Town and Village of Waterbury,

Vermont

2018 Local Hazard Mitigation Plan

Prepared by the Town and Village of Waterbury, Waterbury Vermont

March 14, 2018

Effective Date of FEMA Final Approval

February 12, 2018

Date of Adoption by Waterbury Town and Village

Town and Village of Waterbury
28 North Main Street
Waterbury, VT 05676

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I. Introduction

Natural and human-caused hazards may affect a community at any time. They are not usually avoidable; however, their impact on human life and property can be reduced through community planning. Accordingly, this Local Hazard Mitigation Plan (hereafter referred to simply as the Plan) seeks to provide an all-hazards mitigation strategy that will make the community of Waterbury more disaster resistant and resilient.

"Mitigation" is defined as any sustained action that reduces or eliminates long-term risk to people and property from natural and human-caused hazards and their effects. Previous Federal Emergency Management Agency (FEMA), State and Regional Project Impact efforts have demonstrated that it is less expensive to anticipate disasters than to repeatedly ignore a threat until the damage has already been done. While hazards cannot be eliminated entirely, it is possible to identify prospective hazards, anticipate which might be the most severe, and recognize local actions that can be taken ahead-of-time to reduce the damage. These actions, also known as 'hazard mitigation strategies' can (1) avert the hazards through redirecting impacts by means of a structure or land treatment, (2) adapt to the hazard by modifying structures or standards or, (3) avoid the hazard through improved public education, relocation/removal of buildings in the flood zone, or ensuring development is disaster resistant.

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.

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 and resilient.

II. Purpose of the Plan

The purpose of this Plan is to assist the Town and Village of Waterbury in identifying all hazards facing the community, ranking them according to local vulnerabilities, and identifying strategies to reduce risks from hazards of highest concern. Implementation of this plan will make our community more resistant to harm and damages in the future, and will reduce public costs.

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.

This 2017 Plan is the five-year update of the previously approved Plan as conditionally adopted by the Town and Village governing bodies of Waterbury, Vermont on December 3, 2012 and approved by FEMA on March 13, 2013. This Plan reflects changes in development, progress in local mitigation efforts and changes in priorities. Several updates and improvements have been made that strengthen the Plan for the entire community to become more resilient in potential hazards.

Specific updates include:

- The Town and Village's inclusion in the Community Rating System (CRS)—October 2016
- Several long-term mitigation projects and strategies have been completed—2013-2017
- Extensive public outreach and education—Ongoing
- Updated Flood Insurance Rate maps—March 2013
- New Local Flood Hazard Zoning Bylaws—June 2016

Old assumptions have been challenged throughout, and new information has been added to make the plan stronger and more useful for the Waterbury officials and residents who will implement the hazard mitigation strategies in the future.

III. 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. 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 western 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 municipality's 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 that comprised at one time almost 50 buildings. Beginning in the late 1970's this hospital was transformed into the Waterbury State Office Complex, and was rebuilt after extensive damage from Tropical Storm Irene in 2011. The Complex employs over 1,000 state employees. 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. Since the 2000 census, the population grew by 3.6%, and 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. New development is restricted in identified flood prone areas. There is a delicate balance for allowing new and expanding development while maintaining mitigation priorities. It is a constant public process to educate property owners to threats and impacts of investments in high risk areas and the reasons for strict regulations for development.

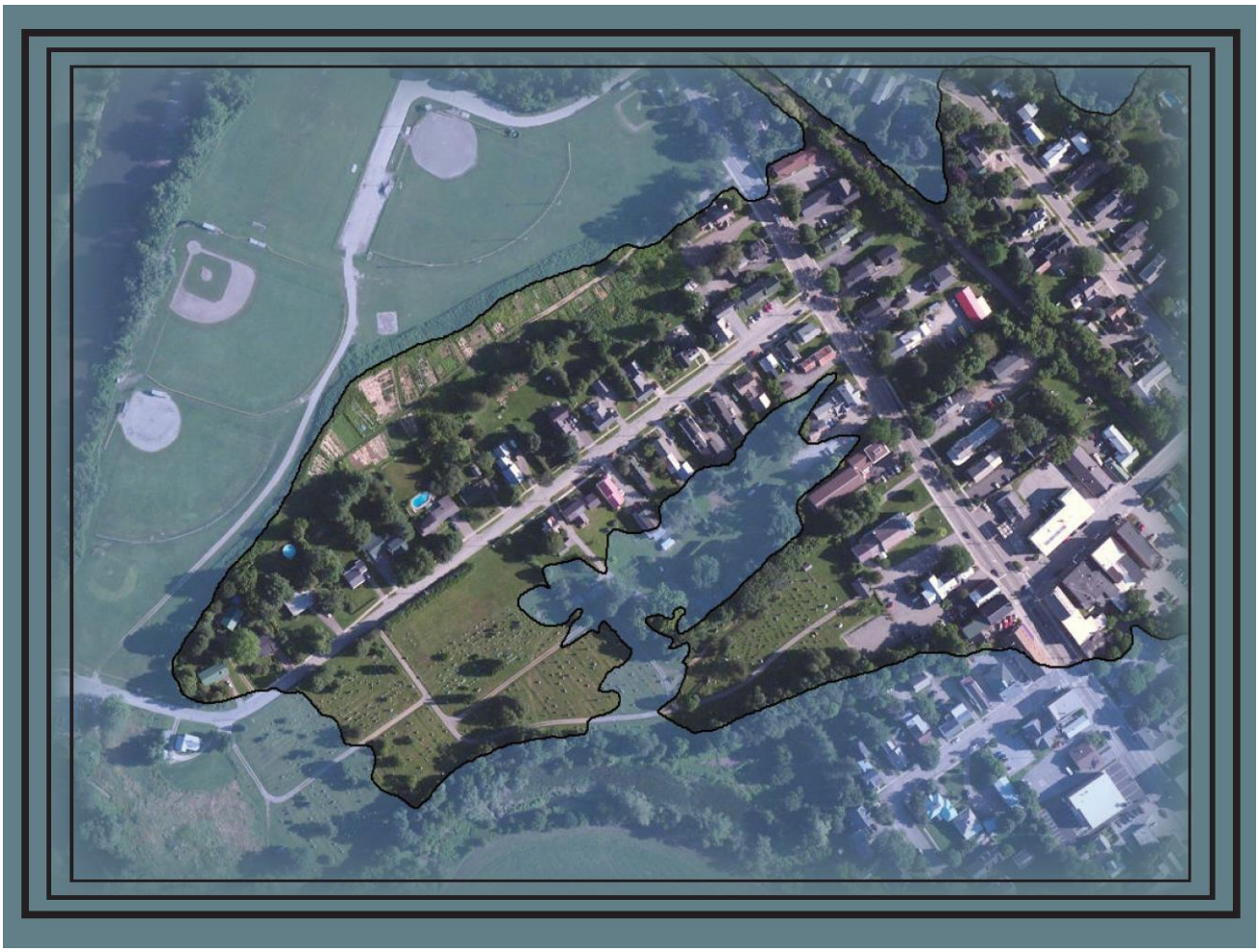
Waterbury's public wastewater facilities serve land only within the Village of Waterbury. All other development relies upon on-site waste disposal systems. In regards to water supply, the municipal system serves the Village, portions of Waterbury Center and the Duxbury-Moretown Fire District. Supply sources include three drilled wells in Waterbury off Sweet Road near the Stowe Town line and three surface water sources on Village-owned land—1,500 acre watershed 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.

The Village of Waterbury is patrolled by the Village Police Department, although as of June 2017, the village voters voted to eliminate the police function in the village area to become effective December 31, 2017. 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 participates in the Capital Fire Mutual Aid System. The privately owned and run 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.

The 2013 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 May 16, 2016 contain updated Flood Hazard Regulations. Both the Town and Village have participated in the National Flood Insurance Program (NFIP) since their original enrollment on 4/15/1982. Waterbury has developed a Local Emergency Operations Plan (LEOP) using the approved template from Vermont Emergency Management. The Village Trustees and Select Board members review and approve the adoption of the LEOP annually at a joint public meeting in the spring of each year. Local officials and volunteers have been trained in the Incident Command System (ICS). Waterbury has adopted the National Incident Command System as well.

In response to the devastating effects of recent flooding from Tropical Storm Irene in 2011, the Federal Emergency Management Agency (FEMA) assisted Waterbury in the development of a Long Term Community Recovery (LTCR) Plan. Local officials, non-profit organizations, and residents have carried out this Plan during the last five years and helped in the development and completion of identified projects as part of the long-term recovery effort. The map below was generated as part of a USGS study in coordination with FEMA as a

result of Tropical Storm Irene. It shows a small portion of the village flood area that impacted by the floodwaters. Additional information and excerpts from this study can be found in the Appendix at the end of this report.



Source for flood map above and reference for Flood Maps on following page:
Olson, S.A., 2015, Flood maps for the Winooski River in Waterbury, Vermont, 2014: U.S. Geological Survey Scientific Investigations Report 2015–5077, 25 p., http://dx.doi.org/10.3133/sir20155077.
ISSN 2328-0328 (online)

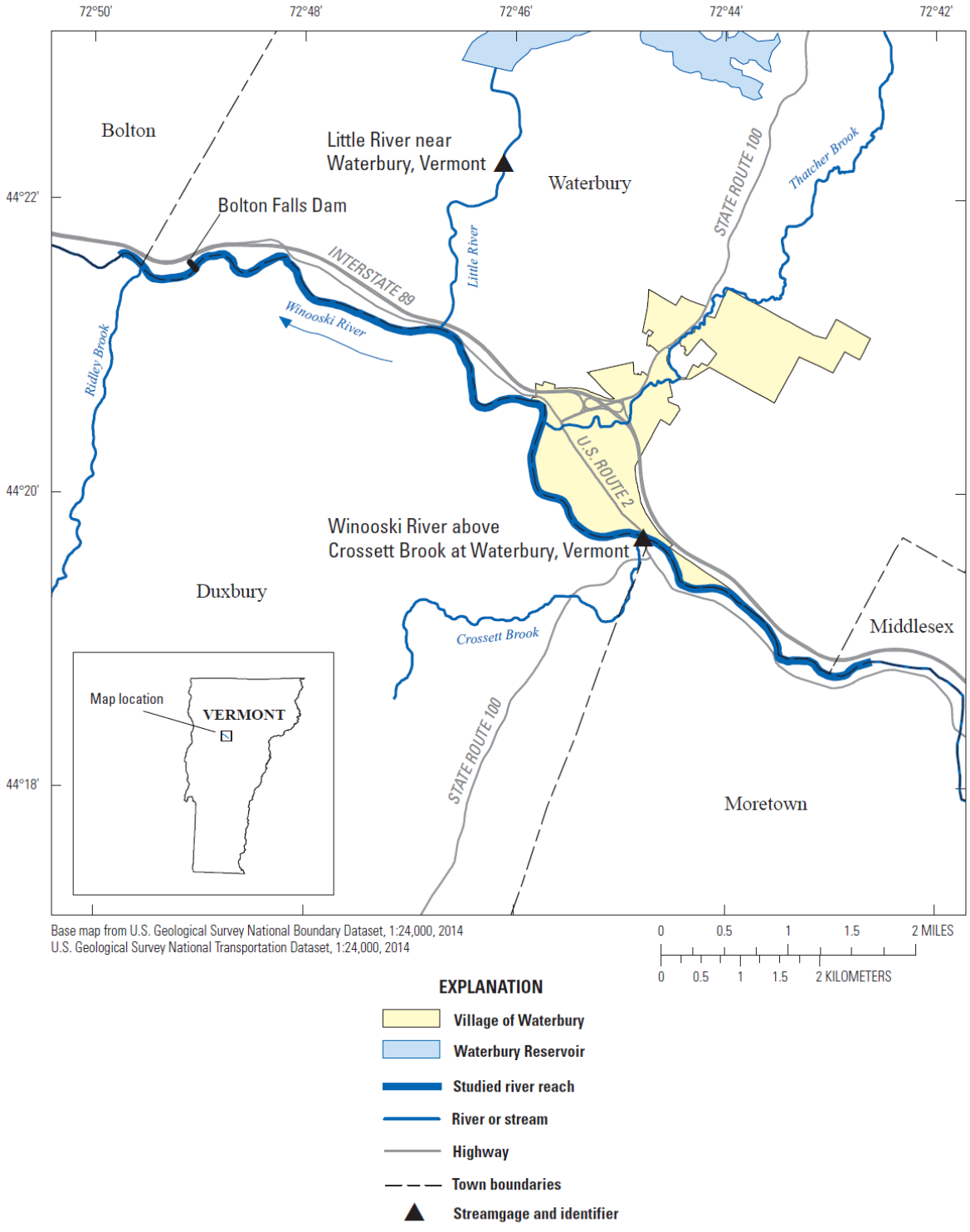


Figure 1. The Winooski River study reach in Waterbury, Vermont, and the locations of the Winooski River above Crossett Bk at Waterbury, VT (0428804) and Little River near Waterbury, VT (04289000) streamgages.

IV. The Planning Process

A. Plan Developers

The Select Board and Village Trustees jointly approved a Floodplain Management Working Group comprised of individuals with a wide range of expertise and community representation to review and assist with the coordination and outreach of long term mitigation and recovery efforts. The members of the Floodplain Management Working Group include:

This section of the Plan satisfies 44 CFR 201.6(b)(1)

Name	Role/Organization	How Participation Was Solicited
Natalie Sherman	Waterbury Village Trustee	The Floodplain Management Working Group was appointed by the Waterbury Select Board and Village Trustees in December 2013. Prior to this, most members had been serving on the Waterbury Long-Term Community Recovery (LTCR) Committee as a result of severe flooding in August of 2011. The LTCR had a two-year sunset date. Due to the magnitude of recovery efforts and mitigation projects, both governing bodies authorized the transition of the LTCR into the FMWG. Since 2013, the FMWG has been updating the projects and initiatives in the 2013 FEMA approved Town and Village of Waterbury Hazard Mitigation Plan. The staff coordinates with the Waterbury governing bodies, the Planning Commission and general public on a regular basis. Meetings with minutes occur monthly and annual reports are posted on the municipality's website, annual reports are printed in the town and village reports.
Steve Lotspeich	Waterbury Community Planner	
Dina Bookmyer-Baker	Waterbury Zoning Administrator	
Rebecca Ellis	Former Select Board member, Dep.Com., VT Dept. Environmental Conservation	
Ann Smith (initial participation)	Friends of the Winooski Watershed	
Laura Ranker	Central Vermont Regional Planning Commission (Emergency Mngt and Mitigation Planning)	
Rebecca Pfeiffer	Vermont Rivers Program, State of Vermont	
Dan Currier	Central Vermont Regional Planning Commission (GIS, River Studies, Transportation)	
Bill Woodruff	Waterbury Public Works Director, Waterbury Town and Village Emergency Management Director	
Barbara Farr	Waterbury, Long-Term Recovery Director, Waterbury Historical Society, Waterbury Town and Village Emergency Management Coordinator	

B. Plan Development 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. This 2017 Waterbury Local Hazard Mitigation Plan will be submitted as a multi-jurisdiction plan for the Town and Village of Waterbury.

