Waterbury Town and Village, VT Local Hazard Mitigation Plan
May, 2012
Adopted December 3, 2012
Prepared by the Town and Village of Waterbury and CVRPC

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1. Introduction

The impact of expected, but unpredictable natural and human-caused events can be reduced through community planning. The goal of this Local Hazard Mitigation Plan is to provide a local mitigation plan that makes the Town and Village of Waterbury more disaster resistant.

Hazard mitigation is any sustained action that reduces or eliminates long-term risk to people and property from natural and human-caused hazards and their effects. Based on the results of previous Project Impact efforts, FEMA and State agencies have come to recognize that it is less expensive to prevent disasters than to repeatedly repair damage after a disaster has struck. This Plan recognizes that communities have opportunities to identify mitigation strategies and measures during all of the other phases of emergency management – preparedness, response, and recovery. Hazards cannot be eliminated, but it is possible to determine what the hazards are, where the hazards are most severe, and identify local actions that can be taken to reduce the severity of the hazard.

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

2. Purpose

The purpose of this Local Hazard Mitigation Plan is to assist the Town and Village of Waterbury in recognizing hazards facing the region and the municipality and identify strategies to begin reducing risk.

Waterbury strives to be in accordance with the strategies, goals and objectives of the Vermont State Hazard Mitigation Plan, including an emphasis on proactive pre-disaster flood mitigation for public infrastructure, sound floodplain and river management practices, and fluvial erosion risk assessment initiatives.

3. Community Profile

The Town and Village of Waterbury are located in the northwestern corner of Washington County. Although the two are separate municipalities, the two are socially, economically, and politically intertwined. Village residents are also town residents, but not all town residents are village residents. Throughout this document, references to “Waterbury” include both the town and village; references to the “village” refer only to the incorporated area of Waterbury Village.

Waterbury is bordered by the Lamoille County Town of Stowe to the north, by Middlesex to the east, by Duxbury and Moretown to the south and by the Chittenden County Town of Bolton to the west. The area of Waterbury is 49.85 square miles and the landscape varies from prominent mountains to broad river valleys. According to the Municipal Plan for Town & Village of

Waterbury "the Green Mountain and Worcester Ranges, extending north and south, respectively define the town's western and eastern boundaries. Waterbury's settled areas are more gently rolling, except within Waterbury Village, which lies largely in the level floodplain of the Winooski River Valley." As like many New England towns and villages, much of Waterbury's historic commercial and residential structures were developed in the relatively flat floodplain areas adjacent to prominent waterways, such as the Winooski River and date back to the mid 1800's. Waterbury Villages Historic Downtown District is also listed on the *National Register of Historic Places*.

Elevations in town vary from around 400 feet near the Winooski River, to over 3,000 feet in the Worcester Range, to approximately 3,400 feet atop Ricker Mountain." The Town and Village of Waterbury lie entirely within the Winooski Watershed. The Winooski River runs from east to west and forms the southern boundary of the Town and Village. Mountain streams and brooks including the Thatcher Brook and Little River feed into the Winooski. The largest body of water is the Waterbury Reservoir located at the base of the Green Mountains in the eastern region of the town. Following the devastating flood of 1927 the Army Corps of Engineers constructed the Little River Dam thereby creating the 840-acre reservoir.

The majority of Waterbury's major transportation routes run parallel to the Winooski River, such as Route 2, Interstate 89 and the New England Central Railroad. US Route 100 is the municipalities' other major thoroughfare which runs through a broad valley providing access to the Town of Stowe to the north. Much of Waterbury's commercial, retail and residential development is located along these transportation corridors. Waterbury has three main settlement areas where populations and services are concentrated – historic Waterbury Village, Colbyville (part of Waterbury Village), and Waterbury Center (unincorporated).

Waterbury Village, located at the intersection of Route 2 and Route 100 is the historic commercial, retail and residential hub of the town. It is home to the former Vermont State Hospital, a sprawling historic institutional campus comprised of almost 50 buildings, which is now the Waterbury State Office Complex. Prior to recent flooding from Tropical Storm Irene the Office Complex employed over 1,500 people. Waterbury Center village, located along Route 100, in relation, is a smaller yet defined historical settlement with a combination of retail, commercial and residential development.

According to the US Census, the population of Waterbury in 2010 numbered 5,094 living in 2,385 housing units. From the 2000 census, the population grew by 3.6%, but the number of housing units grew by 18.6%. Recent residential development continues to be scattered, low-density development within the Town's Medium and Low Density Zoning Districts. Commercial development primarily occurs along Routes 2 and 100, and within the Village area.

Waterbury's public wastewater facilities serve land only within the Village of Waterbury. All other development relies upon on-site waste disposal systems. In regards to water supply, the municipal system serves the Village and portions of Waterbury Center. Supply sources include three drilled wells in Waterbury off Sweet Road near the Stowe Town line and three surface

water sources over the town line in Stowe. Source protection plans have been developed to prevent water supply contamination. Green Mountain Power (GMP) provides electricity for the entire Town and maintains three power substations and two hydroelectric facilities in or partly in Waterbury.

In regards to public safety, the Village of Waterbury is patrolled by the Village Police Department. According to the 2010 Annual Report of the Village and Village Officers of Waterbury, the Village Police Department responded to 2,116 incidents which represents a 5% increase over 2009. There is one municipal fire department in Waterbury with two fire stations, one located on South Main Street in the Village of Waterbury and one located on Maple Street in Waterbury Center. Both stations provide dual response for calls in the Town and Village. The Fire Department also provides mutual aid assistance to surrounding communities as part of the Capital Fire Mutual Aid System. The Annual Report indicates that the Fire Department responded to a total of 201 incidents in 2010. The Waterbury Ambulance Service Inc (WASI) provides 24-hour ambulance service to the Town. WASI owns two ambulances which are housed at the Ambulance Station in Waterbury Center. According to the municipal plan "due to a substantial increase in the number of calls in the area involving mountain or back country rescues, WASI members have been working with local firefighters to develop and train a Waterbury-based back-country rescue team."

The 2008 Municipal Plan includes a description and proposed implementation strategies in regards to preservation of historic and natural resources and protecting public safety. The Town and Village of Waterbury Zoning Amendments, dated March 30, 2011 contains Flood Hazard Regulations. Waterbury has developed an Emergency Operations Plan and approved a Rapid Response Plan in 2006. In response to the devastating effects of recent flooding from Tropical Storm Irene, the Federal Emergency Management Agency (FEMA) designated Waterbury for the development of a Long Term Community Recovery (LTCR) Plan. FEMA staff has been working with our local officials, non-profit organizations, and residents to carry out this Plan and help develop a group of projects to be implemented as part of the long-term recovery effort.

4. Planning Process and Maintenance

4.1 Planning Process

Village residents are also town residents, but not all town residents are village residents. Throughout this document, references to "Waterbury" include both the town and village; references to the "village" refer only to the incorporated area of Waterbury Village. Unless otherwise specifically stated as Town or Village, "Waterbury" refers to the entire planning area.

The Central Vermont Regional Planning Commission (CVRPC) coordinated the Waterbury Local Hazard Mitigation Plan process. CVRPC was contacted by the Community Planner, Steve Lotspeich, and sent area specific hazard mitigation material for review. After assessing the material, CVRPC staff held a meeting along with members of the municipal staff on December 8, 2011 at the Municipal Offices. The Waterbury Hazard Mitigation Meeting focused on assessing past mitigation projects and compiling information on its current and future hazard

mitigation programs, projects and activities. The committee for the 12/8/2011 meeting was formed in an ad hoc manner to update the plan. For the next update, a committee will be formed in a similar manner with members from the Planning Commission, Village Board of Trustees, Select Board, road crew, and emergency services.

Attendees included:

- Steve Lotspeich, Community Planner (Town and Village)
- Rebecca Ellis, Town Select Board Chair & State Representative
- Alec Tuscany, Public Works Director (Town and Village)
- Bill Shepeluk, Municipal Manager (Town and Village)
- Annie Geratowski, FEMA Long Term Community Recovery
- Shannon Burke, FEMA Long Term Community Recovery
- Clare Rock, Zoning Administrator (Town and Village)
- Jen Mojo, CVRPC

Preparation for the meeting included a review of the Waterbury Municipal Plan, Waterbury Rapid Response Plan (Town and Village), 2010 Town Report (Town and Village), 2001 Waterbury All Hazards Mitigation Plan (Town and Village), 2011 Waterbury Zoning Regulations (Town and Village), 2011 Vermont State Hazard Mitigation Plan, Winooski Basin Plan Draft 2011, Mid Winooski Phase 1 Stream Geomorphic Assessment 2007, and newspaper articles. Information from these documents was incorporated into this plan. The Waterbury Hazard Mitigation Meeting focused on assessing past mitigation projects and compiling information on its current and future hazard mitigation programs, projects and activities.

The meeting indicated that the Town and Village are most vulnerable to dam failure, flood/flash flood/fluvial erosion, hurricane/tropical storm/severe storms, winter storm/ice storm/extreme cold with power failure. Damages from flood-related events pose the greatest threat to the municipality, as demonstrated by the effects of the recent tropical storm Irene, and will therefore be the focus the Hazard Mitigation Plan.

Additionally, long term flood mitigation strategies were discussed during the FEMA sponsored long term recovery meetings due to the damages caused during Tropical Storm Irene. A “flood mitigation” committee was formed during the process and met on four separate occasions during the months of December and January. Committee members included residents of Waterbury Village and Town, representatives from the Regional Planning Commission, and a representative from the State. Mitigation strategies identified from these meetings are outlined in the Hazard Mitigation Activities matrix. The mitigation strategies identified by the flood committee aim to reduce damages to existing and future developments in the Town and Village.

