storms, emergency preparedness	Purchase and install generator for Town Garage	Road Foreman, Town Administrator	Medium	HMGP	3 years
Severe Storms / Hurricane, Winter storms, emergency preparedness	Purchase additional communication devices for Town DPW vehicles	Road Foreman, Town Administrator	Medium	EMGP	3-4 years

Flooding/Fluvial Erosion, Severe storms/ Hurricane	Upgrade and reconfigure Volkstown Rd/Airport Rd Intersection	Road Foreman, Select Board, Town Administrator	Low	HMGP	4-5 years
Winter Storms/ Severe Cold	Provide training to residents on how to insulate homes (pipes, attics) for extreme cold spells	SB, PC, Fire Dept	Medium	EMGP	2 years
Winter storms/ extreme cold/ice storms	Upgrade electrical systems in municipal buildings and shelters to prevent surge/equipment damage from fluctuating current during ice and wind storms	Fire Dept, SB	Med	General Funds, EMGP, DPIG	3-4 years
Wild Fire	Develop and distribute public education materials about reducing wild fire risk	Fire Dept, Select Board	Med	USDA	3-4 years
Wild fire	Work with State to develop alternative water supplies in Green Mountain National Forest for wildfire suppression purposes	P.C, Fire Dept, VT ANR	Med	EMGP, USDA	3 years
NFIP	Work with elected officials, the State ANR and FEMA to correct existing compliance issues and prevent any future NFIP compliance issues through continuous communications, training and education	Select Board, ANR, Planning Commission	Medium	Town Funds	3 years

The Town is currently in the process of reviewing and considering the adoption of a Fluvial Erosion Hazard Overlay Zone which would prohibit future development within areas susceptible to fluvial erosion. New DFRIM maps are in the process of being reviewed by towns in Washington County, as part of this FEMA map modernization process. AS part of the process towns will be required to review and update current hazard regulations to improve floodplain management. The Town will continue activities related to continued to NFIP compliance including requiring elevation certificates and enhancing local officials, builders, developers and local citizen's knowledge of how to read and interpret the FIRM through the Design Review process.

VEM also emphasizes a collaborative approach to achieving mitigation on the local level, by partnering with ANR, VTrans, ACCD, Regional Planning Commissions, FEMA Region 1 and other agencies, all working together to provide assistance and resources to towns interested in pursuing mitigation projects and planning initiatives.