This section of the Plan satisfies 44 CFR 201.6(b)(1) and 201.6(c)(1)

The Central Vermont Regional Planning Commission (CVRPC) coordinates with the Floodplain Management Working Group (FMWG) on the update of the Waterbury Local Hazard Mitigation Plan process. The Waterbury FMWG meetings learn from past mitigation projects while compiling information on its current and future hazard mitigation programs, projects and activities. This Plan reflects changes in development, progress in local mitigation efforts and changes in priorities.

Preparation of the new updated Plan included a review of the Waterbury Town and Village Municipal Plan, Waterbury Local Emergency Operations Plan (Town and Village), 2013 Waterbury Local Hazard Mitigation Plan (Town and Village), 2016 Waterbury Zoning Regulations (Town and Village), 2013 Vermont State Hazard Mitigation Plan, Winooski River Fluvial Erosion Plan, the River Corridor Plan and a Public Opinion Survey conducted in March 2017. Information from these documents was incorporated into this Plan. The Public Opinion Survey focused on assessing past mitigation projects and compiling information on its current and future hazard mitigation priorities, programs, projects and activities.

Public consensus indicates that the Town and Village are most vulnerable to flooding, potential dam failure, hurricane/tropical storm/severe storms and hazardous material incidents. Repetitive damages from flood-related events pose the greatest threat to the municipality, as demonstrated by the effects of the recent Tropical Storm Irene and the historic flood of 1927, and will therefore be the focus this Hazard Mitigation Plan.

The public participated in the development of the draft through the Public Opinion Survey that was widely available during March 2017. A notice of the draft update was also available through the Front Porch Forum, the municipal website, and the Waterbury Record for public review. Hard copies of the plan were available for review and comment at the Municipal Offices and Waterbury Library. The public was instructed to provide comments to the Waterbury Long Term Community Recovery Director via email or phone. Public comments were reviewed by the Floodplain Management Working Group and taken into consideration when developing this Plan. Future Plan updates will be discussed at public meetings with local officials to allow for ongoing public comment and review. The Select Board and Village Trustees will review and adopt the Plan pending FEMA approval and submit the Plan to VT Emergency Management and FEMA for final approval.

<u>Existing Programs, Projects & Activities</u>
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>

- Local Emergency Response Plan (LEOP)—Updated annually, April 2017
- Designated Emergency Management Director and Emergency Management Coordinator

- Capital Improvement Plan (including equipment replacement)
- Thatcher Brook Primary School Crisis Plan
- Member of the VT-Alert emergency notification system
- Coordination and tabletop exercise with neighboring communities of Duxbury and Moretown
- Business retention plan and communication plan for Main Street Reconstruction project and Route 100 Repaving project
- Study of town-wide need for police services

Hazard Control & Protective Works

- Maintenance Programs (Bridge & Culvert Inventory - 2016)
- Mutual Aid Agreement with Capital Fire MA District

Insurance Programs

- Participation in NFIP, enrolled in the Regular Program 4/15/1982
- Community Rating System (CRS), enrolled 10/1/2016 as a Class 9

Land Use Planning/Management

- Waterbury Municipal Plan, adopted December 2013, update in process
- Waterbury Zoning Regulations, amended 2016, update in process
- Water Source Protection Plan
- Lidar mapping of Waterbury (CVRPC), 2014

Protection/Retrofit of Infrastructure and Critical Facilities

- Emergency Shelters—Thatcher Brook Primary Sch., Waterbury Congressional Church
- Flood proofed Main Street Fire Station and wastewater pump station
- There are fire hydrants where municipal water is available. Dry Hydrants owned by Waterbury are available in 3 locations not served by municipal water; Gregg Hill, Shaw Mansion and Union Street
- Installed generators at the municipal well field, wastewater plant, Thatcher Brook Primary School, main sewer pump station, highway garage, Main Street Fire Station, Maple Street Fire Station

Public Awareness, Training & Education

- Motor vehicle accident response training
- Incident Command System (ISC) training for Local Officials
- First responder CPR & hazmat trainings
- School Fire Safety Program
- Dam Safety Seminar (CVRPC)
- Rail Emergency Preparedness (CVRPC)

C. Plan updates since 2013

The 2017 Waterbury Local Hazard Mitigation Plan reflects several changes to the Town and Village of Waterbury's vulnerabilities to hazards and addresses the changes in priorities to different hazards. These priorities and vulnerabilities have changed in large part due to the implementation of mitigation actions that were listed in the 2013 Plan. The implementation of several of these mitigation actions have reduced the municipality's vulnerability to specific hazards.

Several new hazards were added to this 2017 LHMP that may pose a risk to the community. The 2013

LHMP addressed flash floods, mitigation projects, planning, and preparedness activities. In the 2017 LHMP, the flash flood hazard was expanded to include flooding and fluvial erosion as well as river corridor planning. A community survey in March 2017 indicated that local residents identified that a dam breach might be elevated as a higher potential risk. The 2017 Plan includes an increase awareness of hazardous material spills as a hazard of Medium High/High risk due to the increased traffic on Interstate 89, state and local roads and the Central Vermont Railroad.

There is a concern for increasing risk potential due to climate change which is starting to result in pest infestation and invasive species. Severe weather events may increase or change patterns along with the potential for an extended drought and forest fires which will not be addressed in this Plan.

The village area is experiencing a positive transformation due in part to the recovery and mitigation efforts from severe flooding from Tropical Storm Irene in 2011 and in part to the improved economic vitality of the revitalized community. An active non-profit, Revitalizing Waterbury, has assisted with the business growth and overall interest in promoting and marketing the town and village areas.

The Municipal Flood Hazard Area Zoning Regulations prohibit new development and construction of new buildings in the town's mapped floodways and requires that compensatory flood storage is provided for new encroachments within all Special Flood Hazard Areas (SFHA), which are the areas in the town that are most vulnerable to severe weather, hurricanes, tropical storms, and flooding. Development is regulated in mapped flood hazard areas to reduce impacts on property and the floodplain. Structures located outside the SFHA may also be vulnerable to flood erosion hazards if they are located near a steep, upland stream. Structures in these areas are vulnerable to fluvial erosion as opposed or in addition to inundation hazard. The vulnerability of any new growth would be dependent on its location near a Special Flood Hazard Area (SFHA), or near the VT ANR's mapped River Corridors which includes areas near small streams. Overall, new development in Waterbury since the 2013 Plan has caused no change in community's vulnerabilities and the updated Flood Hazard Area regulations in the Waterbury Zoning Regulations seek to reduce potential damage from inundation hazards by maintaining flood storage throughout the community.

These changes impact the risk and priorities to the community by reducing the exposure to flood prone activities and repetitive loss.

General

- New sections: Plan Development Process, 2013-2017 Mitigation Strategies Status Update charts, Hazard Mitigation Programs, Projects & Activities, Plan Maintenance;
- Data updates: Hazard incidents, emergency declarations, input from Public Opinion Survey;
- Hazards have been reevaluated with the hazard ranking system used by the Vermont Division of Emergency Management.
- Addition of the Mid-Winooski River Corridor Study, Lidar mapping and new Flood Hazard Zoning regulations

Hazards Analysis

- Hazardous Material Spills have become a high risk concern due to increased traffic flows and commodity transport
- Flash Flood/Flood/Fluvial Erosion
- Severe Weather (Thunderstorm. Lightening, High Wind, Hail including Hurricanes/Tropical Storms)
- Extreme Cold/Snow/Ice Storms
- Dam Safety

Maps

- A map of the Town and Village of Waterbury depicting critical facilities, town infrastructure, and the NFIP designated floodway and 100-year floodplain
- An updated map with identified top infrastructure needs
- See additional reference maps in the Appendix

Activities

2013-2017: The Waterbury Long Term Community Recovery Committee (LTCR 2012-14) and then the newly formed FMWG (2014-present) committee, met monthly to begin updating the priorities in Waterbury's existing Local Hazard Mitigation Plan (FEMA Approved in March 2013) and to review and consider the status of various mitigation actions, potential hazards, and the data collection/research process. During the monthly meetings, the LTCR/FMWG committee also discussed and ranked hazards to determine the top mitigation priorities and projects in the community. All meetings and agendas are posted on the municipal website with copies of the previous monthly meeting minutes. All meetings are open to the public and follow the protocol established in Vermont's Open Meeting Law. No public comments were received.

The LTCR met monthly from late 2011 through November 2013 to make progress on the 2013 Approved Mitigation Plan. Since many projects had been undertaken, and the LTCR two-year appointment had come to an end, the Select Board and Trustees appointed a follow-up committee, the Floodplain Management Working Group (FMWG) to oversee all recovery, mitigation and flood/hazard related issues and act in an advisory capacity to the local boards including providing regular updates to the community at large.

Ongoing: Waterbury Community Planner who is also a member of the Floodplain Management Working Group meets at least monthly with members of the Waterbury Conservation Commission and Planning Commission to provide updates on the activities of the FMWG. The Waterbury Community Long-Term Recovery Director met with the Planning Commission on September 25, 2017 to review the draft Plan. All meetings are open to the public and follow the protocol established in Vermont's Open Meeting Law. Editorial comments received were incorporated into the final draft.

September 28, 2017: Dam Safety Training sponsored by the Central Vermont Regional Planning Commission (CVRPC) in conjunction with the Agency of Natural Resources and Green Mountain Power will review Emergency Action Plans and evacuation and notification procedures.

September 25, 2017: The Waterbury Local Hazard Mitigation Plan (LHMP) was a specific agenda item with the Waterbury Planning Commission to provide information and review of the draft 2017 LHMP update.

Public participation and involvement (*44 CFR 201.6(b)(1)*)

This section of the Plan satisfies the requirements of 44 CFR 201.6(b)(3)

February 2017: Town and Village Annual Reports were published with reports from town and village activities and finances for 2016 and plans and budgets for 2017. These reports are made available to all residents, businesses and general public. A report was included from the Floodplain Management Working Group that included a list of completed mitigation projects (included in this Plan) as well as a summary of the update of this Plan being in process for 2017. No comments were received as a result of this publication.
2/7/2017 and 3/8/17: Posted a notice alerting the public to the hazard mitigation planning process that was taking place and provided a Public Opinion Survey at the polling locations on Town Meeting Day and again

for the Village Meeting the following day. The survey was also available on Front Porch Forum and on the municipal website where residents could fill it out electronically. Contact information was provided in the notice to allow those interested in Waterbury's efforts to receive more information and how to find out about upcoming meetings. Several comments were received and incorporated into this LHMP update. The Public Opinion Survey and related comments are in the Appendix section of this Plan.

February and March 2017: Notices were placed on Front Porch Forum and the Waterburyvt.com website alerting recipients that Waterbury was engaging in hazard mitigation planning and updating their Local Hazard Mitigation Plan. Contact information (Long Term Community Recovery Director) was provided in the notice to allow those interested in Waterbury's efforts to receive more information and how to find out about upcoming meetings. No comments were received.

The Waterbury Town and Village Clerk posts all monthly meeting agendas and minutes on the Municipal website at waterburyvt.com.

April 2017 and November 2017: Waterbury Townand Village Clerk advertised two public meetings in the Steele Community Room in Waterbury where hazard preparedness strategies were discussed and strategies were proposed with local officials. Notices were posted online by the Town and Village Clerk. No comments were received.

Governmental participation and involvement

This section of the *Plan* satisfies the requirements of *(44 CFR 201.6(b) (2))*

Provided an update at a joint public meeting of the Select Board and Village Trustees on April 17, 2017 to inform them of the process and anticipated timeline for approval of the LHMP in 2017. The final draft Plan will be presented to both boards for conditional adoption pending FEMA approval.

Provided initial draft Plan to the Waterbury Planning Commission, and attended meeting on September 25, 2017 to discuss Plan strategies and Planning Commission involvement. Comments received were incorporated into the final draft of the Plan.

Provided final draft Plan to the Waterbury Conservation Commission on September 25, 2017, and adjoining municipalities of Moretown, Middlesex, Duxbury, Stowe and Bolton including the Central Vermont Regional Planning Commission and the Chittenden County Regional Planning Commission on September 21, 2017 for review and comments. No Comments were received.

Provided draft to Vermont Division of Emergency Management— November 7, 2017. Comments were incorporated into this revised Plan as of December 5, 2017.

Central Vermont Regional Planning Commission has participated in the Plan development during 2017 at the Floodplain Management Working Committee monthly meetings and have offered constructive comments throughout the planning process.

Waterbury elected officials were given the opportunity to review, provide comments and incorporate feedback the Plan update. Comments were incorporated in the Plan.

Neighboring community participation and involvement

This section of the Plan satisfies the requirements of *(44 CFR 201.6(b)(2)*)

In all correspondence during the distribution of the Plan,

contact information for questions or comments was directed to the Long Term Communit Recovery Director. Other than the written comments at the end of the Public Opinion Survey, (listed in the Appendix), no other written comments were received unless otherwise noted.

Local officials and the Emergency Management Directors in the Towns of Middlesex, Moretown, Duxbury, Bolton, and Stowe were sent draft copies of the Plan on September 21, 2017.

A notice was placed in Waterbury Record in February and October 2017 alerting the public that the hazard mitigation planning process was taking place.

The draft Plan was posted on the Waterbury municipal website on September 29, 2017. Contact information (Long Term Community Recovery Director) was provided in the notice to allow those interested in Waterbury's efforts to receive more information and how to find out about upcoming meetings.