The public participated in the development of the draft that CVRPC placed a notice for additional public comment. A notice of the draft update was also available through the Front Porch Forum web newsletter and the local newspaper, The Waterbury Record and by request from CVRPC for public review. Hard copies of the plan were available for review and comments

from 12/26/2011 to 1/20/2012 at the Town Offices and Waterbury Library. 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 Moretown, Duxbury, Middlesex and Worcester. No comments were received from the public. Public comments submitted in the future will be reviewed by the Community Planner (and CVRPC Staff dependant on funding) and attached as an appendix. In the future, the draft plan will be made available during Town Meeting and other local meetings with State and local officials to allow for more public comment and review. After Approval Pending Adoption, the plan will go before the Select Board and Village Board of Trustees for adoption.

This Waterbury Local Mitigation Plan will be submitted as a multi-jurisdiction plan for the Town and Village of Waterbury.

Existing Programs, Projects & Activities

Waterbury Town and Village share mitigation programs, projects and activities. Waterbury Town and Village participate in the following ongoing or recently completed programs, projects and activities.

<u>Community Preparedness Activities</u>

- Rapid Response Plan, 2006
- Emergency Operations Plan
- Capital Improvement Plan (including equipment replacement)
- Waterbury Safe Routes to School Team

<u>Hazard Control & Protective Works</u>

- Maintenance Programs (Bridge & Culvert Inventory – 2006)
- Mutual Aid Agreement

<u>Insurance Programs</u>

- Participation in NFIP

<u>Land Use Planning/Management</u>

- Waterbury Municipal Plan, adopted 2008
- Waterbury Zoning Regulations, amended 2011
- Source Protection Plan

<u>Protection/Retrofit of Infrastructure and Critical Facilities</u>

- Emergency Shelters – Thatcher Brook Primary School, Waterbury Congressional Church, St. Leo's Hall
- Flood proofed Village Fire Station
- Dry Hydrants

Public Awareness, Training & Education

- Motor vehicle accident response training
- First responder CPR & hazmat trainings
- School Fire Safety Program

4.2 Plan Maintenance

The Waterbury Local Hazard Mitigation Plan will be updated and evaluated annually at a May joint meeting of the Planning Commission, Town Select Board, and Village Board of Trustees. Updates and evaluation by the Planning Commission will also occur within six months after every federal disaster declaration and as updates to municipal plan, zoning regulations, and river corridor plans come into effect. The plan will be reviewed by the Select Board, Board of Trustees, Planning Commission, and public at the abovementioned meeting. CVRPC will help with updates or if no funding is available, the Waterbury Community Planner 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 and at the municipal offices, Front Porch Forum web newsletter, Waterbury Record newspaper, 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 the major business owners (Ben & Jerry's, Green Mountain Coffee Roasters, State of Vermont, etc), Revitalize Waterbury, and Thatcher Brook Primary School. 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 Community Planner.

Monitoring of plan progress, implementation and the 5 year update process, will be undertaken by the Community Planner. Monitoring updates may include changes in community mitigation strategies; new municipal 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 and Village Trustee meetings. Prior to the end of the five year period, the plan will undergo a formal update and submitted to FEMA for re-adoption following the process outlined the schematic found in the Attachments section.

Waterbury shall incorporate mitigation planning into their long term land use and development planning documents. It is recommended the Town and Village reviews and incorporates elements of the Local Mitigation Plan when updating the Municipal Plan, Zoning Regulations and Flood Hazard Area Bylaws. The mentioned documents address the Town and Village. The incorporation of the Local Mitigation Plan into the Municipal Plan, possible future zoning regulations and additional flood hazard bylaws will also be considered after federally declared

or local disasters. The Town and Village shall also consider reviewing future Winooski River Corridor planning documents for ideas on future mitigation projects and hazard areas.

5. Risk Assessment

5.1 Hazard Identification and Analysis

A natural hazard is a source of harm or difficulty created by a meteorological, environmental or geological event. The following natural disasters were discussed and the worst threat hazards were identified based upon the probability of the event and the community's vulnerability to the event. Hazards not identified as a worst or moderate threat may still occur. The probability of natural hazards within both Waterbury Town and Village are the same due to the similar topographic nature of the Town and Village, and lack of geographical specificity for certain hazards which puts the entire planning area at risk. Upon full review of the below mentioned hazards, hazards not identified as worst or moderate threats are not analyzed in the plan due to low frequency of occurrence, limited (if any) past damages and low cost benefit of possible mitigation measures. These hazards include drought, earthquake, structure fire, and tornadoes. Greater explanations and mitigation strategies of low threat hazards can be found in the State of Vermont's Hazard Mitigation Plan.

Hazard	Probability [1]	Community Vulnerability[2]	Worst or Moderate Threat
Landslide	Med	No	moderate
Dam Failures	Low	Yes	worst
Drought	Low	No	
Earthquake	Low	No	
Flood/Flash Flood/Fluvial Erosion	High/med	Yes	worst
High Wind	Med	No	moderate
Hurricane/Severe Storms	Med	Yes	worst
Tornado	Low	No	
Wildfire/Forest Fire	Low	No	
Winter Storm / Ice Storm/Extreme Cold with Power Failure	Med	Yes	worst

The following hazards were found to be most significant in the Town and Village of Waterbury:

- Dam Failure

[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)?

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

Moderate threat hazards to the Town and Village include:
- Landslide
- High Winds

Due to the frequent and severe nature of flooding events, Waterbury has identified flooding is the worst natural hazard within the municipality and will focus on mitigation efforts to reduce the impacts from flooding events.

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	Probability
Type of hazard	General areas within municipality which are vulnerable to the Identified hazard.	Types of structures impacted	Magnitude of hazard	Dollar value or percentage of damages	Likelihood of hazard occurring based upon past events: HIGH = Near 100% probability in the next year. MED = 10% to 100% probability within the within the next year or at least once in the next 10 years. LOW = 1% to 10% probability in the next year or at least once in the next 100 years.

5.2 Worst Threat Hazards

Dam Failure

Dam failure is the breeching of a structure retaining water which may potentially cause loss of life and property to those downstream. The largest dam of concern is the Waterbury dam that was built in response to the 1927 flood. The dam generates an average of 15,000,000 kilowatt hours annually. The dam is 1,845 feet long and 190 feet high. At normal water levels (592 feet),

the reservoir behind the dam contains an of 36, 800 acre feet of water. During maximum high water level periods (629.5 feet) the reservoir contains 82,100 acre feet of water. The dam was modified in 1957 and 1958 to provide safety for larger floods than were originally anticipated. To date there have been no failures of the dam and maintenance/repair work is performed on an ongoing basis by the State of Vermont.

Inundation modeling of the dam was performed by Vermont Center for Geographic Information in 2008 and identifies areas that maybe flooded if the dam were to breech. Within the inundation area are 646 structures and 720 properties. The total acreage of these areas is 1,633 acres. The total damage costs if the dam were to breech is $187, 200, 200 and represents 32% of the properties in Waterbury Town and Village area. The extent of flooding from a dam breach was not determined in CVRPC/VCGI model. Future modeling efforts undertaken could determine the flood depths. The map of the modeled area is an attachment in this plan.

The Town and Village have little communications with the operator, Green Mountain Power. There are currently sirens at the base of the dam to warn those nearby of water releases; however, the sirens are difficult to hear downstream. In 2010, a fisherman was killed during a release. The municipality is concerned about those (fishermen, swimmers, campers who are out of hearing distance of the siren.

Hazard	Location	Vulnerability	Extent	Impact	Probability
Dam Failure	Waterbury Dam – Little River	Properties and infrastructure Downstream – see attached map	Area - 82,100 acre feet of water, depth of flooding is unknown	$187,200,000 in potential property losses	Low

Winter Storm / Ice Storm/Extreme Cold with Power Failure

History of Occurrence (from NCDC website and FEMA DR List.) Due to the area-wide nature of winter storms, snowfall depths vary in and around the Village and Town of Waterbury:

Date	Event	Location	Extent
3/6/2011	Winter storm	Washington County, Waterbury	12-18” of snow, 10,000 customers lost power statewide
2/23/2010	Winter Storm	Washington County, Waterbury	20” of snow and 50,000 customers lost power statewide
2/22/2009	Winter Storm	Washington County, Waterbury	10-18” of snow, 30 mph wind gusts
2/1/2008	Winter storm	Washington County, Waterbury	3-7” of snow and ice ¼-1/2”thick, 50 mph wind gusts
2/14/2007	Winter storm	Washington County,	18-22” of snow

		Waterbury	
1/4/2003	Winter storm	Washington County, Waterbury	12-20” of snow
3/5/2001	Winter storm	Washington County, Waterbury	15-30” of snow
12/31/2000	Winter storm	Washington County, Waterbury	15” of snow
12/29/1997	Winter storm	Washington County, Waterbury	8-21” of snow
12/7/1996	Winter Storm	Washington County, Waterbury	12” of snow
3/21/1994	Winter storm	Washington County, Waterbury	5-11” of snow
11/1/1993	Winter storm	Washington County, Waterbury	10-20” of snow
1/3/1993	Freezing Rain	Statewide	¼” of ice

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.

