

Vermont Economic Resiliency Initiative [VERI]

Woodstock, VT

Community Report
July 2015



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Noelle MacKay, Commissioner of Housing and Community Development

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Vermont Economic Resiliency Initiative (VERI): Woodstock Executive Summary

In communities around Vermont, rapidly melting snow and torrential downpours bring nightmares of washed out bridges, closed roads, flooded basements and shuttered businesses. To calm these fears, Vermonters have been working to better understand the flood risks they face and identify and implement projects that reduce, avoid or minimize these risks. The goal: to protect lives, help businesses remain open and reduce costs to taxpayers for repetitive repair to infrastructure.

After Tropical Storm Irene, Governor Shumlin challenged us to “build back stronger than Irene found us.” The Vermont Economic Resiliency Initiative (VERI) is designed to help meet that challenge. It is modeled after successful project in Bennington, Vermont that minimized business interruption and saved taxpayers money by substantially reducing flood recovery costs (DHCD, 2015). With funding from the US Department of Commerce, Economic Development Administration (EDA), the Agency of Commerce and Community Development, working with the Agencies of Natural Resources and Transportation and the Regional Planning Commissions, launched VERI to help ensure Vermont recovers quickly and remains open for business after disaster strikes.

In the first phase of the project, the VERI team evaluated and ranked areas where economic activity and associated infrastructure are at high risk of flooding. Based on this statewide assessment, input from the team’s economic development steering committee and interest from local municipalities, five areas in seven communities (Barre City and Town, Brandon, Brattleboro, Enosburgh Town and Village, and Woodstock) were selected for a more detailed analysis of the local flood risks to the community and businesses.

Woodstock was selected as a pilot community because it has a densely developed downtown area with significant economic activity, critical transportation infrastructure and commercial buildings at risk of flooding and a history of community engagement including past efforts to identify flood risks throughout the town. For example, the Town of Woodstock has adopted strategies for protecting new development and substantially improved buildings from flood hazards through regulations that offer greater protection to the community than the minimum National Flood Insurance Program (NFIP) guidelines. With its completion of a town hazard mitigation plan in 2015, the town and village now qualify for the intermediate level of state reimbursement (12.5%) for costs related to federally declared disasters.

The team hosted two community meetings and worked directly with local leaders, municipal staff, local businesses and interested citizens to determine the locations of greatest risk and cost, identified potential projects and highlighted the work communities have accomplished to date to reduce the impact of floods. Based on this community insight, along with data collection and analysis, the team evaluated local flood risk to business and infrastructure and identified strategies and projects

Woodstock can implement to minimize rebuilding and recovery costs and ensure businesses stay open -- saving jobs and maintaining the local economy.

This report summarizes the team's work and identifies town-wide bylaw and plan updates and 16 site-specific projects in Woodstock, including the eight projects listed below deemed high priority by the team.

Municipal Policy and Program Recommendations

Top recommendations include the following:

- **Monitor Rebuilding After a Disaster and Participate in the National Flood Insurance Program (NFIP):** People want to return their lives back to normal as quickly as possible after a disaster but local officials (zoning administrators and local boards) must monitor rebuilding to ensure that it does not violate town, state, or federal regulations. Allowing improper repairs after a flood may result in the loss of federal flood insurance and disaster recovery funding for the community. It is important to note that in many instances, buying out businesses and homes located in risky areas is the best way to safeguard against future losses of life and property.
- **Encourage Development Outside of the Floodway in the Village:** The floodway is the fastest moving part of the river during a flood. Buildings and other objects in a floodway can be washed downstream and cause culverts and bridges to clog with debris resulting in significant property damage. To protect the community and the economy, the village zoning bylaw should prohibit all new development in the mapped floodway.
- **Include the VERI Municipal Infrastructure Projects in the Local Hazard Mitigation Plan:** Woodstock can also add the projects listed in this report to the strategies portion of its hazard mitigation plan to improve eligibility for future grants.

High Priority Specific Project Recommendations

Building and Site Improvements: This project would reduce flooding and/or erosion to specific property with improvements to the building and/or surroundings.

- **Floodproof Buildings at the West Woodstock Farmer's Market:** The building at the Woodstock Farmer's Market was flooded during Tropical Storm Irene, resulting in a complete loss of merchandise. Elevating the building or using dry floodproofing techniques could help reduce future losses. A site-specific assessment by an engineer and/or architect is recommended to determine the best method to protect this business with 40 employees.

Channel and Floodplain Improvements: This project lowers the risk of flooding and/or erosion to properties along the river through the improvement of natural river and floodplain functions.

- **Preserve Floodplain Along the Ottauquechee River:** The largest floodplain between the Bridgewater/Woodstock town line and downtown Woodstock is located between the Lincoln Inn and Riverside Mobile Home Park. Protecting this largely undeveloped floodplain through an easement will reduce the risk of future development in a high hazard area and will benefit downstream properties.

Infrastructure Improvements: These are projects that lower the risk of flooding and/or erosion to utilities, roadways and other municipal or state-owned infrastructure.

- **Replace Undersized Bridge on US Route 4 near Deerbrook Way:** During Tropical Storm Irene this bridge clogged with sediment and debris that choked traffic down to one lane and destroyed a home. Replacing the bridge with a larger opening would reduce future flood damage and help ensure this critical east-west transportation corridor remains open for trucks, emergency vehicles, employees, employers and visitors.
- **Improve River and Road Stability on US Route 4:** The road embankments along US Route 4 failed and washed out in multiple locations during Tropical Storm Irene. Since then, the Vermont Agency of Transportation has made improvements to protect this critical corridor from future floods; however, further reinforcement of the roadside embankments would help ensure this road remains open for business and the traveling public.
- **Relocate or Reinforce Drinking Water Line Owned by Woodstock Aqueduct Company:** Woodstock's main water supply line at the Elm Street Bridge ruptured during Tropical Storm Irene and left 1,600 residences and businesses without water for five days. While the water supply lines were upgraded following the flood, more work is needed to improve the system's reliability during major floods. Construction of a redundant water supply line from wells on Stimets Road and VT Route 12 to the reservoir on Cox District Road would help assure the availability of clean water to businesses and the public.
- **Relocate or Reinforce Town of Woodstock Sanitary Sewer Line:** The main sewer line at the Elm Street Bridge also failed and left 925 business and residential customers without sewer service for one week. A section of the replaced pipe downstream of the Elm Street Bridge was reinforced following the storm; however, a section lacks a concrete encasement and is vulnerable to future flood damage.
- **Upgrade West Woodstock Sewer Pump Station:** The sewer pump station across from the White Cottage Snack Bar was out of service for 28 days following Tropical Storm Irene requiring the town to pump and haul untreated sewage to the wastewater treatment facility. Since then, all the electrical wiring has been replaced and elevated, but additional measures are needed to protect the pump station from water and silt during future floods.