The Central Vermont Regional Planning Commission posted the draft Plan on their website in October 2017.

Waterbury coordinates with the neighboring communities of Duxbury, Moretown and Middlesex for emergency services and planning. These communities have been informed of the mitigation work of Waterbury through email contacts, direct mail, and the Waterbury Record. No comments were received.

Review of existing plans, studies, reports, and technical information

Excerpts from some of these studies can be found in the Appendix and/or within the Plan.

This section of the Plan satisfies the requirements of (*44 CFR 201.6(b)(3)*)

- State of Vermont Hazard Mitigation Plan, 2013. This Plan was referenced for the State's hazard mitigation planning processes and description of top hazards for the State of Vermont.
- Waterbury Local Hazard Mitigation Plan (FEMA approved March 2013) with review of comments received from FEMA at the approval date. The Plan was referenced during the plan development process, in regards to the worst threats and mitigation action strategies identified in 2013.
- Waterbury Municipal Plan (Adopted 2013). The Municipal Plan provided background information on the community, as well as more detail on their emergency services.
- Flood Insurance Study: Town and Village of Waterbury, Vermont, Washington County (March 2013). The Flood Insurance Study was referenced for general knowledge of the Winooski River for peak discharge information. This information has been integrated into the Flash Flood/Flood /Fluvial Erosion, Hurricane/Tropical Storm and Severe Summer Weather hazard profiles.
- 2013 Phase I Study, Milone and McBroom, Flood Impediments along the Waterbury Winooski River
- A study on the Mad River Valley Watershed by the CVRPC took place in 2016/2017 by Dubois and King Engineering to examine priority mitigation sites for potential flooding and mitigation projects related to roads, bridges and culverts.
- Milone and McBroom Economic Study: Economics of developing in known flood areas, 2015.
- Olson, S.A., 2015, Flood Maps for the Winooski River in Waterbury, Vermont, 2014: U.S. Geological Survey Scientific Investigations Report 2015–5077, 25 p., http://dx.doi.org/10.3133/sir20155077.
- Federal reports from FEMA, Army Corps of Engineers, NOAA, National Hurrican Center
- Resources for Disaster Recovery and Alternative Funding Sources
- 2017 Vermont Stte Commodity Flow Study, 2009 Hazardous Materials Commodity Flow Study, LEPC #5, and Railroad Commodities Flow Study - 2009

D. Status Update on Mitigation Actions Identified in 2013

The following table outlines the mitigation actions that were proposed in the Waterbury Town and Village Local Hazard Mitigation Plan as approved by FEMA in 2013. The Waterbury Road Foreman attended a meeting in June 2017 to review and discuss road, bridge and culvert projects that are priorities that to be completed. The town and village completed addtional mitigation projects above the priorities identified in the 2013 Plan.

This section of the Plan satisfies the requirements of 44 CFR 201.6(d)(3).

Participants in the planning update process reviewed these actions and reported on the status of each. Actions related to long-term mitigation of natural hazards are so noted:

Table 1: Projects Completed 2013-2017

2012 Mitigation Action	2017 Action Update
Property acquisition of Whalley Trailer Park	Completed through private ownership - Mobile homes were removed and new story manufactured homes are elevated above the 100 year base flood elevation.
Flood proof main waste water pump station	CDBG-Disaster Relief grant awarded; completed in spring 2017. $115,000 CDBG-DR funds with remainder in local funds.
Structural Elevation of 5 homes Village area (see locations in flood hazard analysis)	HMPG completed 1 home. Others in pilot program either were eligible due to cost of elevating historic properties or withdrew from program.
Mitigation reconstruction of municipal office building	Project completed in 2016 with help of $1m in CDBG-DR funds, $2.95m bond, $1m from library and various other sources. Included new library in Municipal Center.
Dry flood proofing of 3 non-residential structures in Village area (see locations in flood hazard analysis)	State Office Complex redevelopment incorporated dry flood-proofing measures in certain buildings; Project redesigned and operational in 2016. $134m Private owner elevated and restored an historic structure as a new business in downtown (Elm St)
Re-engineer Winooski Street to construct dip at bridge	Initial bridge analysis identified in 2013 Plan was not the issue. Strategy evolved into a larger Floodplain Reconnection project. Ongoing
Transform cornfield on State Complex property into wetlands retention/detention basin	State Office Complex redevelopment project included lowering the fields by the river to allow for additional flood storage.
Structural retrofitting of residential and non-residential areas	Project refocused towards facilitating home elevations. Several private properties elevated and floodproofed.
Elevation of electrical systems on 20 properties	4-5 private properties elevated electrical systems above BFE.

2013 Mitigation Action	2017 Action Update
Install sewer line valves on 50 properties	Costs $1,400/home; a publicly funded voucher/incentive program could also benefit these projects. Not pursued at this time due to Main Street Reconstruction project.
Watershed-wide flood study/River profile	ANR River Corridor study completed in summer 2015 (Phase II geomorphic assessment).
Develop sensitive populations survey and list	Maintain vulnerable population list (mobile home parks, senior housing, child care centers) annually in Local Emergency Operation Plan.
Develop back up power generation for well field, wastewater plant, and Thatcher Brook Primary School as emergency shelter	Completed in 2013 with EMPG (50/50) and municipal funds.
Study of Dascombe Rowe Fields – repurposing for multi use recreation activities and floodplain restoration	Replaced back-stop and installed breakaway fencing; Choke Analysis saw little benefit in taking further action.
Adopt more stringent State Codes and Standards for roads	2013 VTrans Road and Bridge standards adopted.
Adopt codes and standards for mandatory use of connectors, brackets and mobile home tie downs with new construction	Standards for mandatory use already apply in the SFHA; Planning Commission considering applying general use standard in zoning regulations.
Provide training to residents on how to insulate homes (pipes, attics) for extreme cold spells	Support Efficiency Vermont and LEAP (Local Energy Association Partnership) with their energy education programs and initiatives.
Improve communication between State, GMP and Town regarding dam issues	Green Mt. Power is updating its Emergency Action Plan and will coordinate with the town and village on and early warning system. In progress.
Install sirens downstream of Waterbury dam to warn of releases	See above priority. In progress for a better early warning system. The town and village did adopt the use of VTAlert in summer 2017, an emergency notification system for all hazards sponsored by VT. Emergency Management.
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	The town was accepted into the rigorous CRS program in October 2016 that incorporates NFIP compliance oversight. New Flood Hazard Zoning Regulations were adopted in May 2016. Outreach and education ongoing.

Table 2: Additional Mitigation Actions Undertaken Since 2013 Plan

Projects	Mitigation Action	Leadership	Priority	Funding Sources	Status COMPLETED
Flood Mitigation	27 Units of affordable housing located at former mitigated State Office Complex property	Non-profit, Downstreet Housing and Community Develop-ment	High	CDBG – Disaster Relief Grant and loan package	2015
Flood Mitigation	Incorporated stormwater treatment and riparian buffer along Winooski River State Office Complex	State of VT/FEMA	High	Federal, State	2014-2015
Flood Mitigation	New Hunger Mountain Children's Center at former State Office Complex property	Non-Profit HMCC	High	CDBG/ bank loan	Fall 2017
Flood Mitigation	Watershed-wide flood study/river profile	ANR, CVRPC	High	FEMA PDM-C, ANR	2015/16
Infrastructure	Installed generators at the municipal well field, main sewer pump station, highway garage, Main Street Fire Station, Maple Street Fire Station	Town and Village of Waterbury	High	DEMHS, EMPG, municipal funds	2012-2013

Planning Activities	Mitigation Action	Leadership	Priority	Funding Sources	Status COMPLETED
Planning	New Flood Hazard Area Zoning Regulations adopted and approved	Town and Village of Waterbury	High	Municipal funds	2016
Planning	Conducted LIDAR mapping studies to identify elevations for key flood hazard areas and investments	CVRPC, Town	High	CDBG-DR	2014
NFIP	Town and Village accepted into to Community Rating System (CRS)	Town, Village, Planning Commission	High	Municipal funds	October 2016

Additional Mitigation Planning Actions	Who	When	How	2017 – Status of Mitigation Actions
ALL HAZARDS Ensure that the Local Emergency Operations Plan (LEOP) is current.	Select Board and Village Trustees	Yearly	Local officials, public meeting, local resources	The Waterbury LEOP was most recently updated and adopted on 04/17/2017. It is also reviewed by the Central Vermont Regional Planning Commission and accepted by Vermont Emergency Management.
Provide emergency response training/ICS course for municipal officials.	Emergency Management Dir./Coordinator, Fire Chief	Ongoing	Local resources	ICS 100 training took place in 2015 for the Select Board and Trustee members, the Emergency Management Director and Coordinator. Local officials believed it would be useful and helpful in an emergency to have more municipal staff trained.
National Incident Management System (NIMS)	Select Board	10/20/2014		Select Board adopted NIMS as part of the effort to be better prepared in future disasters or emergency events.
Educate citizens on long term recovery and mitigation projects	Floodplain Mngt Working Group	Ongoing	Local resources	Annual updates on recovery, mitigation and CRS achievements are published annually in the Town and Village Reports prior to Town Meeting Day.
Approved and implemented VT-Alert for a municipal early warning system as trained and available through the State of Vermont	Waterbury Select Board and Village Trustees	Ongoing	Local resources	Active as of June 2017.

E. Town Capabilities for Implementing Mitigation Strategy

This section of the Plan satisfies the requirements of 44 CFR 201.6(c)(3) and 201.6(c)(4)(iii)

The Town and Village of Waterbury are currently engaged in the following hazard mitigation programs, projects and activities:

	Type of Existing Authority / Policy / Program / Action	Resources: Staffing & Funding	Ability To Expand/Improve On
Community Preparedness Activities	Program—Annual update of Waterbury's Local Emergency Operations Plan (LEOP). Last updated and approved on 04/17/2017. NIMS has been adopted by the town.	Volunteer time from the Select Board/Trustees/ Emergency Management Director	This document is reviewed and updated each year to ensure that the contact information of emergency response personnel is up-to-date. This information is then sent to Vermont Emergency Management for their records. There is no need to expand on this program at this time.
	Inventory Red Cross Shelter supplies at the Congregational Church(UCC) of Waterbury.	Staff time from church personnel.	This is a one-time action, so there is no need to expand or improve on it.
	Program— attendance and participation at Local Emergency Planning Commission (LEPC) #5 meetings	Volunteer time from the Waterbury Emergency Management Director.	Local Emergency Management Director attends meetings. No need to expand or improve on participation.
Insurance Programs	Community Rating System - CRS (April, 2016 effectiveOctober 2016)	Community Planner and Zoning Administrator work together to implement program	This will help reduce insurance rates for properties in the flood areas and includes a significant public outreach process.
	Authority/ Program— participation in National Flood Insurance Program (NFIP). The Town and Village of Waterbury participates in and is compliant with the NFIP by enforcing its flood hazard area regulations, Adopted 2016	The Zoning Administrator serves as the NFIP administrator. Assistance from Vermont ANR.	The Town and Village were first enrolled in the Regular Program on the effective date of its initial Flood Insurance Rate Map (FIRM), dated 4/15/1982. The current effective Town and Village of Waterbury, Village Flood Insurance Study (FIS) and FIRM is dated 3/19/2013.

	Type of Existing Authority / Policy / Program / Action	Resources: Staffing & Funding	Ability To Expand/Improve On
Land Use Planning	Town and Village Plan Adopted Dec. 9, 2013	Volunteer time from Planning Commission, and assistance from Waterbury planning staff and other state staff, Municipal Planning Grant funded consultant.	The Planning Commission will be updating the 2013 Municipal Plan in 2018. The goals and priorities of this Hazard Mitigation Plan will be incorporated into the plan update.
	Authority—Waterbury Zoning Ordinance Effective June 6, 2016	Planning Commission, Waterbury planning staff, Municipal Planning Grant Program.	The Waterbury Zoning Ordinance will be updated in 2018 and include requirements and initiatives to mitigate hazards in high risk areas.
	Authority—Waterbury Flood Hazard Area Zoning Ordinance Effective June 6, 2016	Volunteer time from the Planning Commission, and assistance from Waterbury and Vermont ANR. Funding from Municipal Planning Grants.	The Waterbury Hazard Area Zoning regulations were updated in 2016.
Protection of Infra-structure & Facilities	Road and Culvert Inventory	Staff time and assistance Assistance from the CVRPC, Better Back Roads, DEC Ecosystem Restoration Grants.	The town is currently using the culvert inventory with assistance from CVRPC to further its culvert improvements and track conditions in accordance with the capital improvement plan
	Authority— Certification of Compliance for Town Road and Bridge Standards - Adopted April 4, 2016	Adopted by the Select Board, implemented by the Road Foreman Funding from VTrans	Specifies minimum construction standards for roadway, ditches, culverts and bridges. Town has the authority to require above-and-beyond what is written in the policy in accordance with the capital improvement plan.
	Policy/Program—Waterbury Winter Road Maintenance Policy	Staff time from the Town Road Foreman, Public Works Director, Town/Village Engineer, volunteer time from the Town Select Board. Funding from local budgets to implement	This policy outlines how the town's road network will be maintained during the winter months, and places the safety of winter travel on the "traveling public." This policy may be revised and/or updated at the discretion of the town's Select Board in accordance with the capital improvement plan.

	Type of Existing Authority / Policy /	Resources: Staffing & Funding	Ability To Expand/Improve On
Emergency Planning	Policy/Program—Waterbury Hazard Mitigation Plan (FEMA Approved March 13, 2013), anticipated March 2018	Volunteer time from members of the Floodplain Management Working Group; assistance from CVRPC and Vermont DEMHS. Funding from Vermont DEMHS; Waterbury.	The 2017 Waterbury Local Hazard Mitigation Plan will replace the 2013 Plan. The 2017 LHMP has evolved from the 2013 Plan and has greatly expanded and improved upon it. Future iterations of the LHMP will be updated at least every five years. The mitigation goals and priorities will be referenced in the next Municipal Plan.
	Ongoing Action—The Town and Village of Waterbury has a website where important information is posted.	Municipal office staff with funding from local budget.	Updates, agendas and minutes of local officials and activities including the Floodplain Management Working Group are posted on the municipal website regularly.