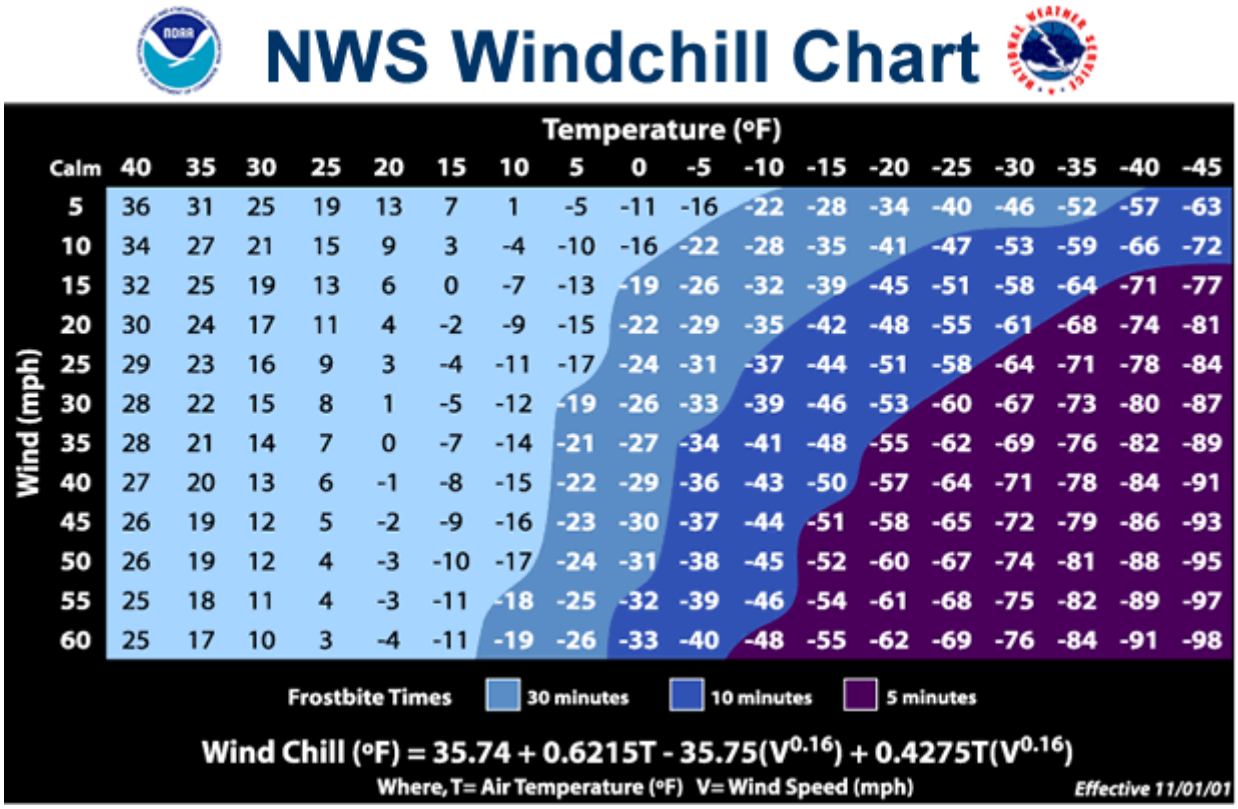
The physical impacts of winter storms are town wide due to the expansive nature of winter storms. For the next plan update, Waterbury will more closely monitor winter storms to determine the worst impacts possible on the Town. Based on past occurrences, the worst anticipated winter weather Waterbury could experience would be 2-3’ in 24 hrs of snow with more at higher elevations and several days of power outages. The worst wind chill temperature Waterbury Town and Village could experience is -60 ° F. Waterbury Town and Village could experience wind chill effects starting at temperatures of 10 ° F. The worst recent storm was in March 2011 and after that the Blizzard of 1888. A scale to measure the extent of winter storms is the Wind chill chart (see below).

Heavy snowfall –Waterbury Town and Village are 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 – Waterbury Town and Village are 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 – Waterbury Town and Village are 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.

In Waterbury, the water supply and associated infrastructure are at risk of freezing. The main source of Waterbury Village and Town's water supply is surface streams located in the Town. If the surface streams freeze, the Town must switch to backup water supplies from underground wells. However, the pumps for the wells do not have back up power generation if there is power failure. Frost at utility line depths can cause service and main line failures.

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 and Village of Waterbury. 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. Waterbury 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 Thatcher Brook Primary School and Waterbury Congregational Church are both Red Cross dedsignated shelters and are located in the Village; however, these locations do not have back up power supplies. Buildings with backup generators include the fire, highway, and water and sewer department buildings.

Hazard	Location	Vulnerability	Extent	Impact	Probability
Winter Storm/Ice Storm	Area Wide, Water supply surface streams	Utilities, trees, roads, old/under insulated structures, sensitive populations	18+" snow in March 2011 Storm in 24 hrs, Blizzard of 1888	additional sheltering/ plowing/ emergency services costs for town - $15,000	High/ Medium

Fluvial Erosion/Flash Flooding/Flooding

History of Occurrences: Local and County Wide Data – nearest flood gauges are Winooski Gauge, Waterbury Village and Mad River Gauge, Moretown (from NCDC website and FEMA DR List)

Date	Event	Location	Extent
8/28/2011	Flood/Tropical Storm	Statewide, Waterbury Town & Village	Winooski Flood gauge knocked out – above 423.3 feet (flood stage is 419 feet) – DR 4022
5/27/2011	Flood	Waterbury Town & Village	Winooski flood gauge at 423.3 feet DR 4001
4/11/2011	Flood	Waterbury Town & Village	Winooski flood gauge at 421.0 feet
10/01/2010	Flood	Waterbury Town & Village	Winooski flood gauge at 421.8 feet
1/19/2006	Flood, Ice jam	Waterbury Town & Village	Winooski flood gauge at 421.9 feet
12/17/2000	Flood	County Wide, Waterbury Town & Village	3" of rain in 24 hrs, $1 M in damages
6/27/1998	Flash Flood	County Wide,	3-6" of rain over 2 day period –

		Waterbury Town & Village	Mad River flood gauge at 14.13 feet (flood stage is 9 feet) DR 1228
1/19/1996	Flood; ice jam	County Wide	Data gap
8/4/1995	Flood	County wide, Waterbury Town & Village	$1.5 M damages; Mad River gauge at 8.12 ft
8/10/1976	Flood	County Wide, Waterbury Town & Village	Mad River flood gauge at 13.47 feet DR 518
9/22/1938	Flood	County Wide, Waterbury Town & Village	Mad River flood gauge at 16.34 feet
11/03/1927	Flood	County Wide, Waterbury Town & Village	Mad River flood gauge at 19.40 feet

Flooding/flash flooding/fluvial erosion is Waterbury Town and Village 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 areas. Fluvial erosion processes occur more quickly and severely during flood events. The low lying areas of Waterbury Village and Town along the Winooski River are most susceptible to traditional flooding. Steeper sloped areas and smaller streams in Waterbury Town and Village are more prone to flash flooding and fluvial erosion.

Flooding of land adjoining the normal course of a stream or river has been a natural occurrence since the beginning of time. If these floodplain areas were left in their natural state, floods would not cause significant damage. Development has increased the potential for flooding because rainfall that used to soak into the ground or take several days to reach a body of water now quickly runs off streets, parking lots and rooftops and through human-made channels and pipes.

The worst anticipated flooding varies throughout the Town and Village of Waterbury. The worst flooding event in Waterbury Village and Town's recorded history occurred in 1927, followed closely by T.S. Irene in 2011. Data from the Winooski flood gauge during both of these events is not available. During the 1927 flood, flood waters reached as high as 17 feet on certain State Complex buildings in the Village. During T.S. Irene up to 8 feet of flooding occurred in on these same buildings. On Main Street in the Village during Irene, the water was about 5 feet high. In the Town during Irene, flash flooding caused areas to flood 1-3 feet in lower areas. Lesser but more regular flooding occurs in Waterbury, with generally 1 -2 feet of flooding in low lying areas every two or three years. According to the Winooski River gauge, at the following water levels, the impact to surrounding areas will be:

Water level (above sea level)	Impact
421	WATER WILL APPROACH LOW LYING PARKING LOTS AT THE WATERBURY STATE OFFICE COMPLEX...AND ROWE FIELD IN WATERBURY WILL FLOOD. DOWNSTREAM IN RICHMOND...BRIDGE STREET AT THE WINOOSKI BRIDGE NEAR THE ROUND CHURCH WILL BE INUNDATED...AND THE RICHMOND PUBLIC PARK WILL FLOOD. THE RIVER WILL BE OUT OF ITS BANKS FROM WATERBURY DOWNSTREAM THROUGH RICHMOND...WITH CONSIDERABLE FIELD FLOODING.
419	WATER WILL FLOOD FIELDS BEHIND THE VERMONT STATE OFFICE COMPLEX IN WATERBURY. FIELD FLOODING WILL OCCUR FROM WATERBURY DOWNSTREAM THROUGH RICHMOND. IF RAIN IS WIDESPREAD...NORTH WILLISTON ROAD IN ESSEX MAY NEED TO BE CLOSED.
417	THE WINOOSKI FROM WATERBURY DOWNSTREAM THROUGH RICHMOND WILL BE AT BANKFUL. SOME MINOR FLOODING OF LOW LYING FIELDS WILL OCCUR.

In the future, Waterbury can better gather data for flooding extent by having individuals call in flood levels in areas around Waterbury.

Waterbury is located within the Winooski River Watershed. The Winooski River forms the border between Waterbury and the towns of Duxbury and Moretown on the south side of the river. Waterbury is drained by the Thatcher Brook, Little River and Graves Brook, which empty into the Winooski. A Phase I Stream Geomorphic Assessment has been performed on sections of these rivers and streams to date. The State and Waterbury are interested in performing Phase II studies and developing a river corridor plan for the area. A corridor management plan will provide strategies for river protection and restoration, as well as mitigate impacts of flooding and fluvial erosion.

The Phase I Assessment revealed extensive channel straightening and armoring of the Winooski River on the Waterbury border and tributaries within Waterbury. Development along river and tributary banks was also high in Waterbury. The majority of reaches in Waterbury were rated as fair to poor due to numerous impacts such as: river corridor development, berms and roads, riparian buffers, channel modifications, bank erosion and ice debris jam potential.

Waterbury Town and Village entered into FEMA's NFIP program on April 15, 1982 and have FIRM maps effective starting April 6, 1998. The Town and Village have recently developed interim flood hazard regulations and had a hearing in January, 2012 for final adoption. The new

regulations continue to limit development in the NFIP 100 year flood plain area. The new regulations aim to resolve compliance issues such as timing for issuance of permits and making repairs on damaged homes. There are no repetitive loss properties in Waterbury Town or Village. The Zoning Administrator is responsible for enforcement of the regulations of both the Town and Village.

Based on Waterbury's FIRMs, there are 221 structures and 585 properties located within the 100 year floodplain. The estimated loss for a severe flooding event is $152,100,000 based on average grand list values. There are no repetitive loss properties in Waterbury. Waterbury Town has 10 active NFIP policies for a total coverage amount of $1, 879,900. Waterbury Village has 72 active policies for a total coverage of $15,817,000. The Town does currently own some floodplain properties with conservation easements.