Public Safety Improvements: Projects that lower the risk of flooding and/or erosion to properties by avoiding future flood risks.

- **Buyout At-risk Properties in West Woodstock:** Several businesses in West Woodstock experienced severe losses from the 1973 flood and from Tropical Storm Irene. Buyouts would help reduce future losses to life and property in this area.

Two high priority projects (to relocate or reinforce the Town of Woodstock Sewer Line and upgrade West Woodstock Sewer Pump Station) were further detailed to help Woodstock take the next steps and to create model project designs to help other communities learn from the VERI project. An analysis was also performed to evaluate options to reduce repetitive flooding at the historic Bridgewater Mill Mall, home to a number of local businesses.

Next Steps

As part of the ongoing community discussion regarding the VERI effort, we recommend the following steps to incorporate community input into the final prioritization and to advance the projects over time:

- Solicit input from individuals and businesses at future community meetings regarding specific projects and overall project prioritization;
- Prioritize one to two projects to pursue each year with assistance from the Vermont Department of Environmental Conservation and Two Rivers-Ottawaquechee Regional Commission staff to identify appropriate funding sources and partners;
- Apply for one to two grants each year to advance project development and/or designs;
- Implement projects as funding allows; and
- Monitor project success.

Tropical Storm Irene taught us many lessons -- a key one was that no one individual, business, organization, town or state agency can address and tackle large and complicated projects alone. Reducing the risk of future floods in Woodstock will require partnerships, funding and time to implement. The Agency of Commerce and Community Development, its sister agencies and the Two Rivers-Ottawaquechee Regional Commission are committed to help Woodstock take the steps outlined in this report to save lives and protect jobs and its economy from future storms and floods. Flooding due to severe storms will happen again, the question is how can we best reduce the recovery costs to communities and ensure businesses remain open.

List of Acronyms

ACCD – Vermont Agency of Commerce and Community Development

ANR – Vermont Agency of Natural Resources

BFE – Base Flood Elevation

CDBG - DR – Community Development Block Grant- Disaster Recovery

CRS – Community Rating System

DEC – Vermont Department of Environmental Conservation

DHCD – Vermont Department of Housing and Community Development

EDA – US Economic Development Administration

EPA – United States Environmental Protection Agency

ERAF – Emergency Relief Assistance Fund

FEMA – Federal Emergency Management Agency

FWHA – Federal Highway Administration

HEC-RAS – Hydrologic Engineering Centers Rivers Analysis System

HGMP – FEMA Hazard Mitigation Grant Program

HMP – Hazard Mitigation Plan

LiDAR – Light Detection and Ranging

NFIP – National Flood Insurance Program

SFHA – Special Flood Hazard Area

TRORC – Two Rivers-Ottawquechee Regional Commission

USGS – United States Geological Survey

VERI – Vermont Economic Resiliency Initiative

VTrans – Vermont Agency of Transportation

WWTF – Wastewater Treatment Facility

Glossary of Terms

Terms are bolded the first time they appear in the text.

100-Year Floodplain – The area that will be inundated by the flood event having a 1% chance of being equaled or exceeded in any given year. Also called 100-Year Flood Zone or 100-Year Flood Hazard Area.

500-Year Floodplain – The area that will be inundated by the flood event having a 0.2% chance of being equaled or exceeded in any given year. Also called 500-Year Flood Zone or 500-Year Flood Hazard Area.

Base Flood Elevation – The computed elevation to which floodwater is anticipated to rise during a 100-year flood.

Culvert – A pipe or tunnel underground, usually under roads, that transports flowing water, sediment, debris and ice from one side to the other.

Emergency Relief Assistance Fund – This program allows towns in Vermont to increase the amount of state aid money they could receive as a match to federal aid for post-disaster recovery.

Erosion – The wearing away of rock or soil by flowing water.

Fill – A quantity of earth, stones, etc., for building up the level of an area of ground.

Flash Flooding – Rapid, short-term flooding often caused by severe rain and/or rapid snowmelt.

Floodplain – Area of land adjacent to a stream or river that stretches from the banks of its channel to the base of the enclosing valley walls and experiences flooding during periods of high discharge.

Floodway – The area immediately adjacent to the channel that must remain open to allow floodwaters to pass.

Flood Resiliency – The ability of individuals, communities, organizations and states to adapt to and recover from flooding hazards without compromising long-term prospects for development.

Hazard Mitigation Plan – A document and planning process that provides actions to reduce the long-term risk to human life, property, and the economy from natural disasters.

Mitigation – Any sustained action taken to reduce or eliminate the long-term risk to life and property from hazard events. It is an on-going process that occurs before, during, and after disasters and serves to break the cycle of repetitive damage and repair.

No-rise Certification – A certification by an engineer that a project will not increase flood heights.

National Flood Insurance Program – A federally funded and locally implemented program to reduce the impacts of flooding through individual insurance policies and incentives for floodplain regulations.

Riparian Buffer – Mixed composition, vegetated land adjacent to a stream separating it from other land uses.

Riprap – The application of rocks to reduce erosion and protect nearby infrastructure or private property. Also known as rock armoring.

Special Flood Hazard Area – The area that will be inundated by the flood event having a 1% chance of being equaled or exceeded in any given year. Also called 100-Year Flood Zone or 100-Year Flood Hazard Area.

State River Corridor – Area delineated by the Vermont Rivers Program adjacent to rivers and streams that provide functions that restore and maintain natural stability for a river. These areas are often at higher risk of erosion.

Project Overview

In May 2013, the Vermont Agency of Commerce and Community Development (ACCD) and Two Rivers-Ottawaquechee Regional Commission (TRORC) received disaster recovery funding from the US Economic Development Administration (EDA) for the Vermont Economic Resiliency Initiative (VERI). The goals of VERI are to:

1. Analyze threats to areas of economic activity and their associated infrastructure;
2. Develop plans to reduce impacts and avoid future losses and costs, and
3. Identify projects that communities and businesses can implement that maximize opportunities for businesses to stay open.

The overarching goal is to ensure that businesses and communities bounce back quickly when disaster strikes, and save time and money in recovery costs.

VERI is led by ACCD's Vermont Department of Housing and Community Development (DHCD) and TRORC, and is in partnership with the Agency of Natural Resources (ANR), Agency of Transportation (VTrans), and Vermont's Regional Planning Commissions. Early in the process, these agencies mapped where flood hazard risks intersect with areas of economic activity and infrastructure.