F. Plan Maintenance

This Plan (the Waterbury Local Hazard Mitigation Plan) will be updated and evaluated by discussing its effectiveness and making note to incorporate any necessary revisions in the update process. Any updates before the next five year cycle will occur annually at a joint Select Board and Trustees meeting along with the annual review of the Local Emergency Operations Plan (LEOP). The Select Board and Trustees will monitor the implementation of the hazard mitigation and preparedness strategies outlined in this Plan by noting those that have been completed, and identifying the next steps required to implement the Plan's remaining strategies. Comments from local officials and the public will be incorporated when relevant. An annual report of the Floodplain Management Working Group that oversees this Plan will be summarized in the Town and Village Reports in February each year. This will generate an opportunity for the public and other town officials to learn about the town and village's progress in implementing mitigation strategies and to give input on future activities and Plan revisions.

Evaluation of the Local Hazard Mitigation Plan will consist of a thorough analysis of the status of mitigation and preparedness strategies by the Floodplain Management Working Group and whether they are being implemented according to the time frames included in tables in this Plan. The Town and Village of Waterbury will evaluate the status of mitigation strategies to assess that goals of the Local Hazard Mitigation Plan are being met. Adherence to the mitigation, preparedness, and ongoing strategy implementation tables included in this Plan will constitute the degree of effectiveness of the Plan. The Town will also evaluate the status of vulnerabilities detailed in this Plan to evaluate their validity. The update of the Plan will bring up-to-date materials that have become outdated due to the passage of time. Waterbury's Community Planner and/or Emergency Management Director will be the point of contact and will take primary responsibility for the monitoring, evaluation, and update process described in this document. This staff person will bring the Plan's maintenance activities to the elected officials agenda and discussions. The Public Works Director is appointed as the Emergency Management Director.

Updates and evaluation of this Plan will also occur within three months after every federal disaster declaration directly impacting the Town and Village of Waterbury. The Town and Village will monitor, evaluate and update this Local Hazard Mitigation Plan annually and after every federally declared disaster according to the graphic in Appendix C. The community shall incorporate the Local Hazard Mitigation Plan when working on Municipal Plan amendments or changes to the Town and Village bylaws.

This section of the Plan satisfies 44 CFR and 201.6(c)(4)(i), 201.6(c)(4)(ii), and 201.6(c)(4)(iii).

At least one year before the Plan expires, the update process will begin (through annual updates, monitoring of progress and evaluation). For this next Plan update, the Select Board and Trustees may appoint a committee of interested citizens (including the Community Planner and/or Emergency Director) to draft changes. Ultimately, it will be the Town and Village's responsibility to update their Local Hazard Mitigation Plan.

The process of evaluating and updating the Plan will include continued public participation through public notices posted on the municipal website, notice within the municipal building, notice in the Waterbury Record and on Front Porch Forum, inviting the public to the scheduled Select Board (or specially scheduled) meeting. The public will be given the opportunity to comment during these public meetings. Additional stakeholders should be invited to the meeting, including: local business and civic/non-profit organizations, CVRPC, and the Vermont Agency of Natural Resources (VT ANR). VT ANR

will be invited because they can provide assistance with NFIP outreach activities in the community, models for stricter floodplain zoning regulations, delineation and possible regulation of river corridor areas, and other applicable initiatives.

Updates will address changes in community mitigation strategies; new bylaws, zoning and planning strategies if appropriate; progress on the implementation of initiatives and projects; effectiveness of implemented projects or initiatives; and evaluation of challenges and opportunities effectiveness in reducing town's vulnerabilities and meeting plan goal. If new actions are identified in the interim period, the plan can be amended without formal re-adoption.

The Town and Village of Waterbury should utilize this Local Hazard Mitigation Plan to incorporate mitigation planning into their long-term land use and development documents. The 2013 Vermont Legislature passed a law requiring all towns to incorporate flood resiliency elements into their town plans as of July 2014. Flood hazard and fluvial erosion hazards will be identified, and strategies and recommendations will be provided to mitigate risks to public safety, critical infrastructure, historic structures and public investments. This Local Hazard Mitigation Plan will help the town and village to comply with the new community flood resiliency requirement for plans adopted after July 2014.

Plan updates will reflect changes in development, progress in local mitigation efforts and changes in priorities. Updates and improvements should strengthen the Plan and the entire community to become more resilient to potential hazards.

V. Community Vulnerability by Hazard

A. Hazard Identification

Mitigation efforts must be grounded in the rational evaluation of hazards to the area and the risks these hazards pose. This is done through a process, which in essence asks and answers three basic questions:

- What bad things can happen, given the town and village's vulnerabilities?
- How likely are they to occur?
- How bad could they be?

This process, which is laid out in the table below, is an attempt to inventory the known hazards, establish the likelihood of them occurring in the future, and then assess the community's potential vulnerability to each. In performing this analysis, we are then able to prioritize actions that are designed to mitigate the effects of each of these disaster types and ultimately make Waterbury a safer place.

It is important that we learn from the past in order to avoid the same disasters and their outcomes. Disasters that have occurred within the town and village of Waterbury, the larger region, and the State of Vermont can give us good information about what types of disasters we can expect in the future and what kinds of damage they might cause. However, while this historical data can inform our perspective of what might happen in the future, it is by no means a prophecy. While the town and village of Waterbury might not have been impacted by a specific hazard in the past, this does not necessarily mean it will never be affected in the future. Indeed, the advance of climate change means that old weather patterns may not remain consistent. For instance, in recent years, Vermonters have seen an increase in the number and severity of storms, especially high intensity rainfall events. Armed with historical data and a healthy respect for climate change and the unknown, we have tried our best to identify hazards and prepare for the future.

Table 1 on the next page represents the ranking method that was used to determine the likely and probable risks to the Town and Village of Waterbury. This is the same methodology that the State of Vermont uses for the State Hazard Mitigation Plan.

Table 1: Hazard Profile

Hazard	Location	Vulnerability	Extent	Observed Impact	Likelihood/Probability
Type of hazard.	General areas in community that may be vulnerable to the hazard.	Community structures, systems, populations, infrastructure that are susceptible to damage or loss from hazard events.	Strength or magnitude, and details of a notable event(s).	Dollar value or percentage of damages.	Occasionally: 1–10% probability of occurrence per year, or at least one in next 100 years Likely: >10% but <100% probability year, at least 1 chance in next 10 Highly Likely: 100% probable in a year

Table 2: Ranking Methodology

Frequency of Occurrence Probability	Warning Time Amount of time generally given to alert people to hazard	Potential Impact Severity and extent of damage and disruption *Note: Severity of damage and disruption generally correlates with magnitude (extent) of an event
1 = *Unlikely* <1% probability of occurrence in the next 100 years 2 = *Occasionally* 1–10% probability of occurrence per year, or at least one chance in next 100 years 3 = *Likely* >10% but <100% probability per year, at least 1 chance in next 10 years 4 = *Highly Likely* 100% probable in a year	1 = More than 12 hours 2 = 6–12 hours 3 = 3–6 hours 4 = None–Minimal	1 = *Negligible* Isolated occurrences of minor property damage, minor disruption of critical facilities and infrastructure, and potential for minor injuries 2 = *Minor* Isolated occurrences of moderate to severe property damage, brief disruption of critical facilities and infrastructure, and potential for injuries 3 = *Moderate* Severe property damage on a neighborhood scale, temporary shutdown of critical facilities, and/or injuries or fatalities 4 = *Major* Severe property damage on a metropolitan or regional scale, shutdown of critical facilities, and/or multiple injuries or fatalities

Table 2 reflects the hazards that we believe can be expected, or are at least possible, in the central Vermont area. We have considered factors such as frequency of occurrence, warning time and potential community impact to rank each and determine which hazards pose the greatest threats to life and property in Waterbury. The worst threats (bolded in the table, below) are then followed-up with discussion and mitigation strategies throughout the rest of this Plan. It should be noted that hazards assigned with the same "Hazard Score" are not in order and their placement in the table should not be assumed to reflect their potential to create hazards for the town. It's important to note that those hazards which were not found to pose the greatest threats may still occur in Waterbury's future; however, they are not the focus of this Plan.

This section of the Plan satisfies the requirements of 44 CFR 201.6(c)(2)(i), 201.6(c)(2)(ii)

Table 3: Waterbury's Potential Risks

Hazard	Frequency of Occurrence	Warning Time	Potential Impact	Hazard Score
Flash Flood/Flood/Fluvial Erosion	**Highly Likely**	**6–12 hours**	**Moderate–Major**	**10**
Severe Weather (Thunderstorm, Lightning, High Wind, and Hail)	**Highly Likely**	**6–12 hours**	**Moderate**	**9**
Extreme Cold/Snow/Ice Storm	**Highly Likely**	**6–12 hours**	**Moderate**	**9**
Hurricanes/Tropical Storms	**Likely**	**12+ hours**	**Moderate–Major**	**8**
Hazardous Material Spill	**Likely**	**None**	**Moderate–Major**	**11**
Structure Fire	Likely	None	Negligible–Minor	9
Wildfire/Forest Fire	Likely	None	Minor	8
Ice Jams	Occasionally	3–6 hours /none	Minor	8
Landslides/Mudslides/Rockslides	Occasionally	None	Negligible	7
Invasive Species/Infestation	Highly Likely	12+ hours	Negligible	5
Tornado	Occasionally	3–6 hours	Moderate	8
Dam Failure	**Unlikely**	**3–6 hours**	**Major**	**8**
Drought	Occasionally	12+ hours	Minor	5
Earthquake	Occasionally	None	Negligible	7
Extreme Heat	Likely	12+ hours	Minor	5

The Waterbury FMWG discussed the results of the hazard ranking activity and determined to focus on hazards that have the potential for a *Moderate to Major impact* balanced with *Highly Likely* to occur. For the purposes of this Plan, Severe Weather (Thunderstorm, Lightning, High Wind, and Hail) is combined into one hazard profile area with Hurricanes/Tropical Storms for analysis due to their overlapping impacts to the town. Due to low probability of impact on some risks, the Floodplain Management Working Committee elected not to detail the following hazards in this LHMP: invasive species/infestations, ice jams, extreme heat, drought, earthquakes, tornadoes, landslides/mudslides/rockslides, wildfire/forest fire and structural fire.

The Public Opinion Survey that was conducted in February and March of 2017, indicated that the top two priority concerns were for loss of life and loss of infrastructure. Any potential loss of life or injury is considered the most important to protect across the board in any disaster, no matter how large or small. The impact of a loss of services and damage to infrastructure is the second most important to protect in any disaster These include not only large-scale services such as the loss of transportation and communication ability, but also the loss of services more directly associated with basic needs such as water, food preparation, and heat. Loss of power for an extended period of time has the potential to greatly impact households who are entirely reliant on a functional power supply in order to prepare food, heat the household, and ensure that the water supply is available. While many residences in Waterbury utilize a variety of methods to ensure these basic needs, it is important to be aware that a number of households rely on electricity alone for all of these functions. During

the five years, Waterbury has been successful in securing generators for key locations such as the Thatcher Brook Primary School (TBPS) which is one designated community shelter. The other shelter located at the Congregational Church on Main Street does not have a generator so that is for non-power loss events. Both have commercial kitchens. Generators are also located at the Main Street Fire Station, the village wastewater plant, the water plant, the municipal well field, main sewer pump station, highway garage, and the Maple Street Fire Station.

A further focus that is important to address in this Plan includes the awareness of the population demographics of Waterbury. This includes a list of vulnerable populations that may need assistance in any incident. Special needs populations include elderly housing projects, child care centers and mobile home parks. The specific locations and contact personnel are located in the LEOP and updated annually.

After engaging in discussions and using the best available knowledge, including the review of the Public Opinion Survey in March 2017, the Floodplain Management Working Group with Town and Village of Waterbury identified the following "top hazards" (based on frequency of occurrence and potential impact) that may have the most likely impact to the community:

- Hazardous material incidents
- Flash Flood/Flood/Fluvial Erosion
- Severe Weather (Thunderstorm. Lightning, High Wind, Hail) including Hurricanes/Tropical Storms
- Extreme Cold/Snow/Ice Storms
- Dam failures

The "top hazards" will be discussed in the following sections. Within each section, previous occurrences of each hazard will be listed, including the county-wide FEMA Disaster Declarations (DR-#), where applicable. Hazards information was gathered from local sources (ex., town and village historical events), the National Climatic Data Center's (NCDC's) Storm Events Database (1950–2015), the Spatial Hazard Events and Losses Database for the United States (SHELDUS) 1960–2015, and Special Reports produced by the National Weather Service in Burlington, Vermont. This section also includes a description of each "top hazard" and a hazard matrix that will also include the following information (please see each hazard profile for a hazard-specific matrix).

B. Hazard Profiles for "Hazards Posing Greatest Vulnerabilities"

1. Hazardous Material Spill or Event

The Village of Waterbury has a high concentration of population, an elementary school, public facilities, commerce, industry, a railroad, an interstate with an interchange, and major highways. The Village is situated in a precarious position in the middle of several major intersecting transportation routes that have frequent and large volumes of heavy traffic. Whether a train derailment or a severe weather event (flood, snow, ice, wind) triggers a traffic incident with a train or truck carrying hazardous materials traveling within the Village boundaries, or an incident occurs due to another factor, a response effort including evacuation could pose a significant problem in the densely populated downtown area.

A report on the Vermont Freight Plan was prepared by Cambridge Systematics, Inc. in May 2012 and revised in June 2017 for the Agency of Transportation. The excerpt below from that plan indicates that most volumes of rail traffic originating in Canada and flow through the state to points south along the New England Central Railroad that goes through the Village of Waterbury. According to this report, 12% of freight movement in 2011 was identified to include chemicals and allied products.