The municipality does currently have some flood protection measures in place. Dascomb Rowe Recreation Fields located in the Village serve as floodplain and helps prevent flooding of the State Complex. Also there are flood control reservoirs on three tributaries of the Winooski – Jail Branch in East Barre, North Branch in Wrightsville, and Little River in Waterbury.

Fluvial Erosion

Fluvial erosion is occurring primarily on the Thatcher Brook. Severe rain events cause greater rates of fluvial erosion along the stream banks. The most notable fluvial erosion areas along Thatcher Brook in the Town are:

- Perry Hill Road – undermining of culvert
- Route 100 – back of antique shop property is eroding away
- Kneeland Flats – scour
- Little River Road - $19,000 for repair work – rip rap
- Vicinity of Stowe Street (Village) – area repaired with rip rap for stream bank stabilization and to protect highway; sewer line damaged - $50,000 to repair

Flash Flooding

Flash flooding events have occurred at least a half dozen times since the late 1980's. Waterbury's small streams can easily become overwhelmed during heavy rain events and cause localized flooding. The Thatcher Brook is especially prone to flash flooding due to channel alterations. The Town roads are more susceptible to flash flooding due to their proximity to the smaller streams, although flash flooding does occur in the Village along the Thatcher Brook. Town roads frequently damaged by flash floods include:

- Barnes Hill Road – road washout
- Mountain View Drive
- Guild Hill Road
- Little River Road – receiving $19,000 FEMA reimbursement
- Class IV Roads
- Ring Road
- Perry Hill Road
- Kneeland Flats – culvert washout

Flooding

Flooding is not a new hazard to Waterbury. Waterbury experienced its worst flood in November of 1927. The 1927 flood caused flooding in the entire Village area. Some buildings within the State Complex had 6 feet of water on their second levels. Water on Main Street was 10 to 15 feet deep. The peak flow of the Little River for that event was an estimated 23,400 cfs (previous recorded maximum was 6,520 cfs). It was estimated $2,000,000 of damage was incurred from the flood. As a result of the 1927 flood, the Waterbury Dam was built to reduce future flood impacts.

Waterbury & Tropical Storm Irene

During Tropical Storm Irene, most of the Village of Waterbury was flooded. Its impacts were compared to those of the 1927 flood. The flood waters during Irene extended well beyond the mapped 100 year floodplain. Structures in the 100 year flood plain had anywhere from 3 to 7 feet of water on the first floor. The flood waters reached areas closer to the edge of 500 year floodplain. The flooding during Irene primarily occurred in Waterbury Village. Major streets in the Village (and associated buildings) that were flooded during Irene were:

- Adams Court
- Batchelder Street
- Elm Street
- Foundry Street
- Healy Court
- Moody Court
- North Main Street
- South. Main Street
- O'Hear Court
- Randall Street
- Union Street
- US Route 2
- Winooski Street
- Whalley Trailer Park
- State Complex Roads (and buildings)

Because of the severity of damages caused by Irene, FEMA has designated Waterbury for involvement in the Long Term Community Recovery process. Additional infrastructure damage includes the main waste water pump station. The repair costs to the main pump station are estimated to be $300,000. The municipal building was also badly flooded. The Town and Village are looking to apply for HMGP funds to repair both the waste water treatment plant and municipal building.

Over 200 private homes and businesses were flooded in the Town and Village plus all the 48 buildings in the Vermont State Office Complex. Residents within these homes and businesses had to be evacuated to higher grounds. Because the water started rising quickly during the day, residents could take action to relocate and secure belongings before nightfall. In this regard, many lives were saved due to the timing of the river rising. The total damage costs from Irene to Waterbury have yet to be calculated. ReBuild Waterbury, and its parent organization Revitalizing Waterbury, Inc. are two non-profit groups associated with assisting residents and businesses recover from Irene. The USA Today article at the end of the plan is just one of many that describes the damage and recovery efforts that are ongoing within Waterbury.

The final report from the Waterbury Long Term Recovery Meetings may also be used in conjunction with this hazard mitigation plan, as many of the projects listed in final report are a result of flood damage from Tropical Storm Irene.

The Waterbury Long Term Community Recovery process was started in December 2011. Waterbury was one of three Vermont communities chosen by FEMA to complete the Long Term Community Recovery (LTCR) Process. The goal of the process was to identify the highest priority projects for Waterbury in the areas of housing, social needs, economic development, natural and cultural resources, municipal planning capacity and infrastructure/flood mitigation. As the process progressed, sub committees for each category met roughly every other week from December to February. Each subcommittee was charged with identifying three to five possible projects for public review. Projects were assigned a champion who would see the project through completion. Projects selected by the public would be passed to the Town Select Board and/or Village Trustees for final approval. Below is a summary of projects that evolved out of the process:

Category	Project	Description	Cost	Sponsor/ Partners
Community Planning & Capacity Building	New municipal building	Build new building to collocate municipal offices, library, police, historical society, welcome center, nonprofit space	$3- 4 million	Town of Waterbury
Community Planning & Capacity Building	Utilization study for municipal building	Evaluate repurposing options of current municipal building	$15,000	Village of Waterbury
Community Planning & Capacity Building	Village Police Facilities	Long term location options to house Village Police Dept.	$70,000/ 2 years	Village of Waterbury
Community Planning & Capacity Building	Assistant Municipal Planner	Hire assistant planner to increase capacity of planning department	$65,000/ year	Town of Waterbury
Economic Development	Business Resource Center	Create resource center to stimulate rapid recovery of business community	$250,000 (first year)	Central VT Economic Dev. Corp.
Economic Development	Community Image Building	Marketing and branding campaign for Waterbury	$15-40,000	Revitalizing Waterbury
Economic Development	Waterbury Arts Center	Develop central community arts center	$5.5 million	Waterbury Activities & Cultural Center,

				MOXIE Productions, Revitalizing Waterbury
Economic Development	Food System Development	Hire a local food coordinator, expand local agricultural, culinary and tourism opportunities	$65,000/ 3 years	Waterbury – Duxbury Food Council
Energy, Efficiency & Transportation	Bicycle/Pedestrian System, Welcome Center, Wayfinding	Develop bike/ped master plan to improvement movement through town and increase foot traffic	$125 – 170,000+	Waterbury in Motion
Energy, Efficiency & Transportation	Center for Resilient Technology & Development	Research, consulting, and training center to create resilient communities and infrastructure	$800,000 - $1.6 million	Liz Schlegel
Energy, Efficiency & Transportation	Waterbury Community Energy	Town wide energy inventory	$220,000	Green Lantern Development
Energy, Efficiency & Transportation	Create Sustainable Transportation System	Town wide carpooling, car sharing, vanpooling, & mass transit	$52,000 + capital	Waterbury LEAP
Housing & Human Services	Coordinate Health Services & Childcare/Preschool Relocation	Assessments for health services & eldercare; Renovations/improvements at 3 child cares site	$150,000	Hunger Mountain Childcare
Housing & Human Services	Affordable Housing Development	Address affordable housing needs of Waterbury	$11 million	Central VT Community Land Trust
Housing & Human Services	ReBuild Waterbury	Provide case management, volunteer coordination, construction management and homeowner assistance	$918,000	Revitalizing Waterbury
Infrastructure & Flood Mitigation	Emergency Power Program	Purchase & install generators at critical facilities	$465,000	Town & Village of Waterbury
Infrastructure & Flood Mitigation	Flood Proof Main Sewerage Pump Station	Flood proof main pump sewerage station at treatment plant	$149,500	Village of Waterbury
Infrastructure	Waterbury	Design a study to model	$80-	Town and

& Flood Mitigation	Village Flood Study	"what if" scenarios and propose future flood mitigation actions	150,000	Village of Waterbury
Infrastructure & Flood Mitigation	Dac Rowe Flood Proofing & Recreation Enhancement	A study to develop flood proof and enhance recreational facilities at Dac Rowe field	$5-10,000	Town of Waterbury
Parks & Recreation	Director of Recreation	Hire a Recreation Director to develop recreational resources within Waterbury	$45,000	Recreation Committee; Town/Village of Waterbury
Parks & Recreation	Parks & Recreation Master Plan	Develop a master plan to address recreation needs and establish future goals	$25-45,000	Recreation Committee; Town/Village of Waterbury
Parks & Recreation	Little River – Village Connector Trail	Feasibility study of multi use recreation trail	$25-$30,000	Recreation Committee, Stowe Mountain Bike Club

As of writing this plan, projects are still in the early approval and funding stages. Projects in the infrastructure & flood mitigation category are included at the end of this plan; however many projects which involve rebuilding in State Office Complex buildings will be flood proofed as they are located close to or within the 100 year floodplain. These projects include affordable housing, childcare center & a new municipal building including a new library and police station.

In addition to the FEMA LTCR process, the staff of ReBuild Waterbury have been managing volunteers to assist homeowners with rebuilding and securing funding for damages. These community groups will remain in place after the FEMA team leaves to keep local recovery processes moving forward.

The majority of the State Office Complex in Waterbury is currently closed. It is going to cost an estimate of over $100 million to rebuild the complex in its current location. The State is proposing to reconstruct the state office complex that will be a combination of the historic buildings as well as a new 70,000 SF office building. To mitigate flooding, the new building will be wet and dry flood proofed, and parking will be on the first level. In addition to restoring floodplain function, many of the buildings in the floodplain will be demolished and retention ponds will be built. The Complex redevelopment should be completed by 2015. The State is working with Waterbury to determine which structures from the complex can be repurposed for use for Waterbury public services such as housing, a new municipal office/police headquarters/library and childcare facilities.

As a result of the majority of the State Complex closing, businesses have suffered severe economic losses. The total economic losses as a result of Irene and the closing of the State Complex have not yet been fully calculated. However, many services that relied on the business of State workers have seen their business cut by up to one half. ReBuild and Revitalizing Waterbury have been working with local business owners to provide technical and financial assistance. The State Agency of Commerce and Community Development, as well as Central Vermont Economic Development Corporation have also been providing assistance to access funding from local, state and federal programs, as well as acting as sponsors for LTCR projects.