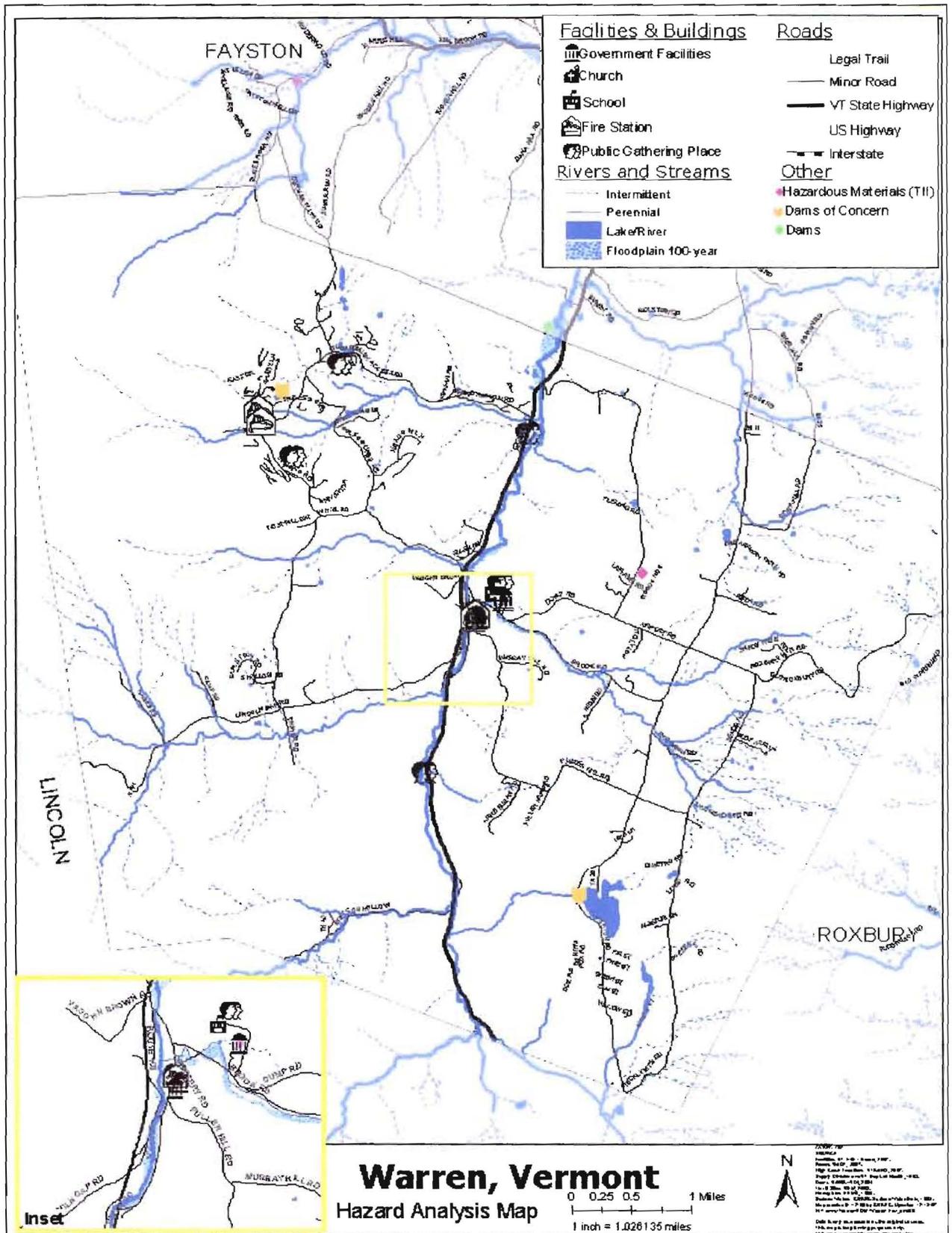
The mitigation activities are listed in regards to local leadership, possible resources, implementation tools, and prioritization. Prioritization was based upon the economic impact of the action, the Community's need to address the issue, the action's cost, and the availability of potential funding. The action's cost was evaluated in relation to its benefit as outlined in the STAPLEE guidelines.

Warren understands that in order to apply for FEMA funding for mitigation projects that a project must meet FEMA benefit cost criteria. The Town must also have a FEMA approved Hazard Mitigation Plan as well.

A High prioritization denotes that the action is either critical or potential funding is readily available and should have a timeframe of implementation of less than two years. A Medium prioritization is warranted where the action is less critical or the potential funding is not readily available and has a timeframe for implementation of more than two years but less than four. A Low prioritization indicates that the timeframe for implementation of the action, given the action's cost, availability of funding, and the community's need to address the issue, is more than four years.

Attachments

- Hazards Analysis Map
- Areas of Local Concern Map
- Maps and Projects from the Mad River Corridor Plan
- Town Resolution Adopting the Plan