> *Cross-Border Trade Volumes by Commodity charts traffic volumes across VT's borders by commodity in terms of tons and dollars. The largest commodity traded, by both metrics, is paper, which accounted for 2.5 million tons and $3.8 billion. Most of this traffic (90 percent by weight) consisted of through flows from the US to Canada. Other key commodities included lumber (1.8 million tons) and crude petroleum (1.2 million tons). Figure 4.13 US-Canada Cross-Border Commodity Flows (to, from and through Vermont) Annual Tons and Dollars Shipped Cross-Border Trade Volumes by Location Figures 4.14 and 4.15 show the volume of trucks and rail containers across Vermont's borders from 1995 through 2008 as recorded in the Bureau of Transportation Statistics' Transtats Database. The highest crossing volumes occur at Highgate Springs, which is located closest to the Montreal metropolitan region, and serves as the crossing point for I-89, U.S. 7 and the New England Central Railroad (NECR).*

A 2017 Vermont State Commodity Flow Study by the Two Rivers-Ottauquechee Regional Commision was just released in Ocotber 2017 that inventories and describes hazardous materials traveling within each of Vermont's Local Emergency Planning Committee (LEPC) districts. Waterbury is within LEPC #5 district. Excerpts from the study are in the Appendix.

A 2009 Hazardous Material Commodity Flow Study on roads and rail with chemical placards traveling through Washington County and Waterbury was conducted by the Local Emergency Planning Committee (LEPC) #5. The Railroad Commodity Flow Study in 2009 supported the Vermont Freight Plan data and included procedures by the rail industry to mitigate hazards and contain any spills should they occur. A large portion of the report is considered confidential but relevant non-confidential excerpts are listed in the Appendix. While most of the vehicles were carrying kerosene, diesel, gasoline, heating oil, and other petroleum products, there were also many with anhydrous ammonia, sulfuric acid, hypochlorite solutions, and fluorosilicic acid.

The Waterbury Local Emergency Operations Plan (LEOP) includes annual Tier II filings for hazardous materials that are stationary and stored within the community. The Waterbury Fire Department has a list of these materials and their locations. The fire department trains regularly to assure safety with chemicals

if and when emergency situations may arise. Stored chemicals are listed below.

List of Chemicals and Hazardous Materials reported in Waterbury on 2016 Tier II forms:

#2 Fuel Oil, Accomplish Acetylene, Anhydrous Ammonia, Bevro-Sheen, Boost 3200, Boost 3201, Cosmic L, Foam Nox, Freon CFC/HCFC, HC-10, Liquid 90, Lube oil, Mandate Plus, Mikroklene DF, Compressed Oxygen, Passivation Acid, Propane, Quorum Clear V, Quorum Yellow LP, Risil Mat, Sodium Hydroxide, Sodium Hypochlorite solution, Sulfuric Acid, Untrasil 76, Diesel fuel, unleaded gasoline w/ethanol, No.2 Diesel Fuel, Regular Gasoline with ethanol, Ultra Low Sulphur Diesel, Kerosene, Xtreme Blue-20 Windshield Washer Fluid, Propane, gasoline, heating fuel, oil, Lead, Lead-acid batteries, Argon, Citric acid, Henkel Hot Melt Adhesive, Lubricating and hydraulic oils, Malto dextrin, Nitrogen, Sodium bicarbonate, Sodium Citratesodium Chloride, Celite545, Lead, Liquid Nitrogen, Sodium Hydroxide, Sulfuric Acid, Zeolite)Chlorodifluoromethane, R507 (Refrigerant), #6 Fuel Oil, AzozBiocide, Acetylene, *AirCon CXT-400, argon, Bromax 7.1 cooling tower antimicrobial, confidence 10-C PBB, DOWFROST HD Heat Transfer liquid, Formula 1031 Corrosion, Inhibitor, Hercules Cryotek-100 & -100/A1, Hydraulic Fluid, Intercool P-300 50/50, Latex Paint, Nitrogen (compressed gas), NOBURST -100, Novec 1230, Oil Based Paint, Oxygen, R 410A Refrigerant, Road Salt, Sulfuric acid in batteries, Sodium Hypochlorite, Calcium Hydroxide hydrated, Lime, Sodium Hydroxide causic soda, Hydrochloric Acid, Vegetation Control 2, 4-D, Gasoline, Ferric Chloride, Poly Aluminum chloride EPIC WW 58, Polymer-Polypro 4948, Polymer-STA-Floc 8827.*

Hazard	Location	Vulnerability	Extent	Impact	Probability
Hazardous Material Spill or Event	Roads, Interstate, Railroad, fixed sites	Village area with higher population densitities, school, businesses	No major incidents to date	Could be catastrophic depending on location, type of hazardous material, time of day, population exposed	Likely

2. Flash Flood/Flood/Fluvial Erosion

The most frequent form of flooding in the State of Vermont and the town and village of Waterbury is riverine flooding, or overbank flooding, which occurs to rivers when they receive more rain or snowmelt from their watershed than they typically experience. Flooding causes the inundation of land that is normally dry. Overbank flooding is experienced more frequently in mountainous and hilly areas where water moves with higher velocities. Flash floods occur when severe storms drop high amounts of rainfall in short periods of time. Flash floods occur more frequently in areas with steep slopes and narrow stream valleys. Riverine erosion is the gradual wearing away of land masses by rivers and streams. River channels are constantly changing. As rivers flow and water moves downstream, water exerts energy upon riverbanks and causes erosion.

Flooding is one of the worst threats to Waterbury's residents and infrastructure. Past instances of flooding have included large rain events that capture rain upriver and drain into the Winooski River basin and low-lying floodplains in the village of Waterbury. Some spring melt events and ice jams can be worsened by the build-up of ice or debris, which can contribute to the failure of important infrastructure (such as culverts, bridges, and dams). Storm intensity is causing damage to roads and deteriorating water quality. Culverts should be checked regularly for prper flow rates and

condition. Roadway crowns could be increased and winder sand removed to help with drainage and to avoid washouts.

The worst flood disaster to hit the town and village of Waterbury, as well as the overarching region and the State of Vermont, occurred on November 3, 1927. This event was caused by up to 10 inches of heavy rain from the remnants of a tropical storm that fell on frozen ground. Eighty-four Vermonters, including the Lieutenant Governor, were killed. The flooding in Waterbury was the worst historic disaster as documented by losing many lives and property. Like many towns in the State, the town and village of Waterbury received heavy precipitation, seeing roughly 6-7 inches of rainfall over the storm period. This flooding prompted the building of the Waterbury Dam on the Little River by the CCC from 1935-1938.

A more recent flooding event that devastated the region and the state was the result of Tropical Storm Irene, which occurred on August 28, 2011. Record flooding was reported across the state and was responsible for several deaths, as well as hundreds of millions of dollars of home, road and infrastructure damage. Due to strong winds, 50,000 Vermont residents were initially without power, and many did not have electricity restored to their homes and businesses for over a week. The flooding caused by Tropical Storm Irene is considered to be the second greatest natural disaster in 20th and 21st century Vermont, second only to the Flood of 1927.

The town and village of Waterbury suffered great damage to property and infrastructure during Tropical Storm Irene, although no lives were lost. It is estimated that Tropical Storm Irene dropped 8± inches of rain over the town and village of Waterbury in a very short span of time. The Mad River and Dog River watersheds along with the upper reaches of the North Branch of the Winooski River watershed caused the Winooski River to flood in Waterbury with minimal infrastructure damage to the local roads. Flooding during the summer of 2013 did cause significant damage to the town roads.

Unfortunately, flooding is very common across the region, with many events impacting the town and village of Waterbury. Waterbury has been severely affected by other flooding events that pre-date Tropical Storm Irene. As such, flooding is one of the worst threats to Waterbury's residents and infrastructure.

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 tributaries in Waterbury are more prone to flash flooding and fluvial erosion. Data on the fluvial erosion damage in number of acres lost was not found in storm events documention. Fluvial erosion extent data is unavailable.

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.

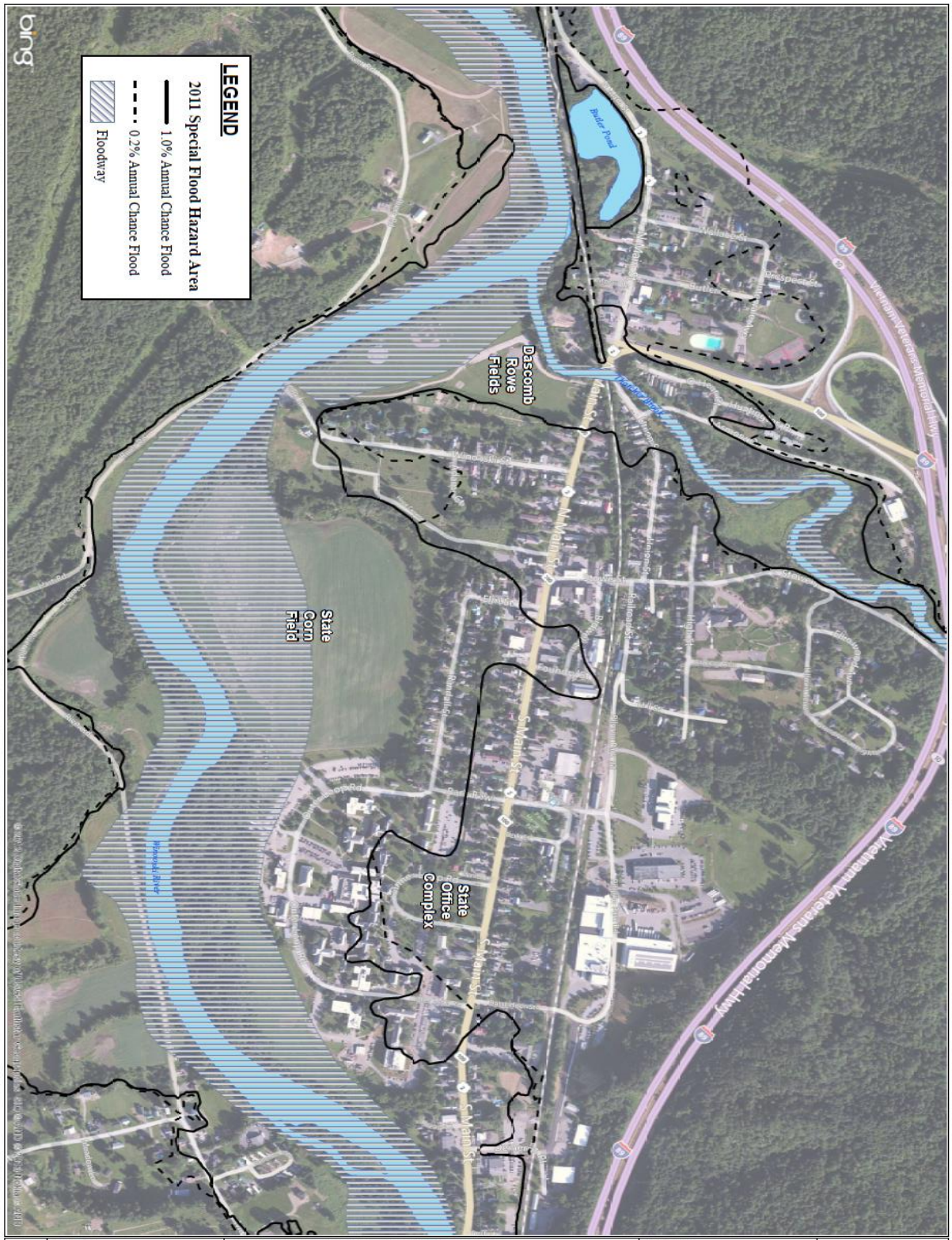


Figure 1

Map By: RKS
MMI#: 4199-05
MXD: Waterbury_FEMA.mxds
1st Version: February 24, 2014
Revision: ---
Scale: 1" = 500'

FEMA SPECIAL FLOOD HAZARD AREAS

FLOODPLAIN ECONOMICS STUDY

WATERBURY, VERMONT

SOURCE(S):
Vermont River Management Program
Vermont Center for Geographic Information
Bing Maps Aerial

0 125 250 500 Feet

Milone & MacBroom
1 South Main Street, 2nd Floor
Waterbury, Vermont 05676
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www.miloneandmacbroom.com

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
9/16/2017	Flood	Washington County: Waterbury Town & Village	Some road damage but not severe in Waterbury, DR-4330
8/2/2013	Severe Flooding	Washinghton County: Waterbury Town & Village	$87,668 in road damge DR-4140
8/28/2011	Flood/Tropical Storm (also severe weather)	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 DR-1995
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, Waterbury Town & Village	3–6" of rain over 2-day period - Mad River flood gauge at 14.13 feet (flood stage is 9 feet) DR-1228
1/19/1996	Flood; ice jam	County Wide	DR-1101
8/4/1995	Flood	County wide, Waterbury Town & Village	$1.5 M damages; Mad River gauge at 8.12 ft, DR-1063
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

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 Office 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. A USGS river gauge is installed on the Route 2 bridge over the Winooski River between Waterbury and Duxbury although during Tropical Storm Irene it was knocked out at 423.3 feet above sea level. 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
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
417	THE WINOOSKI FROM WATERBURY DOWNSTREAM THROUGH RICHMOND WILL BE AT BANKFUL. SOME MINOR FLOODING OF LOW LYING FIELDS WILL OCCUR.

Automated and available stream gauges in Waterbury and upstream are used by the National Weather Service and USGS to monitor river heights especially during high water events.

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. The Zoning Administrator is responsible for enforcement of the regulations of both the Town and Village. The Town does currently own some floodplain property 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 as does the State Office 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.

As of October 2017 there are no repetitive loss properties in Waterbury Town or Village.

	Waterbury Town	Waterbury Village
No of variances	2	0
No of Rep Losses	0	0
LOMCS (Letter of Map Changes)	14	7
No of Policies (1/31/17)	20	132
FIRM DATE	3/19/2013	3/19/2013

This section of the Plan satisfies the requirements of 44 CFR 201.6(c)(2)(ii)

Based on Waterbury's FIRMs, there are 221 structures plus the State Office Complex 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. As of January 31, 2017 Waterbury Town had 20 active NFIP policies for a total coverage amount of $4,671,700 with premiums of $17,531. Waterbury Village had 132 active policies for a total coverage of $43,333,800 with premiums of $351,878.

The Town Tax Assessor maintains and regularly updates a database of all properties for tax assessments. Properties that are in the flood risk areas are identied and assessed accordingly to coincide with the Flood Insurance Rate Maps.