The FEMA LTCR process has provided Waterbury with a long term community recovery plan that was developed with public input from numerous stakeholders from the town/village, and surrounding communities. The LTCR plan provides goals, policies and strategies to make Waterbury more resilient to numerous hazards and will help the community develop in a more sustainable manner. Although municipal capacity and funding to implement all of the projects within the LTCR plan is limited, Waterbury is lucky to have numerous community organizations and committees who are willing to research and see projects through completion.

Hazard	Location	Vulnerability	Extent	Impact	Probability
Flood/Flash Flood/ Fluvial Erosion	NFIP 100 year floodplain, Waterbury Village, Individual roads listed above, State Complex, Waste water plant, low lying areas in Waterbury Town	Private property, mobile home parks, roads, culverts, utilities	1927 flood – 10-15' on Main St., Waterbury Village	$152,100,000 based on grand list values (does not include State Complex)	High/Medium

Hurricane/Tropical Storms/Severe Storms

History of Occurrences: Local and County Wide Data – nearest flood gauges are Winooski Gauge, Waterbury Village and Mad River Gauge, Moretown (from NCDC website and FEMA DR List)

Date	Event	Location	Extent
8/28/2011	TS Irene	Statewide	Tropical Storm - ~6” rain , Mad River flood gauge at 19.07 feet; 9 ft is flood stage (Winooski gauge damaged) DR 4022
5/27/2011	Severe Storm, flash flooding	Waterbury Center (Town)	1” hail (H3), 3-5” of rain, 52 knot winds (Force 10) DR 4001, not a historical Winooski crest
7/21/2008	Severe storms, flooding	County Wide	Not a historical crest – flash flooding nature, 1” hail, 30 knot winds
8/25/2007	Severe Storms	Waterbury Center (Town)	65 mph wind gusts (Force 11), 1” hail (H3)
7/9/2007	Severe Storms, hail, flooding	Duxbury, Waterbury, Middlesex	1”-2.75” hail (H3-7). $20k property damages, DR 1715
6/19/2006	Severe storms	Waterbury (area wide)	55 knot winds (Force10), downed trees and power lines
8/1/2005	Severe Storm	Waterbury Center (Town)	1” hail (H3)
9/16/1999	Tropical Storm Floyd	Statewide	Tropical Storm DR 1307, not a historical crest
6/17/1998	Severe Storms	County Wide	3-6” of rain over 2 day period – Mad River flood gauge at 14.13 feet, DR 1228
5/29/1998	Severe Storms	Duxbury, Waterbury, Middlesex	50 knot winds, heavy rains, downed trees and power lines
7/15/1997	Severe Storms	County Wide	3-5” of rain, Not a historical crest
8/4-6/1995	Severe storms, flooding	County Wide	Mad River flood gauge at 8.12 feet , DR 1063
7/23/1990	Severe Storms, flash flooding	County Wide	DR 875, not a historical crest
8/4/1989	Severe Storms, Flooding	County Wide	DR 840, Mad River flood gauge at 10.23 feet
6/7/1982	Severe Storms	New England	14” of rain, $276 M damages
8/5/1976	Hurricane Belle	Statewide	Gale force winds, 2 deaths, DR 518
7/3/1964	Hail	County Wide	1.5” hail – H4
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.

Similar to flooding, the extent of severe storms is not well documented in Waterbury. The impact of storms is usually flood related. See extent for flooding in the above flood section. Wind impacts are town wide. Wind extent from storms is not well documented as there is no monitoring station in Waterbury. Estimates for wind are gathered from county wide data off the NCDC website. An estimate of the worst anticipated wind extent in Waterbury based on past occurrences would be Category 1 force hurricane winds and H8 hail according to the Hail/Torro scale. At a Beaufort number of 8-9, and hail sized H4 on the Torro/Hailstorm scale, Waterbury may start to experience high wind impacts and damages. In the future, Waterbury could consider installing a monitoring station to better gather data for wind events. Wind events can be recorded using the Beaufort, Saffir Simpson. Hail events can be recorded using the Torro/Hailstorm Scale.

In the future, extent data collected to measure extent of Hurricanes and Severe storms will be measured via the Beaufort wind scale (hurricane/severe storms), Saffir Simpson Scale

(hurricanes), and NWS/Torro Hail Scale (hail).

Beaufort Scale

Beaufort number	Wind Speed (mph)	Seaman's term		Effects on Land
0	Under 1	Calm		Calm; smoke rises vertically.
1	1-3	Light Air		Smoke drift indicates wind direction; vanes do not move.
2	4-7	Light Breeze		Wind felt on face; leaves rustle; vanes begin to move.
3	8-12	Gentle Breeze		Leaves, small twigs in constant motion; light flags extended.
4	13-18	Moderate Breeze		Dust, leaves and loose paper raised up; small branches move.
5	19-24	Fresh Breeze		Small trees begin to sway.
6	25-31	Strong Breeze		Large branches of trees in motion; whistling heard in wires.
7	32-38	Moderate Gale		Whole trees in motion; resistance felt in walking against the wind.
8	39-46	Fresh Gale		Twigs and small branches broken off trees.
9	47-54	Strong Gale		Slight structural damage occurs; slate blown from roofs.
10	55-63	Whole Gale		Seldom experienced on land; trees broken; structural damage occurs.
11	64-72	Storm		Very rarely experienced on land; usually with widespread damage.
12	73 or higher	Hurricane Force		Violence and destruction.

Saffir-Simpson Scale for Hurricane Classification				
Strength	Wind Speed (Kts)	Wind Speed (MPH)	Pressure (Millibars)	Pressure
Category 1	64- 82 kts	74- 95 mph	>980 mb	28.94 "Hg
Category 2	83- 95 kts	96-110 mph	965-979 mb	28.50-28.91 "Hg
Category 3	96-113 kts	111-130 mph	945-964 mb	27.91-28.47 "Hg
Category 4	114-135 kts	131-155 mph	920-944 mb	27.17-27.88 "Hg
Category 5	>135 kts	>155 mph	919 mb	27.16 "Hg
Tropical Cyclone Classification				
Tropical Depression	20-34kts			
Tropical Storm	35-63kts			
Hurricane	64+kts or 74+mph			

Combined NOAA/TORRO Hailstorm Intensity Scales

Size Code	Intensity Category	Typical Hail Diameter (inches)	Approximate Size	Typical Damage Impacts
H0	Hard Hail	up to 0.33	Pea	No damage

H1	Potentially Damaging	0.33-0.60	Marble or Mothball	Slight damage to plants, crops
H2	Potentially Damaging	0.60-0.80	Dime or grape	Significant damage to fruit, crops, vegetation
H3	Severe	0.80-1.20	Nickel to Quarter	Severe damage to fruit and crops, damage to glass and plastic structures, paint and wood scored
H4	Severe	1.2-1.6	Half Dollar to Ping Pong Ball	Widespread glass damage, vehicle bodywork damage
H5	Destructive	1.6-2.0	Silver dollar to Golf Ball	Wholesale destruction of glass, damage to tiled roofs, significant risk of injuries
H6	Destructive	2.0-2.4	Lime or Egg	Aircraft bodywork dented, brick walls pitted
H7	Very destructive	2.4-3.0	Tennis ball	Severe roof damage, risk of serious injuries
H8	Very destructive	3.0-3.5	Baseball to Orange	Severe damage to aircraft bodywork
H9	Super Hailstorms	3.5-4.0	Grapefruit	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open
H10	Super Hailstorms	4+	Softball and up	Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

The impacts of the most recent Tropical Storm, Irene, are outlined in the flood/flash flood/fluvial erosion section of the plan. There were minimal high wind effects from Irene.

In 1999, Tropical Storm Floyd passed through Vermont. The primary impact from Floyd was downed trees and power lines due to high winds. 5-7” of rain fell over the Central Vermont Region; however, flood impacts were offset by drought conditions caused earlier in the year.

In 1938, a category 1 hurricane hit Vermont and caused severe flooding. Windham County received the brunt of the storm. High winds destroyed forests, agricultural lands and did major damage to public and private infrastructure. The State suffered about $15 M in damages from the storm.

Hazard	Location	Vulnerability	Extent	Impact	Probability
Hurricane/ Tropical Storm/ Severe Storm	See flood locations for flooding areas, town wide for wind impacts	Large trees, power lines, culverts/ Bridges, private property	~6" rain – TS Irene ; Mad River flood gauge at 19.07 feet; 9 ft is flood stage (Winooski gauge damaged); Category 1 hurricane winds in 1938	1938 - $15M Statewide; total Irene costs TBD	Medium

5.3 Moderate Threat Hazards

Landslide

A landslide is the sliding of a large mass of rock material, soil, etc., down the side of a mountain or cliff. Landslides can be caused by rainstorms, fires, alternate freezing or thawing and/or by the steepening of slopes by erosion or human modification.

To date there have only been limited small slides in Waterbury Village and Town, that usually occur after heavy periods of rain. Slides have occurred on the following Town roads over the past 10 years:

- Lincoln Street
- Perry Hill Road
- Keefe Lane
- Kneeland Flats
- Little River Road
- Reservoir Road

Exact dates of occurrences for the slides were not recorded as they were not major. The extent of slides has not been recorded either due to the small scale. Based on the limited past occurrences, the extent of the worst anticipated landslide that could occur in Waterbury is estimated to be 200 cubic yards. Waterbury could experience damage with 50 cubic yard slides. The road crew repaired damages on an as needed basis. In the future, Waterbury can keep more detailed records of when slides occurred and how much it cost to repair damages. Extent of the landslides can be recorded according to the Alexander Scale for Landslide Damage when structures are involved or measuring the volume of fill displaced.