Five priority communities were selected for a detailed assessment of those hazards. These five areas include Barre City and Town, Brandon, Brattleboro, Enosburgh Town and Village, and Woodstock. A river science and engineering team consisting of five consulting companies – Bear Creek Environmental, LLC, DuBois & King, Inc., Fitzgerald Environmental Associates, LLC, Landslide Natural Resource Planning, Inc., and Milone & MacBroom, Inc. – was hired to study these communities and assist developing recommended strategies and projects to reduce the vulnerability of infrastructure and businesses to flood damage.

The primary objective of the focus area assessments is to develop strategies and projects to make businesses and the communities more resilient to floods and other disasters.

A number of factors played a role in the selection of the five communities for detailed assessments. First, the project team ranked towns across the state by flood risk, economic activity and infrastructure at-risk. The team then looked at the 20 highest ranking communities and removed any that had undergone or had funding for similar analyses (e.g., Bennington and Waterbury). Next DHCD strived to select five pilot communities that represented different economic profiles (e.g., agriculture, tourism, downtowns) as well as different sizes. Other considerations included risk of future damage, economic factors, and level of community engagement and interest. Together, these factors helped determine the five pilot communities selected.

Why Was Woodstock Selected?

Woodstock was selected as one of the pilot communities for the following reasons:

- The community has significant economic activity -- tourism in particular, with its close proximity to ski areas, tourist sites and a vibrant, state-designated village center;
- Past flood damage to infrastructure and business and close proximity to US Route 4, a critical east-west transportation corridor;
- An engaged community interested in reducing flood risk; and
- Local interest in floodplain protection.

Study Area

Seven miles of the Ottauquechee River are included in the study area for this project. The area begins in Bridgewater, 0.9 miles upstream of the Bridgewater/Woodstock town line. It continues downstream for seven miles ending just east of the intersection of Prosper Road and US Route 4. Utilities outside of the study area were included in the flood hazard analysis if they impacted the study area. Figure 1 is a map of the study area, shown in red, in relation to the villages and several **hamlets** of the two towns.

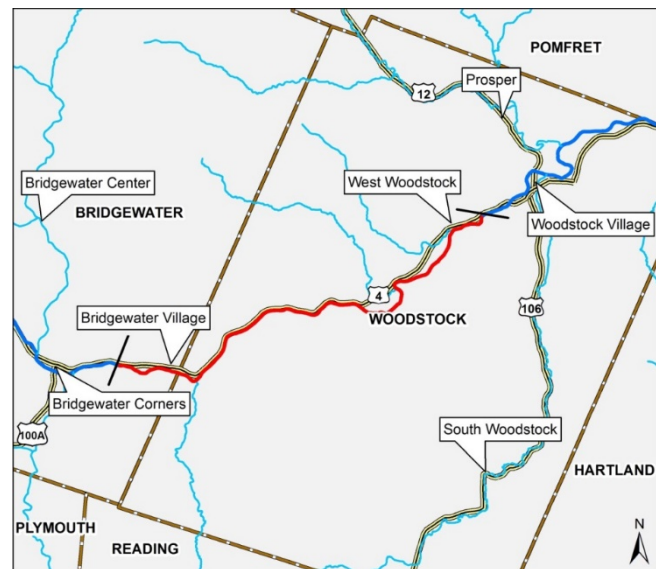


Figure 1: Map of Study Area

The Town of Woodstock is located in east central Vermont in Windsor County. As of 2010, just over 3,200 people lived within the town, which is approximately 45 square miles in size. The Village of Woodstock is a hub of commercial and residential development within the town, and is located along US Route 4 near the intersection with Vermont Routes 106 and 12. The town is divided into four hamlets, known as Prosper, South Woodstock, Taftsville, and West Woodstock (Town of Woodstock, 2014).

As shown in Figure 2, the Ottauquechee River originates in the Green Mountains in the town of Killington and flows east for 41

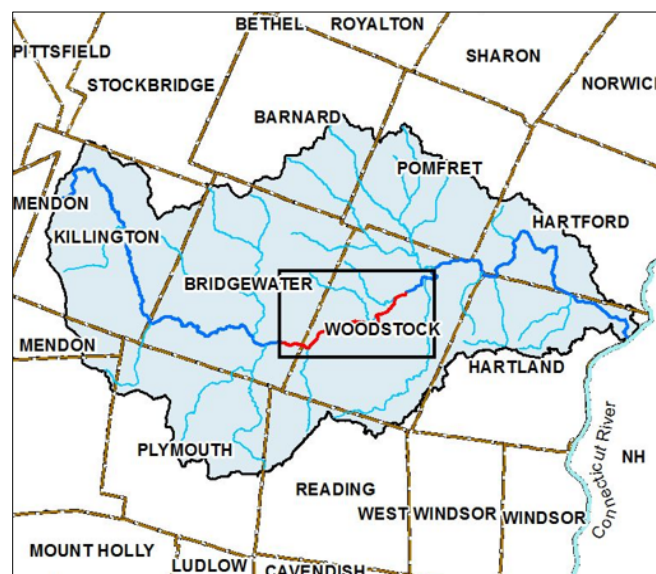


Figure 2: Study area location within the Ottauquechee River Watershed

miles before emptying into the Connecticut River in Hartland, Vermont. It drains approximately 185 square miles of land within both Rutland and Windsor counties (Bear Creek Environmental, 2013).

Historic settlement occurred along the Ottauquechee River as mills and residences were built in the 1800s. US Route 4 connects the communities and runs along Ottauquechee River from its headwaters in Killington to Quechee (Figure 3). This highway is a critical transportation corridor connecting the communities and central Vermont with both eastern New York and New Hampshire's seacoast. Goods and services, employees, businesses and tourists all rely on this highway.



Figure 3: US Route 4 runs along the Ottauquechee River from Killington to Quechee

Throughout most of Woodstock, the Ottauquechee River valley is fairly narrow, though it widens where Beaver Brook and Vondell Brook flow into the river, and in the vicinity of the Village of Woodstock. Land use along the river in Woodstock is a mix of residential, commercial, agricultural, and forest. The Ottauquechee River flows through the center of the more densely developed areas in Woodstock Village and in West Woodstock. Approximately 38 acres of 318 acres (12%) of the **100-year floodplain** in the Woodstock VERI study area is developed (Appendix A).

**Within the study area,
12% of the 100-year
floodplain is
developed.
Development is
concentrated within a
few small areas.**

Research and Outreach

The project commenced with a kick-off meeting in August 2014 at the Woodstock Town Offices to discuss the project and to identify flood risks within Woodstock. DHCD Commissioner Noelle MacKay and Mary Nealon of Bear Creek Environmental, LLC provided background on the project and then took questions from the group. Representatives from DHCD, TRORC, the Town of Woodstock, Sustainable Woodstock, the ANR Rivers Program, the Vermont House of Representatives, and the VERI team attended the meeting.