Fluvial Erosion

Fluvial erosion is occurring primarily on the Thatcher Brook, a tributary of the Winooski River. Severe rain events cause greater rates of fluvial erosion along the stream banks. Culverts should be checked regularly for proper sizing, ditches armored, and the roadway crowns could be increased to better convey water and help improve water quality. Data on the fluvial erosion damage in number of acres lost was not found for any in the listings for storm events. Fluvial erosion extent data is unavailable. The most notable fluvial erosion areas along Thatcher Brook and its tributaries in the town are:

- Perry Hill Road—undermining of culvert
- Route 100—back of antique shop property is eroding away
- Kneeland Flats—scour
- 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. Culverts should be checked regularly for proper sizing, ditches armored, and the roadway crowns could be increased to better convey water and help improve water quality. Town roads frequently damaged by flash floods include:

- Barnes Hill Road—road washout
- Guild Hill Road
- Little River Road—$19,000 FEMA reimbursement
- Ring Road
- Perry Hill Road
- Kneeland Flats—culvert washout
- Backside of Blush Hill Road
- Shaw Mansion Road (dip)
- Crossroad

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.

Hazard	Location	Vulnerability	Extent	Impact	Probability
Flash Flooding/ Fluvial Erosion	FIRM maps, Route 100, Thatcher Brook and tributaries, Maple Street, back roads	Infrastructure such as water and sewer lines, culverts, roads, private properties	Back roads along stream banks	$2,000,000 - Could be large impact on physical infrastructure	Highly Likely

3. Severe Weather (Thunderstorm, Lightening, High Wind, Hail), Hurricanes/ Tropical Storms

Severe weather can occur during any month of the year and include Hurricanes and tropical storms with violent rain storms and 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.

Lightning produces thunder. Lightning is the electrical charges in the atmosphere between clouds, the air, or the ground. In the early stages of development, air acts as an insulator between the positive and negative charges in the cloud and between the cloud and the ground. When the opposite charges builds up enough, this insulating capacity of the air breaks down and there is a rapid discharge of electricity that we know as lightning (as defined by NOAA). The discharge of electricity produces light (lightning) and sound (thunder). Lightning can kill, cause forest fires, and damage property. According to www.ncdc.noaa.gov/stormevents there were no reported events of deaths or severe damage from litghtening in Waterbury from 1960 to the present. While lightening is frequent with summer storms and at times strikes properties causing structural damage or fires, it is not considered a high concern for identification or mitigation.

The extent of severe storms is not well documented in Waterbury. The impact of storms is usually flood related and is listed 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.

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.

Date	Event	Location	Extent
8/28/2011	TS Irene	Statewide	Tropical Storm— 8±" 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

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

Combined NOAA/TORRO Hailstorm Intensity Scales

Size Code	Intensity Category	Typical Hail Diameter (inches)	Approx 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+		Extensive structural damage. Risk of severe or even fatal injuries to persons caught in the open

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			

During Tropical Storm Irene, the lower areas of the Village of Waterbury were 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
- Demeritt Place
- River Road
- Park Street
- Park Row
- Rotarian Way
- O'Hear Court
- Randall Street
- Union Street
- US Route 2
- Winooski Street
- Whalley Trailer Park
- State Office Complex

Because of the severity of damages caused by TS Irene, FEMA had designated Waterbury for involvement in the Long-Term Community Recovery process. The outcome of that process was a list of 22 projects where the majority of the identified projects were completed between 2012 and 2016. The long-term recovery took nearly 6 years to complete.

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 early evening, residents had little time 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 were over $33,000,000 in 2011.

The majority of the State Office Complex in Waterbury was closed from August 2011 through December 2015. Over 1,000 state employees were in temporary quarters in other communities while the rebuilding took place. Most all have returned as of April 2016. A few hundred workers did not return to the renovated State Office Complex due to state agency reconfigurations. The State Hospital, the Agency of Natural Resources and the State Colleges admin offices were moved to other communities. It cost approximately $134,000,000 to rebuild the complex in its current location. The State underwent and enormous reconstruction effort to restore the state office complex that is now a combination of the historic buildings as well as a new 70,000 SF office building. To mitigate flooding, the new building was wet and dry flood proofed, and with the first floor above the 500 foot flood elevation. In addition to restoring floodplain function, many of the buildings in the floodplain were demolished and retention ponds built.

The FEMA LTCR process had 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 provided goals, policies and strategies to make Waterbury more resilient to numerous hazards and will help the community develop in a more sustainable manner. A list of these goals with the completed projects is listed elsewhere in this Plan.

Excerpt from NOAA Bulletin:
East Coast Hurricane Irene Inflicts 48 Fatalities; Damage Over $10 Billion

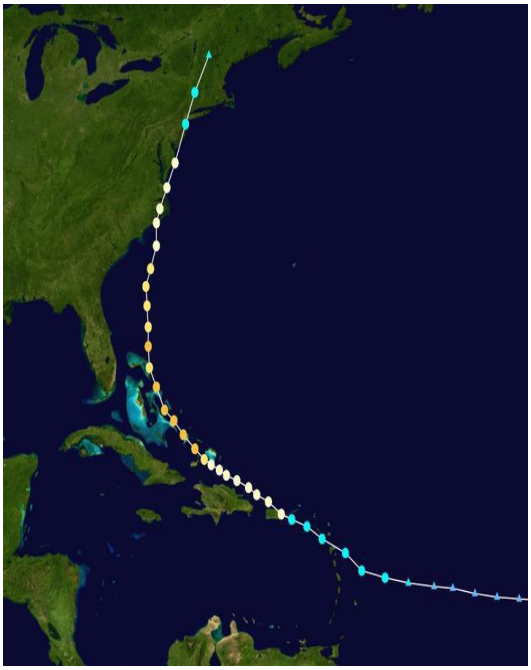
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL ENVIRONMENTAL SATELLITE, DATA AND INFORMATION SERVICE NATIONAL CLIMATIC DATA CENTER, ASHEVILLE, NC

The 27 August 2011 landfall of Hurricane Irene in the North Carolina Outer Banks. Its final awful tally would be 48 dead and over $10 billion dollars in damage spread over its lengthy course.

Irene—the first hurricane of the 2011 Atlantic hurricane season and the first landfalling U.S. hurricane since 2008—emerged off the Cape Verde Islands on August 15th as a well–defined tropical wave. On August 20th, the storm attained tropical storm status, becoming the 9th named storm of the season. This is the second earliest date at which nine storms have occurred; the last time this record was met was in 1936. Tracking west–northwestward, Irene made its first landfall in Puerto Rico, reaching hurricane strength while passing over. It knocked-out power to about one million people. After crossing the Turks and Caicos Islands, Irene underwent rapid cyclogenesis, strengthening to a category 3 storm just prior to passing through the Bahamas. It was reported that roughly 90% of structures on the Acklins and Crooked Islands were destroyed.

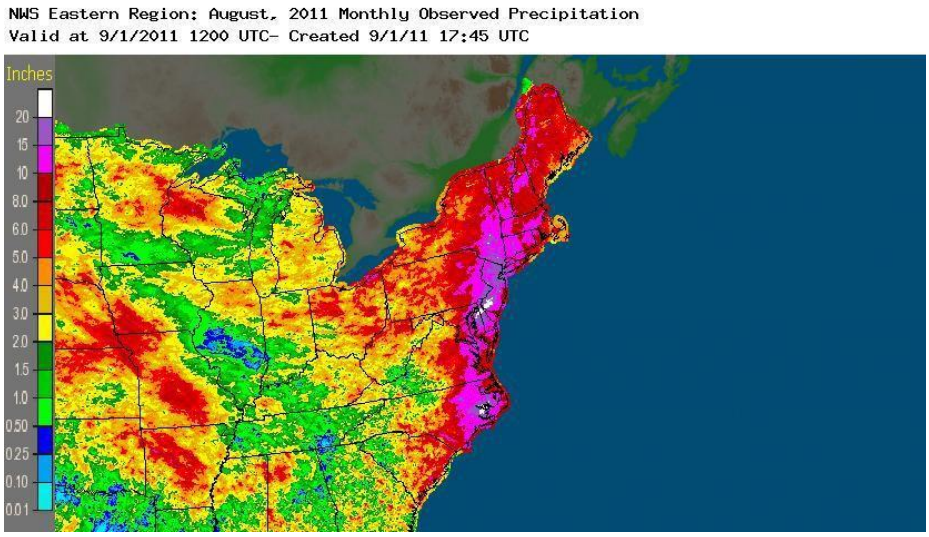
Left: The hurricane on the verge of becoming a category 3 level storm. (All images courtesy of NOAA.)

The storm then curved north– northeast, and made landfall in the Outer Banks region of NC on the morning of August 27th. In Harlowe, NC, a storm surge of 8.5 feet was reported, and in Onslow Bay wave heights reached 27 feet. A total of 20″ of rainfall fell both in Jacksonville, NC and Virginia Beach, VA. In the days following, Irene tracked towards the Northeast, making its second U.S. landfall in New Jersey and its third and final U.S. landfall in Brooklyn, NY. This marks the second hurricane to hit the state of New Jersey in 108 years.



Hurricane Irene's path from the Cape Verde Islands to Brooklyn, NY and Vermont.

Hurricane Irene brought torrential rainfall to parts of New England on August 28th–29th. Vermont, a landlocked state, suffered some of the worst damage from record heavy rains that led to catastrophic flooding in the state. Several towns, including Brattleboro and Bennington, were underwater. According to NOAA's U.S. Records, 26 monitoring stations, including 11 in Vermont, broke their all-time daily maximum precipitation records between the 27th and 29th. In New York, the Passaic River, as measured by the National Weather Service at the Pine Brook gauge, rose above major flood stage on August 28th and reached a new record height of 24.12 ft (7.35 m) on the 30th, surpassing the previous record stage of 23.2 ft (7.1 m). Several towns and areas along the East Coast were cut off as roads and bridges were washed away.



Rains from the storm added to the monthly August precipitation amount, bringing New York City, New York, Philadelphia, Pennsylvania, and Newark, New Jersey their wettest months on record. Newark also set a record for its highest recorded daily rainfall on the 28th, at 8.92 inches (227 mm). An estimated five million U.S. residents and 250,000 Canadian residents lost power as the storm roared through the region. Thousands of flights were cancelled and major transportation services were shut down in major cities including New York City.

Irene was unusually large, boasting an expansive 500 mile (805 km) diameter, and tropical force winds which extended nearly 300 miles (483 km) from its center. It was also slow moving – traveling at a top speed of 20

mph (32 km/h) compared to speeds of 30–40 mph (48–64 km/h) for similarly sized storms. The storm claimed at least 48 lives and caused an estimated $7 to 10 billion dollars in damages in the U.S. and $3.1 billion (USD) in the Caribbean. This total ranks it among the top 10 costliest disasters in U.S. history. In addition, it qualifies 2011 as the year having the greatest number of billion-dollar weather disasters within the United States. Prior to Irene, 2011 had tied 2008 with 9 such huge disasters. Due to the storm's widespread socio–economic impacts, it is expected that the name "Irene" may be retired from future use.

Washington County

5 NE Cabot	28	1700EST					
East Barre	29	0600EST	0	0	15.00M	2.50M	Flood

Flooding from Tropical Storm Irene caused extensive flooding across Washington County VT. The Winooski River was the primary river in flood in Washington County, cresting at 19.05 feet in Montpelier at 21:15 EST August 28, the second highest crest on record. Flooding was extensive in downtown Montpelier. Downstream in Waterbury, the Winooski flooded the Waterbury State Office Complex and portions of downtown Waterbury. Many offices of state agencies were inundated, and active operations at the Vermont state mental hospital and Vermont Emergency Management Emergency Operations Center were forced to relocate during the flood.

Hazard	Location	Vulnerability	Extent	Impact	Probability
Severe Weather Including Hurricanes/ Tropical Storms	FIRM maps, 100 year floodplain, Waterbury Village, roads, State Office Complex, wastewater plant, low areas in the village and town	Private property, mobile home parks, roads, culverts, utilities	1927 flood—10-15' on Main St., Waterbury Village, TS Irene 2011 flooded areas throughout village and town	$152,100,000 Estimated. Irene damage was listed as $10m for private/ municipal & $22m for State Office Complex. Final cost to rebuild the State Office Complex was $134m.	Highly Likely

4. Winter Storms, 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
12/9-13, 2014	Winter Storm	Washington County, Waterbury	Statewide: Public Assistance—$3,949,028, Emergency Work—$2,367,943 DR-4207
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 1/2"thick, 50 mph wind gusts
2/14/2007	Winter storm	Washington County, Waterbury	18–36" of snow
1/4/2003	Winter storm	Washington County, Waterbury	12–20" of snow
3/5/2001	Winter storm	Washington County, Waterbury	15–30" of snow, $1,301,755 Public Assistance funds, $1,296,993 Emergency Work
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	Unknown 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. Problems and issues arise from freezing pipes, power outages and snowloads on roofs. Fuel deliveries can be delayed due to excessive snow and ice which in turn can result in fozen pipes. Powere outages are particularly difficult for elederly and special needs populations that may depend on power or may be house bound. 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.