These areas in Waterbury are susceptible to slides due to the underlying clay soil layers, which slide when wet. To mitigate slides, the road crew stabilizes the susceptible areas with stone rip

rap, additional fill and gravel. The effect of the slides on the Town and Village has been limited due to the small size of the slides. According to the Public Works Department, the greatest impact of the slides is traffic delays while the road is being repaired. Over the past 10 years the municipality has spent roughly $50,000 to repair slide areas.

Hazard	Location	Vulnerability	Extent	Impact	Probability
Landslide	Lincoln St, Perry Hill Rd, Keefe Ln, Kneeland Flats, Little River Rd, Reservoir Rd	Road, trail and culvert infrastructure	200 cubic yards	$50,000 over 10 years	Medium

High Winds

History of Occurrence (from NCDC website and FEMA DR List):

Date	Event	Location	Extent
7/6/2011	Thunderstorm winds	County Wide	Damaging winds, 15,000 customers lost power Statewide
5/27/2011	Severe Storm, flash flooding	Waterbury Center (Town)	1” hail, 3-5” of rain, 52 knot winds
8/25/2007	Thunderstorm winds	Waterbury	56 knot winds
7/9/2007	Severe storms	County wide	2.75” hail, damaging winds
6/19/2006	Thunderstorm Winds	Waterbury (Town and Village)	55 knot winds
9/16/1999	TS Floyd	Statewide	Tropical Storm
5/29/1998	Thunderstorm Winds	Middlesex, Duxbury, Waterbury	50 knot winds, downed trees and power lines
7/15/1997	Severe Storms	County Wide	
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

High wind is defined as an event with sustained wind speeds of 40 m.p.h. or greater lasting for 1 hour or longer or an event with winds of 58 m.p.h. or greater for any duration. Thunderstorms can generate high winds and down hundreds of large trees within a few minutes. The State can also experience tornadoes, which are capable of damaging or destroying

structures, downing trees and power lines and creating injuries and death from collapsing buildings and flying objects.

A tornado is a mobile, destructive vortex of violently rotating winds having the appearance of a funnel-shaped cloud and advancing beneath a large storm system. The extent of tornados can be measured using the Enhanced Fujita scale. An estimate of the worst tornado extent anticipated by Waterbury is an EF0. Tornadoes are less common than hail storms and high winds, but have occurred throughout Vermont. Across the State, however, 34 tornadoes have been recorded between 1950 and 1999, injuring 10 people and causing over $8.4 million dollars in estimated property damage. Nearly all of these incidents occurred from May through August with most of occurring in the afternoon.

The extent of wind events in Waterbury area is not well recorded. However, based on past occurrences, the worst extent of wind events Waterbury could experience would be category 1 strength hurricane winds. Waterbury could start to experience wind damages from winds rated an 8-9 on the Beaufort Scale (see above.) Damages from wind are usually to roofs and power lines. In the past Waterbury has incurred roughly $50,000 of damages from wind events. In the future, Waterbury can install a monitoring station or train spotters to record events according to several different universal scales. These include the Enhanced Fujita Scale (tornados) and Beaufort Scale (high wind – see Severe Storms section):

Enhanced Fujita (EF) Scale		
Enhanced Fujita Category	**Wind Speed (mph)**	**Potential Damage**
EF0	65-85	**Light damage.** Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
EF1	86-110	**Moderate damage.** Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135	**Considerable damage.** Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light-object missiles generated; cars lifted off ground.
EF3	136-165	**Severe damage.** Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.

EF4	166-200	**Devastating damage.** Well-constructed houses and whole frame houses completely leveled; cars thrown and small missiles generated.
EF5	>200	**Incredible damage.** Strong frame houses leveled off foundations and swept away; automobile-sized missiles fly through the air in excess of 100 m (109 yd); high-rise buildings have significant structural deformation; incredible phenomena will occur.
source: http://en.wikipedia.org/wiki/Enhanced_Fujita_Scale		

As noted before, Waterbury's well water supply is susceptible if power failure occurs during a high wind event, as back up water supplies are without backup power generation.

Hazard	Location	Vulnerability	Extent	Impact	Probability
High Winds	Area Wide, Water wells	Power lines, trees, structures, well water pumps	Category 1 hurricane winds based on past occurrences	$50,000	Medium

6. Mitigation

6.1 Town Plan (2008) Polices that Support Local Hazard Mitigation

- The protection, maintenance, and continued functional use of Waterbury's historic structures, sites, and areas. (*Historic Development & Resources Goal*)
- Protect Waterbury's finite and renewable natural resources, and promote sound stewardship of public and private lands. (*Natural resources*)
- Provide and maintain safe, efficient, and integrated transportation facilities and circulation. (*Transportation Goal*)
- Provide public utilities, facilities, and services to ensure the public's health and safety, and to improve the quality of life in the Waterbury community. (*Community Facilities and Services*)

Waterbury's Municipal Plan will be updated no later than 2013. The Town is interested in adding goals related to mitigation planning goals.

The goals of this Local Hazard Mitigation Plan are:

- **To take actions to reduce or eliminate the long-term risk to human life and property from flooding.**
- **To take actions to reduce or eliminate the long-term risk to human life and property from hurricanes/severe storms/tropical storms.**

- **To take actions to reduce or eliminate the long-term risk to human life and property from dam failure.**
- **To take actions to reduce or eliminate the long-term risk to human life and property from winter storms/ice storms/extreme cold.**

Specific hazard mitigation strategies include:

- Upgrade existing and install additional future drainage systems so that they are adequate and functioning properly
- Educate all residents and business owners so that they are aware of the hazards that exist within Waterbury Town and Village and can protect themselves and insure their property
- Relocate emergency response services and critical facilities functions so that they 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 Identified Hazard Mitigation Programs, Projects & Activities

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

Hazards Mitigated	Mitigation Action	Local Leadership	Prioritization	Funding Resources	Time Frame
Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, tropical storm / Dam Failure	Property acquisition of Whalley Trailer Park	Village Trustees	High	HMGP	2-3 years after grant award
Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, tropical storm	Flood proof main waste water pump station	Village Trustees	High	HMGP	2-3 years after grant award
Flooding, flash floods, fluvial erosion/ Severe Storms,	Structural Elevation of 5 homes Village area (see locations in flood hazard analysis)	Village Trustees/ Town Select	High	HMGP	1-2 years

hurricane, tropical storm		Board			
Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, tropical storm	Mitigation reconstruction of municipal office building	Town Select Board	High	HMGP	2-3 years after grant award
Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, tropical storm	Dry flood proofing of 3 non-residential structures in Village area (see locations in flood hazard analysis)	Village Trustees/ Town Select Board	High	HMGP	1-2 years
Flooding/ Severe Storms	Re-engineer Winooski Street to construct dip at bridge	Town Select Board	High	HMGP	1-2 years
Flooding/ Severe Storms/ Dam Failure	Transform cornfield on State Complex property into wetlands retention/detention basin	Village Trustees/ Town Select Board	High	HMGP	1-2 years
Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, tropical storm	Structural retrofitting of residential and non residential areas (see locations on flood hazard analysis)	Village Trustees/ Town Select Board	High	HMGP	1-2 years
Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, tropical storm	Elevation of electrical systems on 20 properties (see locations on flood hazard analysis)	Village Trustees/ Town Select Board	High	HMGP	1-2 years
Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, tropical storm	Anchor fuel oil tanks on 50 properties (see locations on flood hazard analysis)	Village Trustees/ Town Select Board	High	HMGP	1-2 years
Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, tropical storm	Install sewer line valves on 50 properties (see locations on flood hazard analysis)	Village Trustees	High	HMGP	1-2 years

Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, tropical storm	Watershed-wide flood study/River profile	Town Select Board, Village Trustees, CVRPC, ANR	High	EPA, USDA, ANR	2 years
Severe Storms, hurricane, tropical storm /Winter Storms, ice storms	Develop sensitive populations survey and list	Town Select Board, Village Trustees Emergency Services	Medium	EMGP, Municipal funds	2-3 years
Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, tropical storm/ winter storms, ice storms	Develop back up power generation for well field, wastewater plant, and Thatcher Brook Primary	Village Trustees, Town Select Board Public Works	High	HMGP, Municipal funds	2 years
Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, tropical storm	Study of Dascombe Rowe Fields – repurposing for multi use recreation activities and floodplain restoration	Village Trustees, Town Select Board, ANR	Med	HMGP, Municipal funds	2-3 years
Flooding, flash floods, fluvial erosion /landslide	Adopt more stringent State Codes and Standards for roads	Public Works, Town Select Board, Village Trustees	Med	Municipal funds	2-3 years
High winds	Adopt codes and standards for mandatory use of connectors, brackets and mobile home tie downs with new construction	Town Select Board, Village Trustees	Med	Municipal funds, EMGP	3-4 years
Winter Storms/ Severe Cold	Provide training to residents on how to insulate homes (pipes,	Town Select Board,	Medium	EMGP	2 years

	attics) for extreme cold spells	Village Trustees PC, Fire Dept			
Dam Failure	Improve communication between State, GMP and Town regarding dam issues	Town Select Board	Med	Municipal funds	2-3 years
Emergency Preparedness	Install sirens downstream of Waterbury dam to warn of releases	State, Public Works	Med	Municipal / State funds	3 years
NFIP Compliance	Work with elected officials, the State and FEMA to correct existing compliance issues and prevent any future NFIP compliance issues through continuous communications, training and education	Planning Commission ANR	Med	HMGP	2 years

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 actions listed aim to reduce the future damages cause by hazards on existing and new development. The mitigation activities listed are 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.