Mad River Corridor Plan Maps and Projects

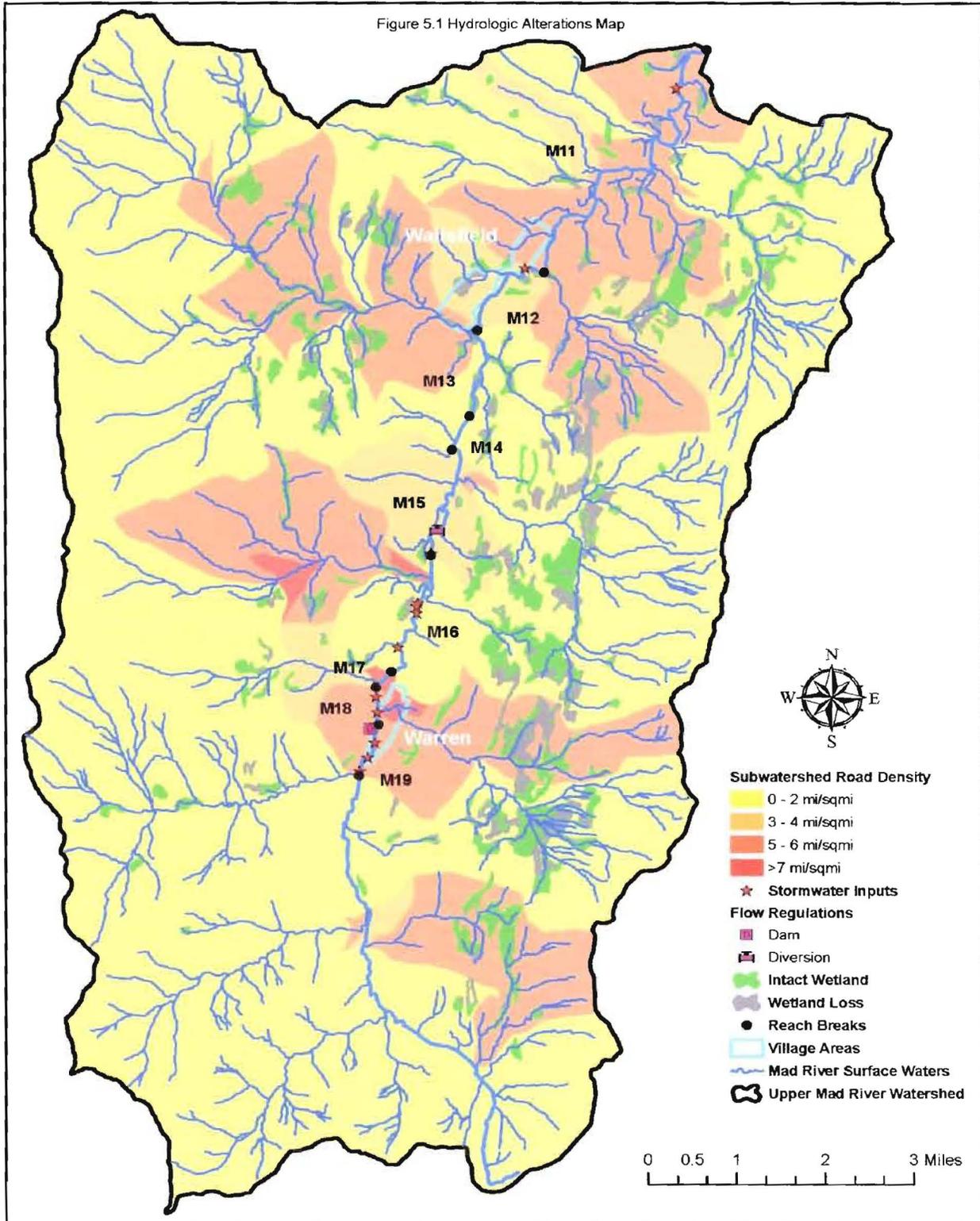