Following the kick-off meeting, the team reviewed existing information about the study area referenced in this report. The river scientists on the team walked the Ottauquechee River to observe the current conditions of the river and floodplain and to note the proximity of river features to economic assets.

Field observations included:

- Locations and dimensions of river bank **erosion** and rock reinforcement (Figure 4);
- Areas with significant accumulation of sediment in the channel;
- Potential areas of conflict where **tributaries** join the Ottawaquechee River;
- Bridge and **culvert** dimensions and conditions;
- **Riparian buffer** conditions;
- Floodplain access; and
- Proximity of buildings to flood hazard areas.



Figure 4: Rock riprap placed at the Riverside Mobile Home Park following Tropical Storm Irene to reinforce the bank

The first community forum hosted by DHCD and TRORC was held on October 2, 2014 at the Billings Farm and Museum (Figure 5). Community members, business owners, homeowners, state representatives, town leaders and community organizations attended the forum.

DHCD Commissioner Noelle MacKay opened the meeting by discussing the importance of helping businesses bounce back rather than break after disasters. Then the floor was opened for ideas and questions from community members and discussion among the group.

Community members highlighted a number of areas in Woodstock that present possible risks:

- Water, sewer and power infrastructure;
- Storing propane tanks near the river are a hazard;
- Flooding, erosion, and ice jam problems related to Kedron Brook;
- Barnard Brook flooding;
- Bank stability issues on Cloudland Brook;
- Tributaries to the Ottawaquechee are an erosion risk hazard;
- Concern over resale of previously flooded properties; and
- Emergency preparedness.



Figure 5: Woodstock Community Forum

Woodstock community members highlighted successfully completed as well as ongoing town projects following Tropical Storm Irene, including:

- Town of Woodstock has upgraded culverts;
- Billings Farm planted trees along the river to reduce farm flooding and improve the riparian buffer;
- A couple of projects have been undertaken at the bend in the Ottauquechee River at the foot of the Billings Farm field (an area known locally as “the Jungle” in East Woodstock).
 - Snow dump area was severely eroded during the flood. The Town received Community Development Block Grant - Disaster Recovery (CDBG-DR) funding to move the snow dump.
 - The Town of Woodstock has obtained grants to make the former snow dump into a park.
 - **Riprap** was replaced protecting the main sewer line to the Wastewater Treatment Facility (WWTF).

**“How do disasters
impact businesses, and
how can we help them
weather the storms?”**

Commissioner Noelle MacKay,
Vermont Department of Housing
and Community Development

Flood History and Town Accomplishments

Flood History and Risk

According to the United States Geological Survey (USGS, 2014), the Ottauquechee River has had eight major floods since 1869. One of the most severe accounts was the Flood of 1927. More recent accounts of flood damage include the storm event of June 1973 and Tropical Storm Irene in August 2011.

In June of 1973, the historic Vermont Native Industries Mill, located near the Bridgewater/Woodstock town line, was forced to close due to building inundation (Vermont Mountain Cabin, 2015). Several businesses on the northern bank of the river in West Woodstock were total losses. Figure 6 shows the site of the White Cottage Snack Bar immediately after the 1973 flood, which was completely destroyed during the flood (Vermont Standard, 2013).



Figure 6: Photo of the White Cottage Snack Bar after the Flood of 1973 (Vermont Standard, 2013)

Tropical Storm Irene

Tropical Storm Irene brought over seven inches of rain to the Woodstock area over the course of one day and exceeded a 100-year flood event. Maps documenting the damage that occurred (TRORC, 2014a) are included in Appendix B. Road and bridge damage was the most costly of all types of damage from the storm in Woodstock (Figure 7) with FEMA public assistance for Woodstock totaling over five million dollars. Numerous town roads were damaged as well -- the iconic Holt Iron Bridge was destroyed and the river washed out US Route 4 embankments leaving only one lane passible just west of Deerbrook Way.

Tropical Storm Irene Damage Cost by FEMA Category

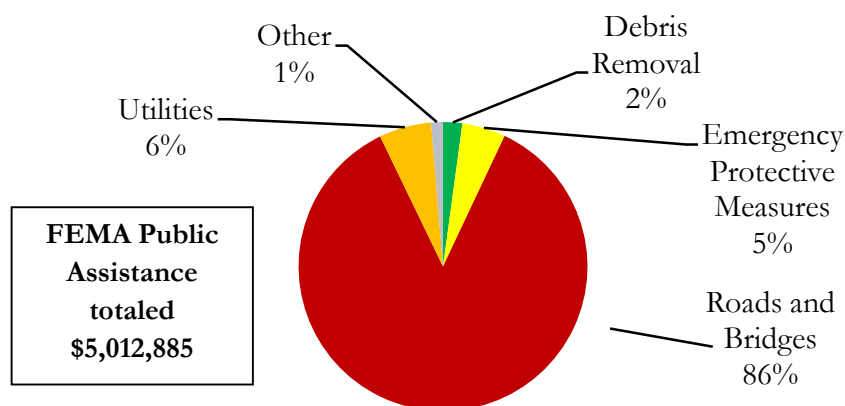


Figure 7: Flood damage costs in Woodstock (FEMA, 2012)

Flooding impacted numerous businesses as water filled the basement at the Bridgewater Mill Mall. A total of eight businesses are located in this historic woolen mill, which has been flooded repeatedly since its construction in 1825. Slightly farther east on US Route 4, flooding occurred in the basements of four other businesses, Thymeless Herb Farms, the Farmhouse Inn, the Woodbridge Café, and the Sleep Woodstock Motel.

Extensive damage also occurred at the Riverside Mobile Home Park, located on an especially vulnerable inside bend of the river just southwest of West Woodstock. Of the 40 mobile homes in the Park, 18 sustained damage from flooding (Town of Woodstock, 2011a). A map documenting the damaged mobile homes is included in Appendix B.

In the more developed area of West Woodstock, the storm caused severe damage to businesses and utilities. Flooding reached businesses on Mill Road in West Woodstock, including Dead River Propane, where floodwaters scattered and washed away numerous propane tanks. Major damage was sustained by three additional businesses on Route 4, as shown in Figure 8. The Woodstock Farmer's Market, which serves as one of the major local grocery stores, was flooded and lost all of



Inundation at the Woodstock Farmer's Market



Destroyed Vermont Standard building



Destroyed Dead River Propane Office building



Destroyed White Cottage Snack Bar building

Figure 8: Tropical Storm Irene damage in West Woodstock, Vermont. (TRORC, 2011)

its merchandise, causing \$750,000 in damage, as well as lost income from recovery time (Irvine, 2012). Roaring floodwaters severely damaged the offices of Vermont Standard, Dead River Propane and the White Cottage Snack Bar.