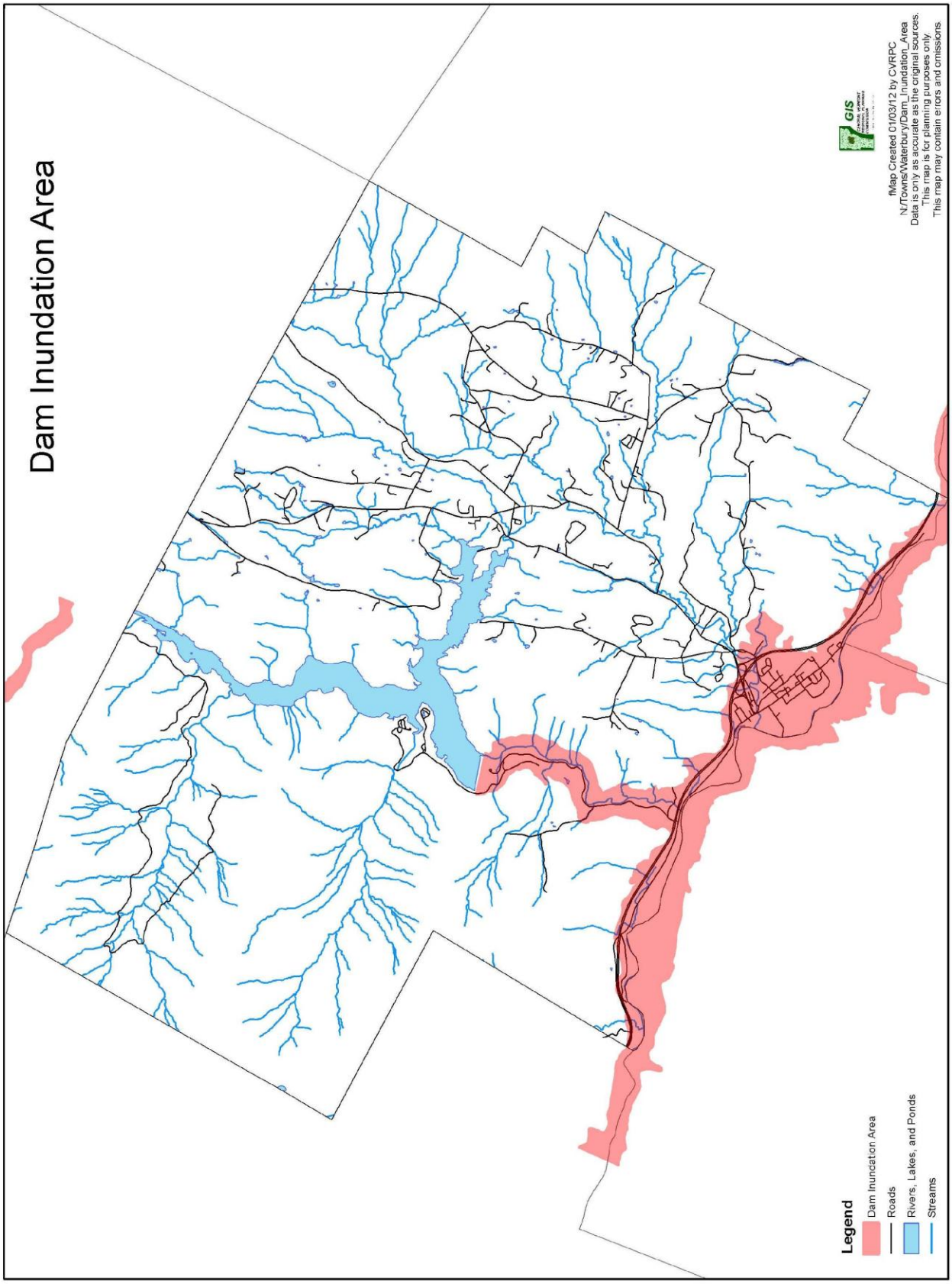
Waterbury understands that in order to apply for FEMA funding for mitigation projects that a project must meet FEMA cost/benefit criteria. The Town and Village must also have a FEMA approved Hazard Mitigation Plan.

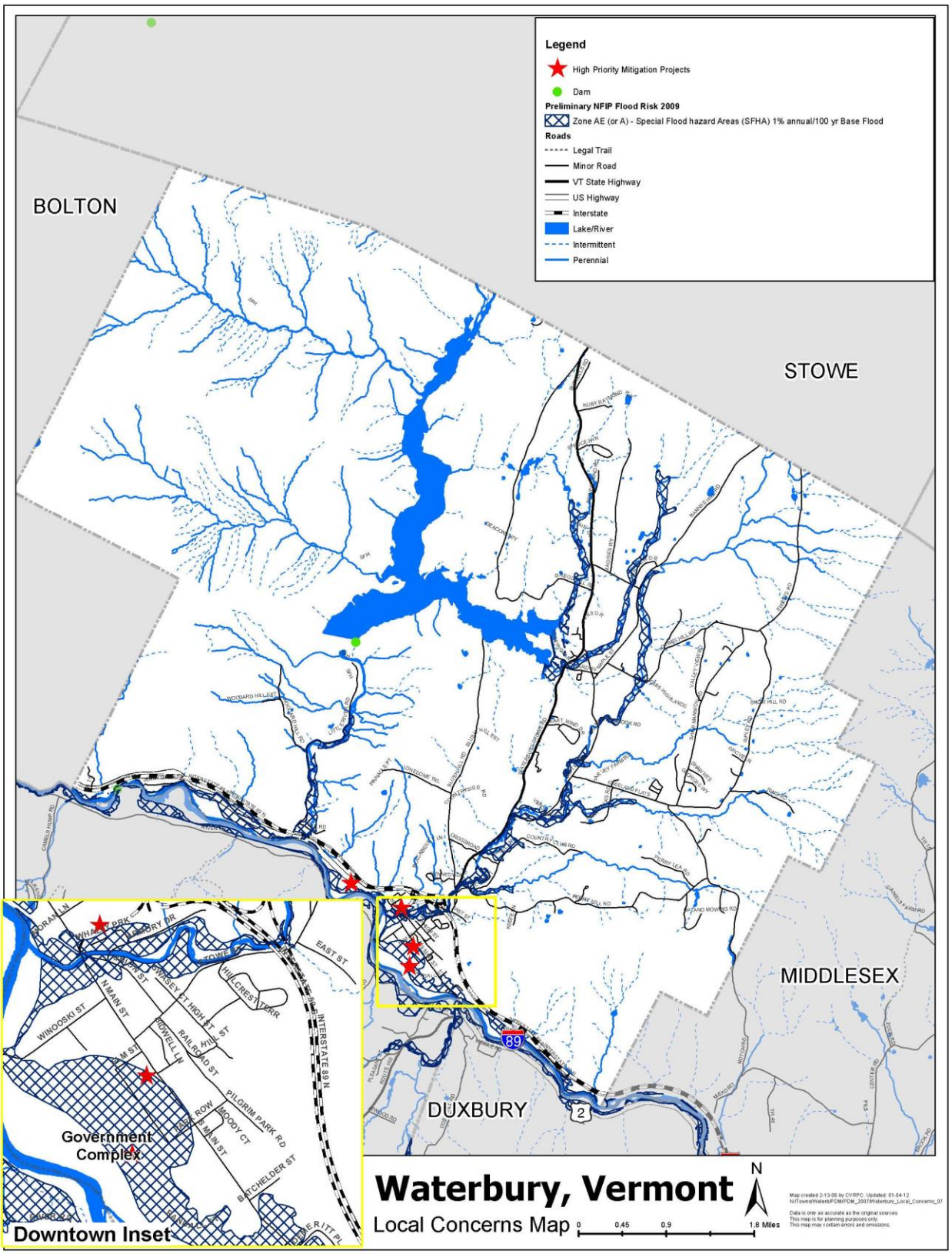
A High prioritization denotes that the action is either critical or potential funding is readily available and should have a timeframe of implementation of less than two years. A Medium prioritization is warranted where the action is less critical or the potential funding is not readily available and 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

Dam Inundation Map
Local Concerns Map
Irene photos
5 year plan review/maintenance process
Town Resolution Adopting the Plan


Dam Inundation Area
Legend
Dam Inundation Area
Roads
Rivers, Lakes, and Ponds
Streams
GIS
fMap Created 01/03/12 by CVRPC
N:/Towns/Waterbury/Dam_Inundation_Area
Data is only as accurate as the original sources.
This map is for planning purposes only.
This map may contain errors and omissions.


Legend
High Priority Mitigation Projects
Dam
Preliminary NFIP Flood Risk 2009
Zone AE (or A) - Special Flood hazard Areas (SFHA) 1% annual/100 yr Base Flood
Roads
Legal Trail
Minor Road
VT State Highway
US Highway
Interstate
Lake/River
Intermittent
Perennial
BOLTON
STOWE
MIDDLESEX
DUXBURY
Government Complex
Downtown Inset
Waterbury, Vermont
Local Concerns Map
N
0
0.45
0.9
1.8 Miles

The Winooski River flows over Winooski Street in Waterbury Village, Vt. (Glenn Russell - AP)

Waterbury FD, Main Street, Waterbury Village - By Glenn Russell, Burlington Free Press

Waterbury, Vt., residents try to recover from flood

By Sandra Block, USA TODAY

Updated 11/7/2011 12:10 PM

- **Comments** 32

Reprints & Permissions

WATERBURY, Vt. – When Tropical Storm Irene dumped 15 inches of rain on New England, residents of this village in northern Vermont expected the nearby Winooski River to overflow its banks. Few were prepared, though, for the flood's ferocity.

By Glenn Russell, Burlington Free Press

Firefighter Mandy Drake clears a storm drain in front of the Waterbury Fire Department in the wake of tropical storm Irene in August 2011. The building was evacuated as high water from the Winooski River flooded downtown.

By Glenn Russell, Burlington Free Press

Firefighter Mandy Drake clears a storm drain in front of the Waterbury Fire Department in the wake of tropical storm Irene in August 2011. The building was evacuated as high water from the Winooski River flooded downtown.

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On the afternoon of Aug. 28, the water rose so quickly that hundreds of residents were forced to abandon their homes and move to higher ground. When they returned, they found that the water had filled their basements and submerged their first floors. The floodwaters had overturned barrels of heating oil stored in the basements of homes and office buildings, turning neighborhoods into hazmat zones and permeating the air with oily fumes.

Some 200 homes in Waterbury were severely damaged or destroyed, representing nearly a third of all the Vermont homes damaged by Irene-related flooding.