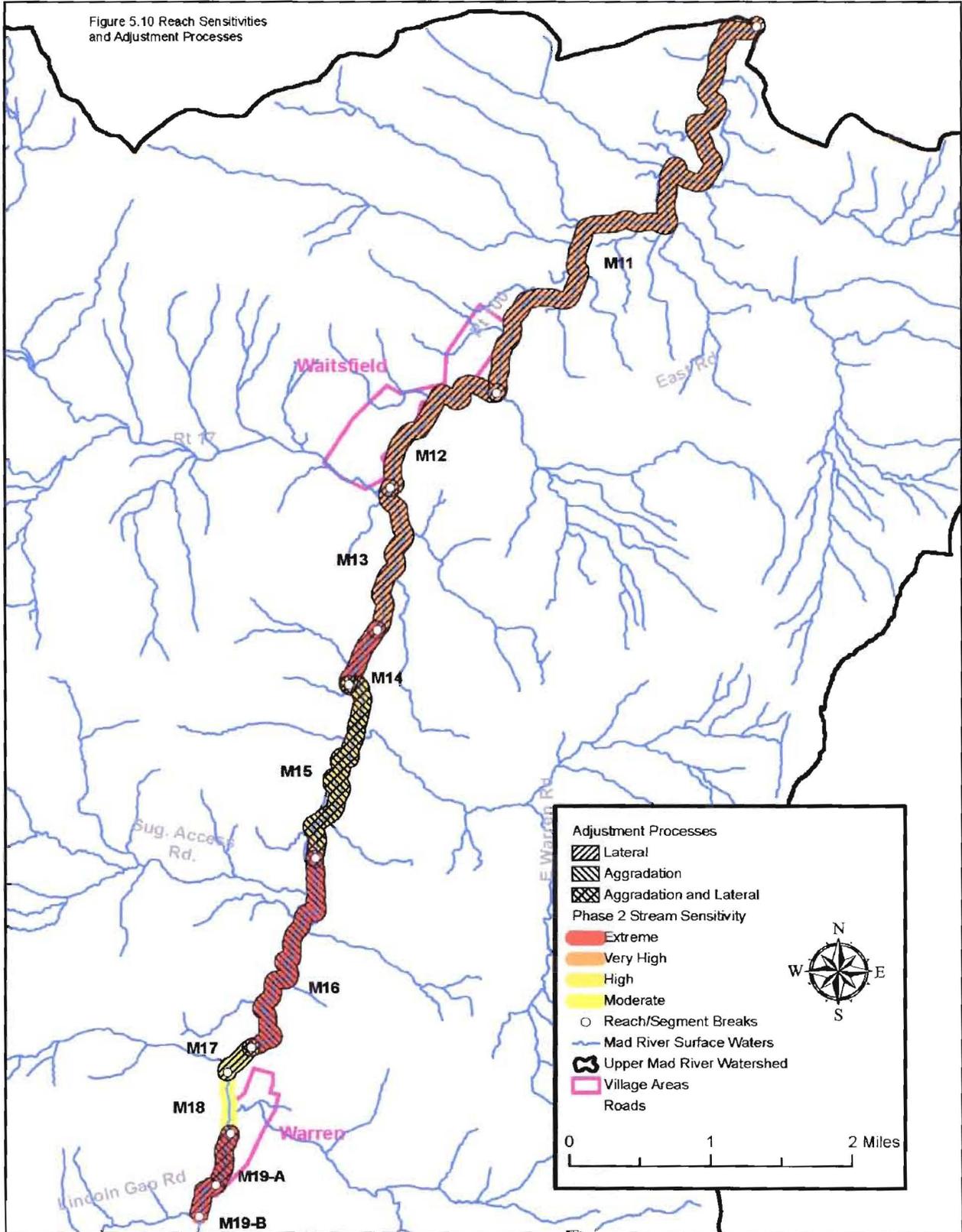