After road and bridge damage, public utility damage accounted for the second highest cost due to Tropical Storm Irene. Woodstock's public sewer system was damaged in a number of locations along the Ottauquechee River leaving 925 customers without sewer service for one week.

In addition to sewer damage, a primary drinking water line ruptured during Tropical Storm Irene, where it crosses under the Ottauquechee River at the Elm Street Bridge. This left 1,600 customers without drinking water for five days.

While everyone remembers the big events, flood damage in Woodstock from rapid snowmelt and flash floods are common. In fact, Windsor County has seen floods of varying severity nearly every year between 1999 and 2014, many of which have required FEMA funds to aid in recovery (Town of Woodstock, 2015).

The team conducted a mapping analysis to identify at-risk businesses and facilities in the flood hazard zones using FEMA flood maps (FEMA, 2007) and the **State River Corridor** (Vermont Agency of Natural Resources, 2015). See Appendix B for complete details.

The businesses at highest risk have at least a portion of their building in the designated FEMA **floodway**. During a flood event, the floodway typically conveys the highest velocity waters and is one of the areas of greatest erosion risk. Also of importance is identifying businesses and important facilities and utilities in the 100-year floodplain (also known as the **Special Flood Hazard Area**) and the State River Corridor.

The table below provides a breakdown of the number of businesses and the number of employees that work in these buildings within these three flood/**fluvial erosion** hazard zones. These data only show if buildings are within the flood zone and do not show the elevation of the building relative to the flood zone elevation.

What is the Floodway?

The floodway is the area immediately adjacent to the channel that must remain open to allow floodwaters to pass.

What is the 100-year Floodplain?

The 100-year floodplain is also called the Special Flood Hazard Area, and is the base floodplain shown on FEMA maps.

What is the State River Corridor?

The River Corridor is the area delineated by the Vermont Rivers Program adjacent to rivers and streams that provide functions that restore and maintain natural channel stability. These areas are often at higher risk of erosion and/or flooding.

Table 1: Businesses in Flood/Erosion Hazard Zones in VERI Study Area			
	Floodway	100-year Floodplain	State River Corridor
Number of businesses	3	19	26
Number of Employees	61	169	366

The Dead River Propane Offices, the Woodstock Farmer's Market and Riverside Mobile Home Park are three businesses in West Woodstock that are located in the floodway. The White Cottage Snack Bar and the Vermont Standard building were in the mapped floodway prior to Tropical Storm Irene. All five of these businesses experienced severe damages during the 2011 flood. Nineteen businesses in the VERI study area in Woodstock are located in the 100-year floodplain.

Town Accomplishments

The Woodstock community has been engaged over the past several years with planning and projects to reduce the risk of flooding to local businesses, infrastructure and residences. As described below, these efforts have addressed both town-wide policies and site-specific initiatives to reduce flood risks.

Town-Wide Flood Policy

The town has worked closely with TRORC to study the Ottauquechee River and to prepare a town **Hazard Mitigation Plan** (Town of Woodstock, 2015). A study of the Ottauquechee River in Woodstock and Bridgewater (Bear Creek Environmental, 2013) was conducted under the direction of TRORC through funding by the State of Vermont Ecosystem Restoration Program. Town resiliency initiatives are also reflected in regulations that offer greater protection to the community than the minimum National Flood Insurance Program (NFIP) guidelines.

Zoning regulations for the Town of Woodstock provide ways to protect new development from hazards:

- Development within the FEMA floodway is prohibited within the town, and allowed in the Village if it does not cause an increase in flood heights.
- All new buildings to be built within the 100-year floodplain (outside of the floodway) must have lowest floor elevations (including the basement) that are greater than one foot above the **base flood** elevation (BFE).
- For a building undergoing significant improvements, the lowest floor must be at least one foot above BFE or be floodproofed so that it is water tight to at least one foot above BFE.
- If a new or substantially improved building within the 100-year floodplain has an enclosed area below its lowest floor, this area must be designed to equalize flood forces on the structure by allowing for the entry and exit of floodwaters (Town of Woodstock, 2010).

In 2014, the state of Vermont established an **Emergency Relief Assistance Fund** (ERAF) to provide matching funding for federal assistance after federally declared disasters. This program allows towns in Vermont to increase the amount of state aid money they can receive as a match to federal recovery aid. Towns that take certain steps to become more prepared are eligible for increased state money. Certain damage costs from federally declared disasters are reimbursed 75% by federal money. The state of Vermont contributes a minimum of 7.5% of the total cost, but if a town takes additional steps, the state aid can increase to 12.5% or 17.5% of the cost, leaving less for the town itself to pay (State of Vermont, 2015a).

In early 2015, the Town of Woodstock qualified for increased state aid for federally declared disasters. As seen in the table below, Woodstock and Woodstock Village have policies, plans and programs in place to receive the 12.5% state funding (State of Vermont, 2015; State of Vermont, 2015b). A key next step for the Village and Town is to protect State River Corridors or protect flood hazard areas from new encroachment and participate in FEMA's **Community Rating System** (FEMA, 2014a).

Table 2: How Woodstock Met Its ERAF Match		
ERAF Rating	Town 12.5%	Village 12.5%
Participate in the National Flood Insurance Program	Yes	Yes
Adopt 2013 Road & Bridge Standards	Yes	Yes
Adopt a Local Emergency Operations Plan	Yes	Yes
Adopt a Local Hazard Mitigation Plan	Yes	Yes
Steps to increase State aid to 17.5% (need one to qualify)		
Adopt no new development in State River Corridor	No	No
Adopt no new development in Flood Hazard areas and participate in the Federal Community Rating System (CRS)	No	No
ERAF Match	12.5%	12.5%

In January 2015, Woodstock drafted a town hazard mitigation plan that further outlines town goals pertaining to flooding and **flood resiliency**. Several of the actions the town identified to mitigate the risks of **flash flooding**, flooding, and fluvial erosion are included below.

- Maintain and update town bridge and culvert inventories.
- Regularly inspect and maintain town bridges and culverts.
- Upgrade/upsized, repair, or clean the culverts listed in the Village and Town's priority list as determined by Better Backroads culvert inventory.
- As part of the Town Plan updates, determine if revising and strengthening the Town's Flood Hazard Regulations is necessary to remain compliant with federal and state laws.
- Adopt fluvial erosion hazard/river corridor regulations.