- **VIDEO:** The aftermath of the flood and rebuilding effort in Waterbury, Vt.
- **STORY:** Students document the worst flood in decades
- **PHOTOS:** From Hurricane Irene

Today, the toxic smell is gone and most of the Dumpsters that lined the streets in the days after the flood have been replaced by contractors' trucks. Displaced homeowners are eager to rebuild, but the town's recovery faces significant challenges. Private insurance policies don't cover flood damage, and because floods here are rare — the last major flood was in 1927 — few homeowners and businesses had federal flood insurance. Only 71 policies were in effect in the village at the end of August, according to federal data. For all of Vermont, 3,665 flood insurance policies were in force when Irene hit.

Steve and Amy Odefey are among the fortunate. Even though the family has never had so much as a wet basement in their 100-year-old

house on Randall Street, they had flood insurance. "I'll be a lot happier writing the premium check now," Steve Odefey says.

Still, the Odefeys' insurance won't cover the loss of their personal property, nor will it cover the entire cost of repairs. For example, insurance will pay only to replace the portion of their first-floor walls that got wet, even though, as a practical matter, they'll need to replace the walls all the way to the ceiling, Odefey says. No contractor wants to match new drywall on the bottom half with the undamaged plaster-over-lath portion of the walls, he says.

After the waters ebbed, damaged roads and bridges were rebuilt fairly quickly. Rebuilding homes is taking much longer because homeowners must navigate a complex maze of state, federal and personal resources, says Chris Nordle, an attorney and member of ReBuild Waterbury, a non-profit formed to organize volunteers and raise funds for recovery efforts.

"When you're talking about 200 homeowners in a village of a couple thousand, you've got 200 little mini disaster-management programs going on," he says. "That's one of the things I have a hard time getting my head around."

Communal living

In addition to raising funds, ReBuild Waterbury is trying to find housing for residents left homeless by the flood. It's a tall order.

Some displaced residents are living in campers in their driveways, hoping that they can move back into their homes before it gets much colder. Others are staying with family and friends whose homes were unaffected by the flood. Nordle and his wife, Michelle Abajian, hosted a family of four and their two dogs for a month after the flood. M.K. Monley, an elementary school art teacher and member of ReBuild Waterbury, is providing temporary housing for a couple and their 1-year-old child. The Odefeys are staying with Reed and Maureen

McCracken, owners of CC Outdoor Store. They hope to be back in their home by Christmas.

Source: ESRI By Janet Loehrke, USA TODAY

Low-cost housing was scarce even before the flood; now it's practically non-existent. More than 40 mobile homes in Whalley Park in Waterbury were destroyed, according to the *Waterbury Record*. At Patterson Park in nearby Duxbury, all 19 mobile homes were flooded. Residents can't return to the parks until the owners repair damaged land and septic systems, and it's unclear whether that will happen. Residents who move or dispose of their trailers are ineligible for assistance from FEMA.

Businesses battle back

Jeffrey Larkin, co-owner of Arvad's Grill and Pub on South Main Street in Waterbury, hasn't had a drop of water in his building in the 22 years he's been in business. Not surprisingly, he doesn't have flood insurance. "Our building was not in the flood plain, so we were never required to have it," he says. "It's expensive and doesn't cover things like inventory."

Unlike homeowners, who can apply for up to $30,200 in federal disaster assistance, businesses aren't eligible for FEMA grants. The best they can hope for in terms of government assistance is a low-interest loan. Arvad's, which is open for business, borrowed $100,000

from the Vermont Economic Development Authority to repair flood damage and replace lost inventory, Larkin says.

John and Jen Kimmich, co-owners of the Alchemist Pub and Brewery on South Main Street, had flood insurance, but the policy didn't cover damage to the building's basement, "which is the lifeblood of our business," John Kimmich says.

By Jym Wilson, USA TODAY

Steve Odefey's house was severely damaged by flooding caused by Hurricane Irene.

Luckily, the Kimmiches have income from a new, small-production brewery that's a mile north of Waterbury. The brewery was scheduled to open Sept. 2, and "the timing couldn't have been more perfect," Kimmich says. "It kept us from going out and filling out job applications." They hope to reopen the Alchemist by winter 2012.

Some areas, such as the Killington ski resort area, didn't participate in the National Flood Insurance Program, says Jill Maynard-Nolan, an insurance agent based in Rutland. Even if business owners and homeowners there had wanted to buy flood insurance before Irene, she says, it would have been prohibitively expensive. The Killington Resort suffered significant damage from the flood but was open in time for the first snow of the season in late October.

Two years ago, Chris McInerney and Steve Pardoe invested more than $300,000 to add a restaurant to the Flat Street Brew Pub in downtown Brattleboro. That investment "pretty much washed down the river" after Irene, McInerney says.

McInerney hopes to have the bar open by Thanksgiving but doesn't know when, if ever, they'll be able to reopen the restaurant. "We had a ton of insurance. We just didn't have flood insurance," he says. "Our policy is 114 pages long, with a one-half-page flood exclusion. The flood exclusion voids everything else."

The flood created other perils for business owners that no amount of insurance will address.

One of Waterbury's largest employers was the state government, which employed nearly 1,600 workers at an office complex in the center of town. After the flood inundated the buildings' basements and ground floors, employees were reassigned to other state offices. Now the state is considering permanently closing the complex and selling the property, which is worrisome to local businesses such as Arvad's. "We're missing 1,600 employees that normally work and shop and eat and do all their business here," Larkin says. "It will be a long time before it (Waterbury) is revitalized if those people don't come back."

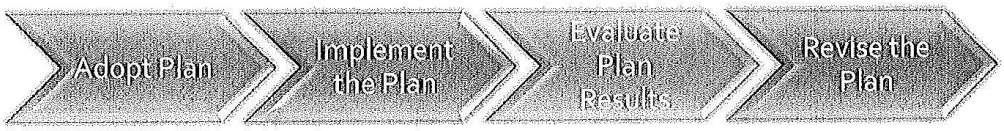
Sweat equity

Two days after the flood, representatives from Hope Force International, a disaster relief organization that has assisted flood victims in New Orleans and Nashville, showed up in Waterbury. Representatives from the organization visited every home that was affected by the flood and reported their findings to town leaders. Their conclusion: Nearly 80% of homeowners affected by the flood couldn't afford to pay contractors to repair all of the damage to their homes. Without volunteer labor to put up drywall, replace roofs and perform other tasks, the group was told, many Waterbury residents would never fully recover.

Reed McCracken, whose home and business were spared by the flood, says the group's message inspired him to volunteer for the rebuilding effort.

"Many of our closest friends in town were flooded," he says. "How do we go back to life as usual when everybody we hang out with is suffering and trying to rebuild their lives? It puts all of our problems in a totally different perspective."

5-Year Plan Review/Maintenance



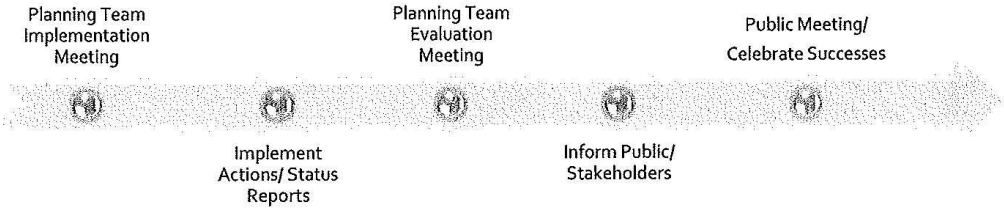
- Brief local leadership on plan approval
- Formally adopt plan
- Publicize plan approval and adoption
- Celebrate success

- Confirm/clarify responsibilities
- Integrate mitigaction actions
- Monitor and document implentation of projects and actions
- Establish indicators of effectiveness or success

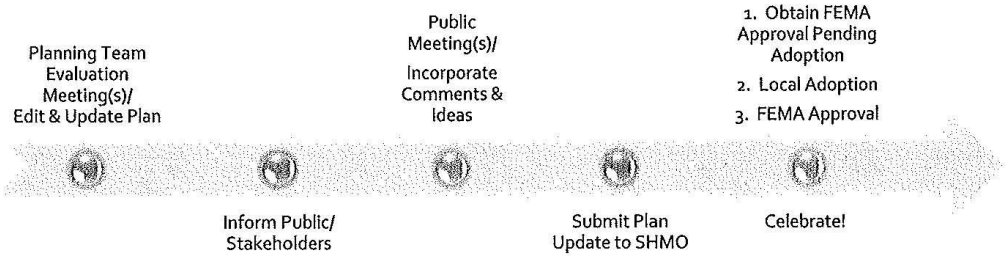
- Effectiveness of planning process
- Effectiveness of actions
- Document success & challenges of actions
- Update and involve community
- Celebrate successes

- Review factors affecting community's context
- Analyze findings; determine whether to revise process or strategy
- Incorporate findings into the plan

After Plan Adoption-Annually
Implement and Evaluate



Fifth Year, and After Major Disaster
Evaluate and Revise



CERTIFICATE OF ADOPTION

The Town of Waterbury Select Board
Village of Waterbury
Trustees
A Resolution Adopting the Local Hazard Mitigation Plan
December 3, 2012

WHEREAS, the Town and Village of Waterbury have worked with the Central Vermont Regional Planning Commission to identify hazards, analyze past and potential future losses due to natural and manmade-caused disasters, and identify strategies for mitigating future losses; and

WHEREAS, the Waterbury Local Hazard Mitigation Plan contains several potential projects to mitigate damage from disasters that could occur in the Town and Village of Waterbury; and

WHEREAS, a duly-noticed public meeting was held by the Town of Waterbury Select Board and Village of Waterbury Trustees on DEC 3, 2012 to formally adopt the Waterbury Local Hazard Mitigation Plan;

NOW, THEREFORE BE IT RESOLVED that the Town of Waterbury Select Board and Village of Waterbury Trustees adopt the Waterbury Local Hazard Mitigation Plan.

Chair of Town Select Board

President of Village Trustees

ATTEST

Town & Village of Waterbury Clerk