Figure 5.10 Reach Sensitivities and Adjustment Processes



Project #, Stream Type, Evolution Stage, RGA, RHA	Site Description and Importance, Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits (All projects are aimed at achieving RMP goals)	Potential Partners and Costs	Land Use Conversion
		snowmaking pond to reduce pressure and chance of avulsion into the pond. Possibly gain/recreate some floodplain on the right bank adjacent to the snowmaking pond and/or on the left bank just downstream of the Rt 100 bridge.				
M15-4	Warren Trestle Bridge has sediment deposition upstream, stepped footers and deteriorating abutments.	Replace structure with an appropriately sized bridge.	The Town of Warren and VTRANS have been working to find a larger trestle bridge and have apparently located one.	Keeping the trestle style will preserve that icon of the valley.	David Hoynes at VTRANS, Town of Warren	None, bridge already exists.
M16-1 C-F departure III Fair Fair	Channel experienced a stream type departure of C to F (incision 2.1, entrenchment 1.2) and has lost floodplain access. Altered by channel straightening and bank armoring, and constriction from Rt. 100, increasing stream power. Some riprap being undermined. Area upstream of Riverside Park is heavily armored on left bank.	Protect corridor in the vicinity of Riverside Park to allow for channel adjustment and sediment attenuation. Depositional reach currently has limited sediment attenuation areas, which exacerbates sediment deposition problems in downstream reach at Snowmaking Pond.	Feasibility depends on willingness of landowners to cooperate. High priority as this is one of the few areas until M15 where sediment attenuation is possible.	Improved biotic habitat and reduced sediment loading of Mad River watershed to Winooski and Champlain Basins. Reduced risk of future structural damage.	Town of Warren, RMP, MRCP. Cost of corridor acquisition or easement acquisition. Or dev. & mgmt. rights	Limit structural development of Riverside park.
M16-2 C-F departure	Channel experienced a departure of C to F (incision 2.1, entrenchment 1.2) and	Protect corridor in the upper reach to allow for channel adjustment and sediment	Feasibility depends on willingness of landowners to	Improved biotic habitat and reduced sediment	RMP, MRCP. Cost of corridor acquisition or	Convert low-intensity agricultural

Project #, Stream Type, Evolution Stage, RGA, RHA	Site Description and Importance, Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits (All projects are aimed at achieving RMP goals)	Potential Partners and Costs	Land Use Conversion
III Fair Fair	has lost floodplain access. Armoring in upper reach along Rodger's parcel.	attenuation. Remove bank armoring on left bank where future meanders will not impact Route 100.	cooperate. High priority because attenuation areas are limited in reach.	loading of Mad River watershed to Winooski and Champlain Basins.	easement acquisition. Or dev. & mgmt. rights	lands to forest.
M16-3 C-F departure III Fair Fair	Channel experienced a departure of C to F (incision 2.1, entrenchment 1.2) and has lost floodplain access. Altered by channel straightening and bank armoring, and constriction from Rt 100, increasing stream power. Some riprap being undermined.	In areas without building and road constraints, restore incised section of reach through "active" restoration of bed forms and/or floodplain features in equilibrium with channel bed elevation and increased stream power. Protect the stream corridor and plant buffer vegetation in conjunction with restoration projects.	Medium – high priority as there is no recently abandoned floodplain, but there are some potential areas where floodplain could be lowered. Appears to have been depositional reach in past.	Improved biotic habitat and reduced sediment loading of Mad River watershed to Winooski and Champlain Basins.	RMP Relatively high to excavate new floodplain. Additional costs in corridor easements/ acquisition & plantings	Convert low-intensity agricultural lands to forest.
M17-1 B to F departure IV Fair Good	Reach is in a bedrock gorge with some aggradation observed. Wooded buffer is greater than 100 feet. 50 Feet of riprap was on the left bank at the Bradley Brook confluence.	Protect stream corridor to prevent encroachment and buffer clearing.	Low priority for corridor protection due to the wooded corridor and unlikely encroachment pressure.	Maintained buffer for input of LWD and shading for biotic habitat.	RMP, MRCP Cost of corridor acquisition or easement acquisition.	Largely forested corridor.
M18-1 Ba I Fair Good	Reach in a rock gorge downstream of the Warren Crib Dam and confined by bedrock banks. Channel adjustment is unlikely due to bedrock. Some of the	Protect the woody vegetation in the corridor to prevent further clearing. Possibly plant buffer in area just downstream of M19 reach break.	Low-Medium priority for protection because current encroachment has not impacted channel stability (due to bedrock controls).	Preserves wooded setting of the village. Maintained buffer for input of LWD and	Town of Warren. Low cost to implement policy.	Residential, Warren Village. No "conversion" would be needed - only