Site-Specific Projects

In addition to town-wide initiatives, site-specific projects in Woodstock reflect a greater awareness of flood protection measures and avoidance strategies. A number of projects have involved the acquisition and relocation of buildings in high hazard areas. This type of flood protection measure is the most effective, and Woodstock has a number of examples. Rather than rebuilding again in the same location, the Vermont Standard moved to a new location at Lincoln Corners. What remained of the building was demolished and the

"It has been three-and-a-half years since Tropical Storm Irene hit and now that all the repairs are done and reimbursements made, local officials can see some positive effects from the storm... 'We have a lot of improved infrastructure,' said [Woodstock] Town Manager Phil Swanson."

(Fields, 2015.)

Woodstock Farmer's Market purchased the site for additional space. The former Lake Sunapee Bank on US Route 4 was also flooded and the building was moved farther back from the road and the Ottauquechee River. The bank moved its location to a nearby single family home, which was relocated and raised. The Town of Woodstock took similar measures when it chose not to replace the destroyed Holt Iron Bridge, removing a river-road conflict and making the community safer.

The town also developed a new building standard for the Riverside Mobile Home Park to help protect residents from future flooding.

These buildings will be raised so that their first floor is two to three feet above the base flood elevation and secured onto a concrete slab (Figure 9). The elevation was selected because flooding during Tropical Storm Irene, in the location of the mobile home park, was two to three feet above base flood elevation (Town of

Woodstock, 2011a). Even with these improvements, residents at this park remain vulnerable to being trapped in their homes during a flood event. Relocating the homes to higher ground would improve public safety.



Figure 9: Elevated mobile home at Riverside Mobile Home

Downstream of the mobile home park, two West Woodstock businesses took steps to reduce their flood risks. However, both businesses remain at-risk of fast floodwaters eroding the river bank in the vicinity of their buildings. One of three buildings at Dead River Propane was removed due to significant damage. Of the remaining buildings, one was renovated and used as office space, and one left as is and used as a garage. The office building was dry floodproofed because the elevation of its bottom floor is not greater than one foot above base flood elevation. The dry floodproofing at the Dead River Propane Offices included:

- Applying a concrete membrane “thoroseal” to seal the lower portion of the walls;
- Installing door dams at each exterior door (Figure 10);



Figure 10: Dead River Propane offices have sealed walls and door dams to keep floodwaters out

- Creating new office space with cement floor (not damaged by water and mud);
- Elevating electric services 42 inches above the floor;
- Raising the furnace on blocks to elevate it one foot above floor; and
- Building a roof to cover a four foot gap between the office building and garage to reduce snow loading (Town of Woodstock, 2012).

On the eastern side of the Dead River Propane Offices, the White Cottage Snack Bar, a local favorite restaurant, also faced major recovery after the storm. The building was destroyed by floodwaters and was torn down and rebuilt. The new structure (Figure 11) incorporates several features to increase its flood resiliency including the following:

- Relocating the building 25 feet closer to US Route 4 and 10 feet to the west to increase the distance between the building and the Ottauquechee River;
- Building a four-season structure with wood siding to replace the canvas siding;
- Elevating the concrete slab 1.5 feet above base flood elevation; and
- Installing refrigeration compressors and condensers on the second floor of the new building (Town of Woodstock, 2011b).



Figure 11: The White Cottage Snack Bar was rebuilt farther away from the river

Farther downstream, post flood sewer repairs were made to quickly restore service. The sewer main under the Elm Street Bridge was replaced and reburied within the streambed and the pipe sections exposed by floodwaters between the Elm Street Bridge and the Woodstock Wastewater Treatment Facility were armored with riprap.

Strategies and Projects to Protect Woodstock

A combination of previous studies, field data collection, flood damage information and community input was used to develop projects to protect Woodstock businesses. Town zoning bylaws and permits were reviewed to provide recommendations for strategies that reduce flood losses. Based on community input and data gathering, the team developed a list of flood **mitigation** objectives for the Woodstock focus area to address important economic centers and vulnerable infrastructure and utilities. These objectives include:

1. Keep major roadways open (e.g., US Route 4);
2. Protect businesses and residences from flooding and erosion; and
3. Increase flood readiness of town water supply and sewer system.

Using the objectives outline above, the team developed a list of projects to protect businesses and infrastructure within the study area. Strategies and projects for the Town of Woodstock are summarized below, including municipal policy and program recommendations followed by site-specific project recommendations.

Municipal Policy and Program Recommendations

Reducing the impacts of floods involves an ongoing process of evaluating and adjusting policies to minimize risks through protection, prevention and education. Accordingly, the VERI team first reviewed Woodstock's municipal plan, hazard mitigation plans and land use regulations to identify the policies they contain and those that are absent. The team also reviewed related plans for capital improvements, conservation, emergency and preparedness and continuity of operations. These documents were reviewed with the goal of identifying gaps and opportunities to improve the flood preparedness, safety and resilience of residents, visitors, businesses and local government.

The team then used the US Environmental Protection Agency's (EPA) flood resiliency checklist that was developed from a study in the Mad River Valley in Vermont (US EPA, 2014). This checklist includes overall strategies to improve flood resilience as well as specific strategies to conserve land and discourage development in river corridors; to protect people, businesses, and facilities in vulnerable settlements; to direct development to safer areas; and to implement and coordinate stormwater management practices throughout the whole watershed.

The checklist review found Woodstock currently employs 33 of 56 items on the checklist including promoting better management of stormwater runoff, utilizing steep slope development regulations, encouraging new development in safer areas and many more (TRORC, 2014b).

The results of both reviews identified 13 planning or policy opportunities that were then organized into four groups: Regulations, Community Planning, Emergency Planning, and Education and Outreach. The distribution of opportunities to improve policy and programs is shown in Table 3.

Table 3: Categories of Municipal Policies and Programs		
Category	Description	Policies or Programs
Land Use Regulations	Avoid and minimize land use conflicts around watershed resources that help lower the risk of flooding and/or erosion to properties.	4
Community Planning	Develop long term goals, recommendations and budgets to improve flood resilience.	3
Emergency Planning	Specific projects for supporting mitigation and recovery actions for flooding and other hazards.	3
Education and Outreach	Programs targeted at critical businesses and vulnerable populations to educate them about flood risk, mitigation and recovery.	3

The results of the plan and policy reviews were then combined and scored with either a one (ineffective), three (limited) or five (effective) using the following three objectives:

1. Reduces flood risk (proposed project lowers the flood level);
2. Reduces erosion risk (proposed project lessens the vulnerability to erosion); and
3. Protects businesses, infrastructure and property.