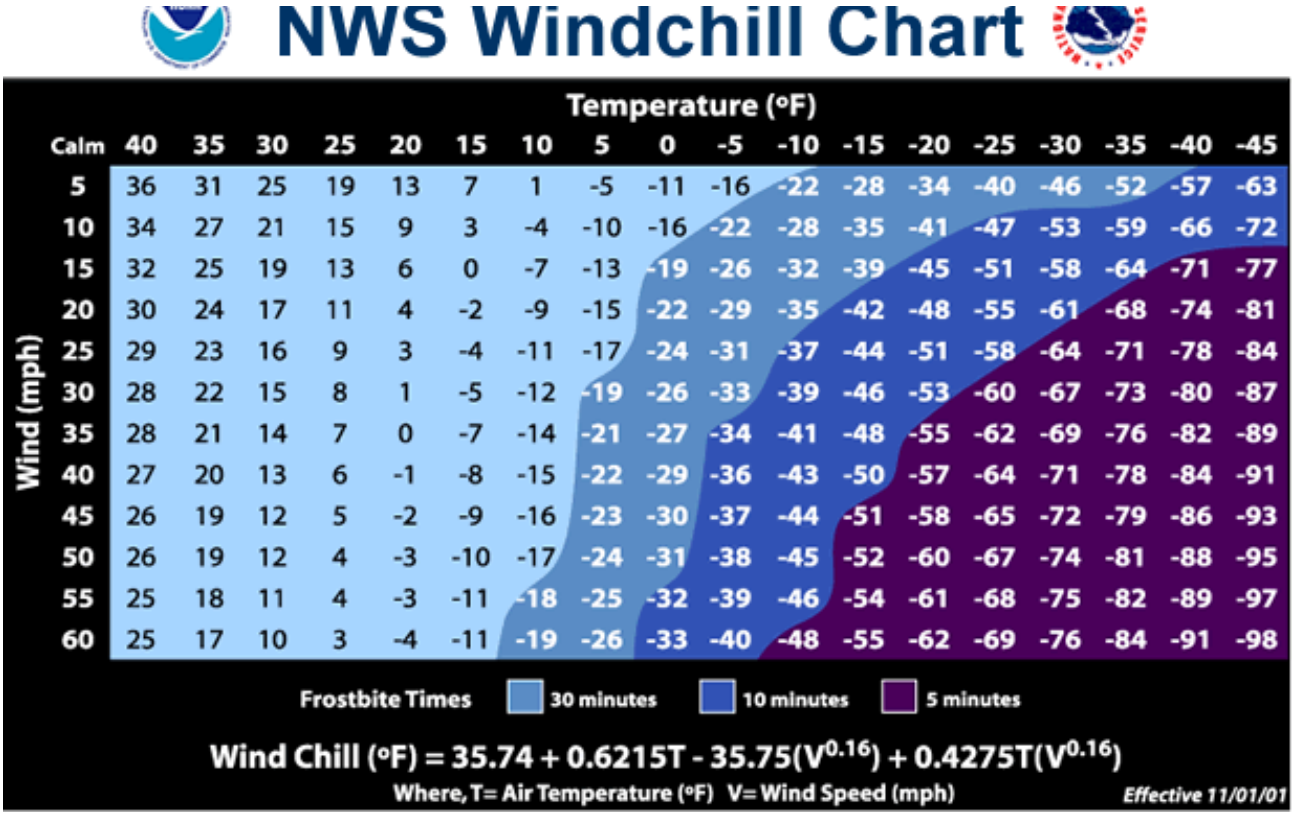
The physical impacts of winter storms are town wide due to the expansive nature of winter storms. For the next plan update, Waterbury will more closely monitor winter storms to determine the worst impacts possible on the Town. Based on past occurrences, the worst anticipated winter weather Waterbury 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 before 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 a half inch or greater. Impacts include power lines and communication towers.

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. The pumps for the wells do 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.

The coldest recorded dates on record in Burlington, Vermont according to the NOAA National Weather Forecast Offices are as follows:

-30 degrees Feb 12th, 1979 & Jan 15th, 1957
-29 degrees Jan 27th, 1994 Dec 29th & 30th, 1933
-28 degrees Feb 9th , 1934 & Feb 1st, 1920
-27 degrees Feb 7th, 1993, Jan 4th, 1981, Feb 11th, 1979, Jan 11th, 1968, Jan 31st, 1920, Feb 5th, 1908

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 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. Planning and preparedness efforts include 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 designated shelters and are located in the Village; the church does not have a back-up power supply. 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,	Utilities, trees, roads, old/under insulated structures, Special needs populations	18+" snow in March 2011 Storm in 24 hrs, Blizzard of 1888	Additional sheltering/ plowing/ emergency services costs for town—$15,000	Highly Likely

5. Dam Failure—Moderate Threat

Dam failure is the breaching of a structure retaining water which may potentially cause loss of life and property to those downstream. Wikipedia describes the dam as: The largest dam of concern in Waterbury is the Waterbury dam that was built in response to the 1927 flood. The Waterbury Dam was built between 1935-1938 by 2,000 men working for the Corps of Engineers, United States Army, to serve as one of three dams to control the flow of Little River, Vermont, Winooski River and its tributaries. In 1927, flood waters from the Winooski River killed over 55 people and caused an estimated $13,000,000 in damage. Along with flood control, the dam also generates electric energy, generating an average of 15,000,000 kilowatt-hours (54,000,000 MJ) annually.

The 1,845 feet (562 m) long earthen dam is filled with 2,200,000 cubic yards (1,700,000 m^3) of material, including 3,490 cubic yards (2,668 m^3) of clay in its center portion. The rocks, which serve as the dams walls, were hand placed during the dam's original construction in 1938. The dam was modified in 1957 and 1958 to provide for increased security.

The dam and the reservoir it creates, the Waterbury Reservoir, are located in the town of Waterbury in northwestern Washington County. This is classified as a high risk dam due to the population of potential impact below the dam.

The dam is 190 feet high. The normal water level is approximately 592 feet. During maximum high water level periods (629.5 feet) the reservoir contains approximately 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. The dam has undergone repairs in the 1950s, mid-1980s and again in the early 2000s.

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 breach. 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 breach 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 at the end of this Plan.

The ranking as a "high hazard" dam is based on Vermont Division of Emergency Management's classification, "according to the dam's potential for causing loss of life and property damage in the area downstream of the dam if it were to fail" and uses a Downstream Hazard Classification system like that used by the U.S. Army Corps of Engineers as found in Table 4-24 in the Vermont State Hazard Mitigation Plan, November 2013 on page 4-95 and as shown below. The ANR Dam Safety Program inventory has 1240 dams of which 61 are high hazard dams. Of the 61 high hazard dams, ANR has jurisdiction for 40 of them including the Waterbury Dam. According to the State Hazard Mitigation Plan, none of the ANR regulated dams are in imminent danger of failure.

Table 4-24
Downstream Hazard Classification of Dams

Class	Hazard Category	Potential Loss of Life	Potential Economic Loss
3	Low	None expected (No permanent structures for human habitation)	Minimal (Undeveloped to occasional structure or agriculture)
2	Significant	Few (No urban developments and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry, or structures)
1	High	More than few	Excessive (Extensive community, industry, agriculture)

Green Mountain Power owns the Waterbury dam. The Central Vermont Regional Planning Commission (CVRPC), Agency of Natural Resources, Vermont Emergency Management and the Town and Village of Waterbury have mutual interests to assure the safety of human life and property below the dam. Emergency preparedness measures and community outreach is taking place during the writing of this Plan. There is a siren at the base of the dam to warn those nearby of water releases; however, the siren is difficult to hear downstream. Waterbury has adopted the VTAlert emergency notification process for immediate notifications of persons who have signed up for the alerts via land line, cell phone, computer.

The information below is an excerpt from the website of the Army Corps of Engineers: www.nae.usace.army.mil/Missions/Civil-Works/Flood-Risk-Management/Vermont/Waterbury/

The dam at Waterbury Reservoir in Waterbury is situated on the Little River, about 2.5 miles above its confluence with the Winooski River. From Waterbury, the dam can be reached by traveling two miles west on U.S. Route 2, then right on Little River Road for three miles.

In conjunction with East Barre Dam and Wrightsville Reservoir located upstream from Waterbury, the Waterbury Reservoir provides flood protection to the downstream communities of Duxbury, Bolton, Richmond,

Williston, Jericho, Essex, Colchester, Burlington, South Burlington, and Winooski. The Waterbury Dam is listed as a high risk in the Vermont Hazard Mitigation Plan. There is an Emergency Action Plan (EAP) on file with the State. The Wrightville Dam in Montpelier and the Marshfield Dam in Marshfield are also considered high risk dams with EAPs that feed into the Winooski River. And failure of those dams would impact the Village of Waterbury.

The dam consists of an 882-foot-long semicircular concrete conduit 10.5 feet high and 14 feet wide; two 230-foot-long steel conduits, each with a diameter of four feet six inches; a 290-foot-long steel circular conduit with a diameter of four feet; three 26.5-foot-high tainter gates, with two gates each measuring 20 feet wide and the third 35 feet wide; and a spillway cut in rock with a 154-foot-long concrete ogee weir. The weir's crest elevation is 15.5 feet lower than the top of the dam. Waterbury Reservoir was one of four flood damage reduction projects constructed in Vermont by the Civilian Conservation Corps (CCC) in the 1930s. Construction was overseen by the Corps' North Atlantic Division. Because of accounting procedures, the construction costs of Waterbury Reservoir were not calculated separately, but instead lumped together with the construction costs of East Barre Dam, Wrightsville Reservoir, and the Winooski River Local Protection Project. The construction costs of these four projects totaled $13.7 million. Following completion, Waterbury Reservoir and associated lands were turned over to the state of Vermont for operation and maintenance.

The present day configuration of the dam is the result of two major modifications that allow a greater amount of water to pass through the spillway, increasing the dam's structural integrity. The first modification, which began in September 1956, included raising the dam three feet and installing the 35-foot-wide tainter gate. This work was completed in November 1959 at a cost of $861,000. The second modification began in January 1985 and involved constructing the 290-foot-long steel conduit, rebuilding the toe of the dam, and grouting the dam's foundation to control seepage. This work was completed in December 1985 at a cost of $4.8 million. Future tainter gate repairs are estimated at $45 million.

For most of the year, Waterbury Reservoir has a pool of 860 acres with a maximum depth of approximately 100 feet. During the winter, the pool is drained to a surface area of between 250-300 acres by the Green Mountain Power Corporation, owners of the hydroelectric power plant at the base of the dam (see below), in anticipation of spring rains and snowmelt. The flood storage area of the project, which is normally empty and utilized only to store floodwaters, totals 1,330 acres and extends approximately six miles upstream through Stowe. The project and all associated lands (including part of Mount Mansfield State Forest) cover 12,912 acres. Waterbury Reservoir can store up to nine billion gallons of water for flood control purposes. This is equivalent to 4.8 inches of water covering its drainage area of 109 square miles.

Hazard	Location	Vulnerability	Extent	Impact	Probability
Dam Failure	Waterbury Dam–Little River	Properties/ Infrastructure in Village of Water-bury, Route 2, Bolton and Richmond	Area — 82,100 acre feet of water	$187,200,000 Est. potential property losses, downstream properties	Unlikely

The Emergency Action Plan (EAP) for this high risk dam provides information on the potential impacted area and the people and businesses at risk of flooding if the dam should fail and provides the estimated time for the flood wave to travel from the dam to the impacted locations. The EAP and map identifies the immediate area

downstream from the dam, the Village of Waterbury, Bolton and Richmond as areas that would be impacted should there be a serious breach or failure of the dam. It has been some time since the EAP has been reviewed by the town and there we have been told that the EAP is being updated by the owners. The town staff will reach out to the dam owners to assure proper identification of local points of contact and likely areas of impact are up to date in case of emergency situations.

Monitoring devices are available at the dam for flood control, operations and flow and are checked constantly by Green Mountain Power at their regional offices in the Burlington area.

C. Vulnerability Summary

As a result of the above profiled hazards, the Town and Village believes the following vulnerabilities to be of highest concern due to their potentially severe consequences and likelihood of occurrence:

- **Hazardous Material Spill or Event:** The Village of Waterbury has a high concentration of population, school, public facilities, railroad, interstate and major highways. The Village is considered the crossroads where the various transportation systems intersect. Should a hazardous spill or other event occur it could be potentially catastrophic for those in the immediate and surrounding area. Potential risks include a train derailment with hazardous materials and/or large vehicles transporting hazardous materials on the interstate system close to the Village center, dense population and school.

- **Flash Flood/Flood/Fluvial Erosion:** One of the highest threats and most common threats involves flood impacts on roads and the Village center, especially facilities for children, elders, and community emergency shelters. Under-sized bridges and culverts factor into the threat, with Waterbury being home to many known, problematic flood areas. Flood hazard mapping (Special Flood Hazard Areas) does not adequately encompass all areas that could be flooded, thus potentially making some residents too complacent in regard to the threat. In addition, numerous homes and public facilities are located in the 100 and 500-year floodplain and could be impaired by a major flood event. Vulnerable commercial and public structures to severe weather and flooding include: the main sewewr pump station, the wasterwater treatment plant, the Waterbury Village area, Routes 2 and 100, the Main Street Fire Department, the Waterbury State Office Complex.

- **Severe Weather (Thunderstorms, Lightening, High Wind, Hail) including Hurricanes/ Tropical Storms:** A good portion of Waterbury's severe weather results in flooding, especially when it involves a hurricane or tropical force winds and rain. However, storms and high winds are problematic with the mountain and valleys in the community. Power outages and road blockages occur in high winds, especially when trees topple and take down power lines and restrict transportation. In the summer months, power outages are generally less problematic than in the winter months due to life safety and freezing issues.

- **Extreme Cold/Snow/Ice Storms:** Prolonged power outages and downed land lines and cellular communications can greatly hamper public and business services for

indeterminate periods of time and could severely impede response efforts, fuel deliveries, road access and could be especially harmful to vulnerable populations (e.g., the elderly and disabled).

- **Dam Failure**: While this is a low probability, the results of a dam breach would cause loss of life and catastrophic damage that would be more severe than the more predicable flash floods and other severe weather events. Mitigation goals include becoming more involved in the next update of the Emergency Action Plan with Green Mountain Power and better communication on early warning systems.

VI. Mitigation

The Town and Village of Waterbury have been part of the National Flood Insurance Program (NFIP) since 1986. The Flood Hazard Area Regulations and Overlay District are part of the Zoning Regulations for the Town and Village and meet or exceed the minimum standards in the federal CFR. The Flood Hazard Area Regulations were re-written in 2016 to be more effective in mitigating the damage from future flood events and to ensure that new development and re-development within the 100-year floodplain will receive minimal damage from flooding.

This section of the Plan satisfies the requirements of 44 CFR 201.6(c)(3)(i), and 201.6(d)(3)

The Town and Village of Waterbury were accepted as members of the FEMA Community Rating System (CRS) in October, 2016 at a Level 9 that provides for a 5% reduction in flood insurance premiums for property owners that have flood insurance. The CRS program has a strong mitigation component that includes public education and outreach, local regulation, and other programs that help mitigate the impacts of flooding.

The Hazard Mitigation Plan is incorporated by reference in the 2013 Municipal Plan. When the Municipal Plan is amended and re-adopted in 2018 this new Hazard Mitigaiton Plan will also be incorporated by reference. The following goals of this Hazard Mititation Plan and excerpts from the current Waterbury Municipal Plan express the underlying principals that support and help define our local hazard mitigation program.