Project #, Stream Type, Evolution Stage, RGA, RHA	Site Description and Importance, Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits (All projects are aimed at achieving RMP goals)	Potential Partners and Costs	Land Use Conversion
	Warren Village development encroaches into the corridor.			shading for biotic habitat.		new develop. limited.
M19A-1 C-F departure III Fair Fair	Stream corridor included residential development, roads, and low buffer width. A departure from C to F had occurred and the channel lacks floodplain access (incision 2.01). May have been a B type before the crib dam.	Adopt a no filling or cutting in the stream corridor policy to prevent further encroachments.	High feasibility. High priority due to current level of fill and development.	Maintained buffer for input of LWD and shading for biotic habitat. Reduced property damage.	Town of Warren. Low cost to implement policy.	Residential, Warren Village. No "conversion" would be needed - only new develop. limited.
M19A-2 C-F departure III Fair Fair	This segment has been straightened and partially armored and is influenced by sedimentation upstream of the Crib Dam. Channel is aggrading and attempting to widen but hindered by riprap application.	Remove Crib Dam. Investigate whether allowing some of the coarse gravel sediment to move downstream would cause negative impacts to infrastructure or channel adjustments downstream.	High priority due to the structure being non-essential. Recommended to be done in conjunction with corridor protection of sediment attenuation areas downstream (i.e., reach M16).	Improved biotic habitat and fish migration. Reduced flood/erosion risks. Improvement of incision in downstream reaches (M16)	High cost, especially if sediment needs to be removed. Town of Warren, RMP, USCOE	Possibly controversial due to age of dam/historical nature. Some residential properties and lawns may be reconfigured for new channel dimensions.
M19A-3	Covered Bridge north of Warren Village. Channel is aggrading and attempting to widen but hindered by riprap application.	Replace covered bridge or widen the bridge footings to accommodate the equilibrium channel width.	High priority if crib dam removed due to bed changes and potential increased adjustments.	Improved biotic habitat. Reduced flood/erosion risks. Improvement of incision in downstream reaches (M16)	VTAOT, Town of Warren	Possibly controversial due to historic significance of bridge. No major land use conversion required.

Project #, Stream Type, Evolution Stage, RGA, RHA	Site Description and Importance, Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits (All projects are aimed at achieving RMP goals)	Potential Partners and Costs	Land Use Conversion
M19A-4	Stream corridor included residential development, roads, and low buffer width. Project area is upper segment from bedrock controls down to riprap on left bank - length approx. 500 feet.	High priority corridor protection in upper segment. Prevent further structural development and plant woody buffer.	Difficult due to numerous small parcels and existing encroachments.	Improved biotic habitat. Reduced flood/erosion risks.	Low - cost of plant materials and volunteers. Town of Warren, RMP, FMR, Landowners	Some lawns and yards would be converted to woody buffer.
M19B-1 C-F III Fair Fair	Upstream of Rt 100 - Channel is overwidened and confined by Route 100. The channel is incised (IR=2.8) and has riprap preventing bank erosion and transferring power downstream. Two bedrock ledges control the grade at the downstream end.	Restore the incised reach through protecting the corridor on the left bank if possible and recreate some floodplain on the left bank, either through floodplain lowering or installation of sediment trapping grade control structures to attenuate flow and sediment.	Medium high priority as constraints and constrictions exist with limited options from this area downstream past the snowmaking pond. This is the last area before Warren Village to reduce velocities or attenuate some sediment.	Improved biotic habitat. Reduced flood/erosion risks.	High cost to lower floodplain. RMP	Current Bobbin mill and access road would likely require relocation, unless benefits can be gained from the small terrace areas downstream on left bank
M19B-2	The Rt 100 bridge at the downstream end has a wide span at the roadbed, however large amounts of riprap fill the channel and floodplain sides in a trapezoid shape.	Widen rip rapped banks to reduce flood flow constriction and sediment discontinuity.	Requires coordinating with VTRANS. Moderate costs associated with rock removal.	Reduced erosion pressure on banks upstream of bridge.	VTRANS, VTAOT. Cost of Equipment and stabilization materials.	Not significant.

Abbreviations:

RB/LB: Right Bank/Left Bank (facing downstream)

MF: Mass Failure

5-Year Plan Review/Maintenance



After Plan Adoption-Annually Implement and Evaluate



Fifth Year, and After Major Disaster Evaluate and Revise