The three scores were added to provide a total score. Cost and ease of implementation, political realities and limitations as well as input from the community were also considered. To assist the town with implementation, potential partners and funding sources were identified. Each recommendation was further explained and next steps were identified. This information was compiled into easy to read charts found in Appendix D.

The highest ranked regulatory changes included two to minimize river and land use conflicts and improve public safety. Recommended town plan updates included updating the capital and hazard mitigation plans to make these and other improvements were implemented to reduce threats to infrastructure over time.

The top priority policy and program recommendations were presented at the community forum and local feedback was incorporated into the final prioritization, below.

Top recommendations include the following:

- **Monitor Rebuilding after a Disaster and Participate in the National Flood Insurance Program (NFIP):** People want to return their lives to normal as quickly as possible after a disaster but local officials (zoning administrators and local boards) must monitor rebuilding to ensure that it does not violate town, state and federal regulations. Allowing improper repairs after a flood may result in the loss of federal flood insurance and disaster recovery funding for the community. It is important note that in many instances, buying out

businesses and homes located in risky areas is the best way to safeguard against future losses of life and property.

- **Encourage Development Outside of the Floodway in the Village:** The floodway is the fastest moving part of the river during a flood. Buildings and other objects in a floodway can be washed downstream and cause culverts and bridges to clog with debris resulting in significant property damage. To protect the community and the economy, the village zoning bylaw should prohibit all new development in the mapped floodway.
- **Include the VERI Municipal Infrastructure Projects in the Local Hazard Mitigation Plan:** Woodstock can also add the projects listed in this report to the strategies portion of its hazard mitigation plan to improve eligibility for future grants.

Specific Project Recommendations

A variety of existing river data and stakeholder information was used to develop flood protection projects for the VERI study area in Woodstock. This information in conjunction with 2014 field work documenting economic assets and further discussions with stakeholders helped set the stage for these recommendations.

A table summarizing recommended projects to protect businesses and infrastructure from flooding is included in Appendix E. Maps showing the location of each project site in Woodstock, along with the relevant economic asset and flood hazard information are also included in Appendix E. The recommended projects fall into four primary categories as summarized below:

Table 4: Mitigation Project Types		
Category	Description	Number of Projects
Building and Site Improvements	Lowers the risk of flooding and/or erosion to specific properties through improvements to the building and/or surroundings, e.g., sealing off buildings to prevent water infiltration.	5
Channel and Floodplain Management	Lowers the risk of flooding and/or erosion to properties along the river through the improvement of natural river and floodplain functions, e.g., tree plantings along unstable river banks.	3
Infrastructure Improvements	Lowers the risk of flooding and/or erosion to roadways and other municipal or state-owned infrastructure, e.g., increasing the size of bridges and culverts to pass more flood waters.	6
Public Safety Improvements	Lowers the risk of flooding and/or erosion to properties through the avoidance of future flood risks, e.g., FEMA buyouts of improved properties highly vulnerable to flooding.	2

To begin, the team screened and prioritized each project. Each project received a score of one (ineffective), three (limited) or five (effective) for the three objectives:

1. Reduces flood risk (proposed project lowers the flood level);
2. Reduces erosion risk (proposed project lessens the vulnerability to erosion); and
3. Protects businesses, infrastructure and property.

The three scores were added to provide a total score, which was then weighted based on the importance of the project in the region. Projects that would result in a regional economic boost were given the greatest weight, while projects that would offer minimal economic benefit to the business economy received a lesser weight.

Project partners and stakeholders, including representatives from DHCD, ANR, TRORC, and the Town of Woodstock, provided feedback on a draft list of mitigation strategies and their priorities in November 2014. The feedback was incorporated into the final prioritization of projects. Projects that received the highest priority rating are detailed below. Many of the high priority projects are from the *Infrastructure Improvement* category, as those at-risk areas potentially affect the greatest number of community members and businesses.

Building and Site Improvements

Floodproof Buildings at the West Woodstock Farmer's Market: West Woodstock businesses were hit hard by floodwaters from Tropical Storm Irene. There are three primary options to floodproof commercial buildings.

1. **Elevate the building:** This could involve filling a basement and raising utilities (furnaces, electrical panels, etc.) to a higher floor above the base flood elevation – or – it could include jacking up the structure and extending the foundation.
2. **Dry floodproofing:** Under this scenario the building is not elevated, rather walls are made watertight. Impermeable layers are added to the walls and floors, and the foundation structurally must be able to withstand the forces of standing and moving water acting on the building.
3. **Wet floodproofing:** This option is used in situations where elevation and dry floodproofing are not viable. A combination of flood vents/openings, elevating utilities and special building materials is used with this technique. The building materials must be able to be covered in water, mud and other pollutants without difficult clean up or damage.

The method of floodproofing selected depends upon the structure, size, age and location of the building. Each building requires a site-specific assessment by a structural engineer. In all cases, outdoor fuel tanks servicing buildings in special flood hazard areas should be anchored and elevated.

The White Cottage, in West Woodstock, provides a good example of utilities being placed on the second floor above the base flood elevation. The Dead River Propane Offices provide an example of using dry floodproofing to reduce future flood losses by elevating electrical wiring, sealing the walls and utilizing flood logs to seal the doors.

The cost of floodproofing the Farmer's Market is estimated to be about \$30,000, but would require a site-specific assessment by a structural engineer to determine the best methods and costs. A possible funding source for elevating a building is FEMA Hazard Mitigation Grant Program (HMGP).

Channel and Floodplain Management

Preserve Floodplain Along the Ottawaquechee River Upstream of Riverside Mobile Home Park: Generally, the floodplain of the Ottawaquechee River is narrow within the VERI study area. Just upstream of the Riverside Mobile Home Park, the floodplain broadens, creating an important location for the storage of floodwaters and sediment. Preserving floodplain upstream of the Riverside Mobile Home Park is identified as a high priority project in the Ottawaquechee River Corridor Plan (Bear Creek Environmental, 2013). The goal of this channel and floodplain management project would be to preserve as much of the 95 acres of undeveloped floodplain within the SFHA as possible between the Lincoln Inn and Riverside Mobile Home Park. This section of undeveloped floodplain constitutes approximately one-third of the total undeveloped floodplain within the study area and is important for allowing floodwaters to slow down, sediment to settle out, and for maintaining good water quality and wildlife habitat.

The project could involve a corridor easement to protect the floodplain from development and channel management activities or could involve the outright purchase of the land by the town, land trust or conservation group. A map showing the extent of a possible ANR River Corridor Easement and the estimated cost is provided in Appendix E. Not only does this project protect existing businesses within the watershed, but it reduces the chance of future development within the special flood hazard area and State River Corridor.