A. Hazard Mitigation Plan Goals

1. To reduce injury and losses from potential Hazard Material Events.
2. To reduce injury and losses from the natural hazard of Flash Flooding/Flooding/Fluvial Erosion.
3. To reduce injury and losses from the natural hazard of Severe Weather (Thunderstorms, Lightening, High Wind, Hail) including Hurricanes/Tropical Storms.
4. To reduce injury and losses from the natural hazard of Extreme Cold/Snow/Ice Storms.
5. To reduce injury and losses from the hazard of a Dam Breach.

B. Excerpts from the Waterbury Municipal Plan 2013—Goals & Objectives Supporting Local Hazard Mitigation

Chapter 6 Goals, Objectives as applicable

1. The responsible stewardship and sustainable use of Waterbury's natural resources in a manner that protects and enhances the town's and the broader region's environmental wellbeing for the benefit of present and future generations.
3. Flood resiliency, mitigation and restoration following flood events such as Tropical Storm Irene.
8. Prevent and control the spread of invasive exotic species in Waterbury through town actions, public engagement with landowners and other residents, and collaborative efforts with other towns and partners.
9. Protect and enhance the quality of Waterbury's surface waters through the maintenance of riparian buffers along river corridors and streams.
10. Mitigate damage sustained from flooding through land use regulations, flood proofing of critical facilities in the floodplain, engaging landowners in proactive measures to flood proof, and participate in the FEMA sponsored Community Rating System (CRS) to help further these efforts and reduce flood insurance premiums.

Chapter 9 Public Facility Goals, and Objectives as applicable

1. 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.
2. Provide utility services and municipal facilities that support orderly growth and controlled development at a rate and in locations that Waterbury can accommodate.
4. Provide clean, safe, and sufficient water to areas currently served by public water systems.

Chapter 11 Land Use Goals and Objectives as applicable

1. Ensure that new development is compatible with and does have an undue adverse impact on Waterbury's public services and infrastructure, transportation safety and mobility, and natural and scenic resources.
6. Maintain and develop a public water and sewer system consistent with the goals, objectives, and actions identified in Chapter 9.
16. The overall density of new development will be limited in order not to overburden the capacity of the existing road network or place undue burden on the town's ability to provide road maintenance and other public services.

Additional Goals

- The Waterbury Municipal Plan was updated and adopted on December 9, 2013, and will be updated for a 2018 readoption date.
- Waterbury's policy is to support and annually update the Waterbury Local Emergency Operations Plan.
- Waterbury has adopted the VTAlert emergency notification communication system to alert residents and visitors to emergency situations if and when they occur.

C. Hazard Mitigation Strategies: Preparedness Programs, Projects & Activities

This section of the Plan satisfies the requirements of 44 CFR 201.6(c)(3)(ii), 201.6(c)(3)(iii) and 201.6(c)(3)(iv).

Vermont's Division of Emergency Management encourages a collaborative approach to achieving mitigation at the local level through partnerships with Vermont Agency of Natural Resources, VTrans, Vermont Agency of Commerce and Community Development, Regional Planning Commissions, FEMA Region 1 and others. These agencies and organizations can work together to provide assistance and resources to towns interested in pursuing hazard mitigation projects.

With each mitigation strategy, general details about the following are provided: local leadership, possible resources, implementation tools, and prioritization. The prioritization category is based upon the economic impact of the action, Waterbury's need to address the issue, the cost of implementing the strategy combined with the benefit received, and the availability of potential funding. A range of mitigation strategies was considered by the FMWG, and those that were determined to be feasible are included in the table below.

Strategies given a "High" prioritization indicate they are either critical or potential funding is readily available, and should have a timeframe of implementation of less than two years. A "Medium" prioritization indicates that a strategy 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.

The Town and Village of Waterbury understands that, in order to apply for FEMA funding for mitigation projects, a project must meet more formal FEMA benefit cost criteria. A project seeking FEMA funds would undergo a full benefit-cost analysis in the FEMA-approved format. The Town and Village must have a FEMA-approved Local Hazard Mitigation Plan as well.

This section of the Plan satisfies 44 CFR 201.6(c)(4)(i) and (ii) and 201.6(d)(3)

The following strategies will be incorporated into Waterbury's long-term land use and development planning documents. In addition, the municipality will review and incorporate elements of this Local Hazard Mitigation Plan into updates for the municipal plan, zoning regulations, capital improvement plans and flood hazard/ river corridor bylaws. The Waterbury Planning Commission will incorporate mitigation strategies included in this Plan into the Waterbury Municipal Plan's goals, policies, and recommendations in the next update. The Municipal Plan, zoning regulations and flood hazard/FEH bylaws will also be considered after declared or local disasters.

Table 1: Waterbury Local Hazard Mitigation Strategies -2017

For a detailed description of each of these top priorities, please see additional information in the Appendix. A robust list of additional funding sources are also listed in the Appendix.

Town and Village of Waterbury Priorities	Hazards Mitigated	Mitigation Action	Responsible Jurisdiction	Priority	Possible Funding Resources	Time Frame
1	Infrastructure /Flooding	Improve physical infrastructure: Main St. Reconstruction, culverts, manage village stormwater drainage, protect utilities	Town, Village, VTrans, Revitalizing Waterbury, CVRPC	High	VTrans, Municipal Funds	Summer 2018-fall 2020
2	Flooding/ Severe Storms	Implement floodplain reconnection strategies to increase low-lying areas that can accommodate floodwaters and reduce flooding	State of VT, VEM, Town, Village	High	HMGP	Year 2–4
3	Infrastructure /Flooding	Colbyville drainage along Route 100, possible ROW expansion	State of Vermont, State Highway	High	HMGP, VTrans	Spring 2018-fall 2019
4	Infrastructure	Stowe St. Bridge—replace and upsize functionally deficient bridge that was installed following the Flood of 1927. This is a critical connection for pedestrians	Town of Waterbury, State of Vermont	High	VTrans, Town of waterbury	Year 2–5

		and access to the VTrans Park and Ride				
5	Infrastructure	Upsize Lincoln Street culvert on Graves Brook and restore floodplain along northern bank to prevent additional sediment transport downstream	Select Board, Public Works Director, Road Commission, VTrans	High	HMGP, EPA, VTrans	Year 1–4
6	Infrastructure	Upsize culverts and bridge on Guptil Road, Shaw Mansion Road, Ripley Road	Select Board, Road Commission, VTrans	High	HMGP, VTrans	Year 1–4

Table 2: Planning, Outreach And Education Strategies - 2017

Planning Strategies	Hazards Mitigated	Planning and Preparedness Actions	Responsible Jurisdiction	Priority	Funding Resources	Time Frame
	Dam Safety/ Emergency Preparedness	Public education for residents and communities downstream on evacuation and early notification procedures	ANR, Public Works, Waterbury Emergency Manager	High	Municipal / State funds	Fall 2018
	Dam Safety	Coordinate with dam owner and community on Emergency Action Plan (EAP) contacts and information flow for dam safety and preparedness	Emergency Services, GMP, CVRPC, Town, Village	High	EMPG, Municipal Funds	Spring 201, ongoing
	Planning/ Regulations	Update Flood Hazard Area regulations to include river corridors	Town Select Board,Village Trustees	Med	Municipal funds	Year 2–4
	Planning/ Emergency Preparedness	Coordinate with Duxbury for emergency evacuation, communication and coordination on River Road and flood areas	Emergency Services, Waterbury, Duxbury	Med	Municipal	Ongoing

Planning Strategies (Cont)	Hazards Mitigated	Mitigation Strategies	Responsible Jurisdiction	Priority	Funding Resources	Time Frame
	Mitigation	Consider fuel tank tiedowns for properties in floodprone areas. Consider educational campaign in partnership with Vermont Fuel Dealers Association	Town staff with public and private entities	Med	Estimated *Costs* $500–700/home	Year 2–4
	Planning/ Mitigation	Plan for long-term growth outside of the floodplain. Consider suitable areas for future village development.	Planning Commission, Town, Village	Med	Plan update, Municipal grant	Year 3–5
	Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, trop. storms	Identify strategies and opportunities, including permanent easements, for protecting open space/undeveloped land in the floodplain and river corridor from future development, ID potential areas for easements and restoration	Town Select Board, Village Trustees, Friends of Winooski River, Conservation Commission	Med	Municipal funds	Ongoing
	Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, tropical storms	Engage with State of Vermont and Duxbury to explore mitigation opportunities along state lands, farm lands and River Road	State of Vermont	Med	Grant Funds	Ongoing
	Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, trop. storms	Support state regulations, install signage to prohibit dumping in stream channels, riverbank areas and wetlands	Town, Village, Green-Up, ANR	Med	Municipal funds	Year 1–3
	Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, tropical storms	Consider stormwater management regulations requiring that peak runoff from new development be no greater than pre-development runoff.	Planning Commission, Town, Village	medium	Municipal Planning Grant; Municipal funds	Year 4+

Planning Strategies (Cont)	Hazards Mitigated	Mitigation Strategies	Responsible Jurisdiction	Priority	Funding Resources	Time Frame
	Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, tropical storms	Consider regulations that require Erosion and Sedimentation Control on land that is disturbed during development. Utilize technical bulletins and research publications were available.	Planning Commission, Town, Village	Low	Municipal Planning Grant; Municipal funds	Year 4+
	Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, tropical storms	Consider mandatory use of connectors, brackets and mobile home tie downs with new mobile home applications in and outside of flood prone areas. Utilize technical bulletins and research publications were available.	Planning Commission, Town, Village	Low	Municipal funds	Year 2–3
	Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, tropical storms	Encourage and support use of public and private riparian buffers using the River Corridor Plan as guidance. Utilize technical bulletins and research publications were available.	Conservation Commission	Med	Grant or municipal funds	Year 2–3

Outreach and Education Strategies	Hazards Mitigated	Outreach Strategies	Responsible Jurisdiction	Priority	Funding Resources	Time Frame
	NFIP Compliance	Promote NFIP/CRS compliance by continuous communication, training and education. Utilize technical bulletins and research publications were available.	Work with elected officials, State and FEMA	Med	HMGP	Ongoing
	Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, tropical storms	Support educational campaign program for installation of sewer line valves on properties in the 500-year floodplain. Utilize technical bulletins and research publications were available.	Village Trustees / Town Select Board	Med	Public, private	Year 2–4
	Flooding, flash floods, fluvial erosion/ Severe Storms, hurricane, tropical storms	Utilize the Stream/Flume Table as an educational tool at public events	Friends of Winooski River, Planning Commission	Med	Public. private	Ongoing
	Winter Storms/ Severe Cold	Support LEAP members, Capstone and Efficiency Vermont to conduct outreach to residents on how to insulate homes (pipes, attics) for efficiency and extreme cold spells. Snow and ice loads are regulated by state building codes. Utilize technical bulletins and research publications were available.	Town,Village, Planning Commission, Efficiency Vermont, Vermont Fuel Dealers, LEAP, Capstone	Low	Efficiency Vermont, LEAP	Ongoing

VII. CERTIFICATE OF ADOPTION

Town Waterbury, Vermont Select Board and Village of Waterbury, Village Trustees
A Resolution Adopting the Town and Village of Waterbury, Vermont,
2017 Local Hazard Mitigation Plan

WHEREAS, the Town of Waterbury has historically experienced severe damage from all hazards and it continues to be vulnerable to the effects of the hazards profiled in the **Town and Village of Waterbury, Vermont, 2017 Local Hazard Mitigation Plan,** which result in loss of property and life, economic hardship, and threats to public health and safety; and

WHEREAS, the Town of Waterbury has developed and received conditional approval from the Federal Emergency Management Agency (FEMA) for its **Town and Village of Waterbury, Vermont 2017, Vermont Local Hazard Mitigation Plan (Plan)** under the requirements of 44 CFR 201.6; and

WHEREAS, the **Plan** specifically addresses hazard mitigation strategies, and Plan maintenance procedures for the Town and Village of Waterbury, and

WHEREAS, the **Plan** recommends several hazard mitigation actions (projects) that will provide mitigation for specific hazards that impact the Town and Village of Waterbury with the effect of protecting people and property from loss associated with those hazards; and

WHEREAS, adoption of this **Plan** will make the Town and Village of Waterbury eligible for funding to alleviate the impacts of future hazards; now therefore be it

RESOLVED by Tow n of Waterbury Select Board and the Village of Waterbury, Village Trustees:

1. The **Town and Village of Waterbury, Vermont, 2017 Local Hazard Mitigation Plan** is hereby adopted as an official plan of the Town and Village of Waterbury

2. The respective officials identified in the mitigation action plan of the **Plan** are hereby directed to pursue implementation of the recommended actions assigned to them;

3. Future revisions and **Plan** maintenance required by 44 CFR 201.6 and FEMA are hereby adopted as part of this resolution for a period of five (5) years from the date of this resolution; and

4. An annual report on the process of the implementation elements of the Plan will be presented to the Select Board and Village Trustees by the Emergency Management Director or Coordinator.

IN WITHNESS WHEREOF, the undersigned have affixed their signature and the corporate seal of the Town and Village of Waterbury this ____ day of _____ 201__.

_____ _____

Selectboard Chair Village Trustees, President

ATTEST

_____

Town and Village Clerk

VIII. Appendix

1. **Building and Infrastructure Vulnerability to 10–50 Year Flood Events**
2. **Map and Details of the Waterbury Hazard Mitigation Priorities**
3. **Waterbury Transportation Network**
4. **Hazardous Materials Studies**

   a. 2016 Tier II Facilities in Waterbury with hazardous materials
   b. Excerpts from the VT State Commodity Flow Study 2017
   c. Excerpts from the LEPC #5 Hazardous Materials Rail Commodity Flow Study 2009
   d. Rail Safety Training

5. **Waterbury Dam**

   a. Map - Waterbury Dam Inundation Area
   b. Dam Safety Seminar
   c. Recent Waterbury Dam article in the Waterbury Record

6. **Waterbury Opinion Survey and Comments**
7. **Central VT RPC Flood Study of Mad River and Thatcher Brook announcement**
8. **Waterbury Floodplain Management Working Group 2016 Annual Report**
9. **Winooski Street Bridge Restoration Study Project**
10. **Excerpts - USGS Flood Maps for the Winooski River in Waterbury, VT 2014**
11. **Resources for Implementing the Waterbury Hazard Mitigation Plan**

    a. List of Disaster Recovery Funding Resources 2016
    b. Alternative Funding for Disaster Recovery Witt-Obrien's 2013