Infrastructure Improvements

Replace Undersized Bridge on US Route 4: The opening of Bridge #47, located approximately 1,000 feet west of Deerbrook Way (near the Deerbrook Inn), completely clogged with sediment and debris during Tropical Storm Irene. This resulted in significant damage to US Route 4 and destruction of a single family home. As part of the design process, the structure should be evaluated to improve debris passage. Design and implementation of the project will likely take two to five years due to the environmental permitting, design required and the cost. The cost is expected to exceed \$200,000.

Improve River and Road Stability along US Route 4: The road embankment adjacent to the Ottawaquechee River failed in multiple locations during Tropical Storm Irene leading to the washing

out of roads. VTrans is actively working to improve river and road stability along US Route 4. The design of the US Route 4 corridor in the stretch between Westmont Way (about 2,000 feet east of the Bridgewater/Woodstock Town line) and Meadow Way (east of the Sleep Woodstock Motel) is currently in progress. There are areas where the embankment is eroding and the rock riprap is too small in size or was placed poorly (Figure 12).



Figure 12: Poor rock riprap placement that needs to be reinforced to improve the stability of US Route 4

According to Erik Akins, P.E., Senior Associate with Green International Affiliates, Inc. (Civil Engineering Consultant for VTrans), the project is advancing to the preliminary design stage. Unfortunately, after September 2015, the Federal Highway Administration (FHWA) will no longer provide funding for emergency repair work for damages incurred from Tropical Storm Irene. Due to these funding limitations, the project may be slowed.

Relocate or Reinforce Drinking Water Line Owned by Woodstock Aqueduct Company: The main water supply line at Elm Street Bridge ruptured leaving Woodstock Village and a portion of the VERI study area (West Woodstock) without drinking water following Tropical Storm Irene. The water line runs parallel to the downstream side of the Elm Street Bridge and is buried about six feet below the streambed. Due to the rupture, approximately 1,600 customers were without drinking water for about five days. The Woodstock Aqueduct Company is also considering plans to add a redundant line that would serve in an emergency if the line under the Elm Street Bridge should rupture. The cost is expected to exceed \$200,000 for the redundant line and other improvements. These improvements may be eligible for the Drinking Water State Revolving Loan Fund money to augment Hazard Mitigation Grant Program funds. A summary of flood damages during the storm, items that were replaced post-flood and additional needs for the Woodstock Aqueduct Company is provided in Appendix E.



Figure 13: Municipal sewer pump station in West Woodstock needs to be retrofitted to prevent inundation by floodwaters

Relocate or Reinforce Sewer Line under Elm Street Bridge: The main sewer line crossing at the Elm Street Bridge ruptured leaving Woodstock Village and a portion of the VERI study area (West Woodstock) without sewer service following Tropical Storm Irene. Approximately 925 customers in Woodstock and more than 25 businesses were left without sewer service for one week. The estimated cost of reinforcing the sewer line in the vicinity of the Elm Street Bridge is \$100,000 to \$200,000. A conceptual design for this project is included in the next section of this report.

Upgrade West Woodstock Sewer Pump Station: The West Woodstock Sewer Pump Station (Figure 13), located across from the White Cottage, was flooded and silted over during Tropical Storm Irene. While all the electrical wiring was replaced and elevated, the pump station still needs two foot to six foot tall sleeves with ladder rungs over the pump area and a wet well to protect it from the next event. The cost of the upgrades is estimated to be in the range of \$50,000 to \$100,000. A conceptual design for the sewer pump station is provided in the following section of the report.

Public Safety Improvements

Buyout At-risk Properties in West Woodstock:

In West Woodstock a number of commercial buildings were significantly damaged by Tropical Storm Irene, and our team recommends further study of the feasibility of property buyouts. The study would include identification of specific buildings and further evaluation of the pros and cons including direct and indirect flood damage reductions, impact on the economy, cost and funding sources. Robust public participation including meetings with individual property owners and affected businesses is a critical part of the evaluation because these buyouts represent peoples' lives, income and history.

"I highly endorse [the sewer and water line upgrades] as top priority, as I was able to get to Woodstock on the first Friday after Irene and saw the folks using porta-potties and potable water supplied on the town green."

Todd Menees, Vermont Department of Environmental Conservation

Table 5: Buyout Considerations for West Woodstock Businesses	
Pros	Cons
Removes business and people from harm's way	Some businesses have already invested money in rebuilding and/or floodproofing
Property can be used by community as a public park or wildlife area	The federal buyout process can take years
Fair compensation for property based on value prior to the disaster	Business is located in a well-traveled corridor and may not want to relocate

Conceptual Project Designs to Protect Woodstock

Using input from the community and our team's professional judgment, the team selected three flood protection projects to advance to a conceptual design stage. These projects include: floodplain reconnection by lowering the field across from the Mill Mall and two projects that improve flood resiliency of the municipal sewer system. The designs represent key components of the projects and are 20-30% complete. The town and other organizations can use this information to further prioritize projects, to evaluate potential project effectiveness and to secure funding for additional project design and implementation. Conceptual design drawings are provided in Appendix F.

Create Floodplain at the Bridgewater Mill Mall

Project Overview and Objectives

One way to reduce flooding to a group of businesses is to find ways to create upstream floodplain that slows and reduces the floodwaters reaching those businesses. Floodplain creation involves lowering an area adjacent to the river to provide storage of floodwaters and sediment. In an effort to evaluate the effectiveness of creating floodplain along the Ottauquechee River, the consultant team created a river model using a software program developed by the US Army Corps of Engineers called Hydrologic Engineering Centers Rivers Analysis System (HEC-RAS) (US Army Corps of Engineers, 2010).



Figure 14: Field across the river from the Mill Mall

The Mill Mall area was selected to evaluate the floodplain creation because of the potential benefits to businesses (the basement of which flooded during Tropical Storm Irene) and because the land on the opposite side of the river is currently too high to be accessed by flood flows. The land on the opposite bank (Figure 14) is a hay field of the Taylor Farm. The conceptual design entails lowering the elevation of approximately 2.5 acres of this land by four to six feet (Figure 15).

The floodplain creation project would provide local storage of floodwaters, sediment, woody debris and ice.

Data Analysis and Results

Eleven cross sections were selected that describe the elevation of the river and the floodplain in the vicinity of the Mill Mall. The cross sections were defined using LiDAR (Light Detection and Ranging), a remote sensing technology. River discharges (amount of water in the river at a given time) used as input for the model were taken from the FEMA Flood Insurance Report for Windsor County (FEMA, 2007). Based on the results of the river modeling, the floodplain creation lowers the water level at the Mill Mall by about 0.7 feet during a 100-year flood event.

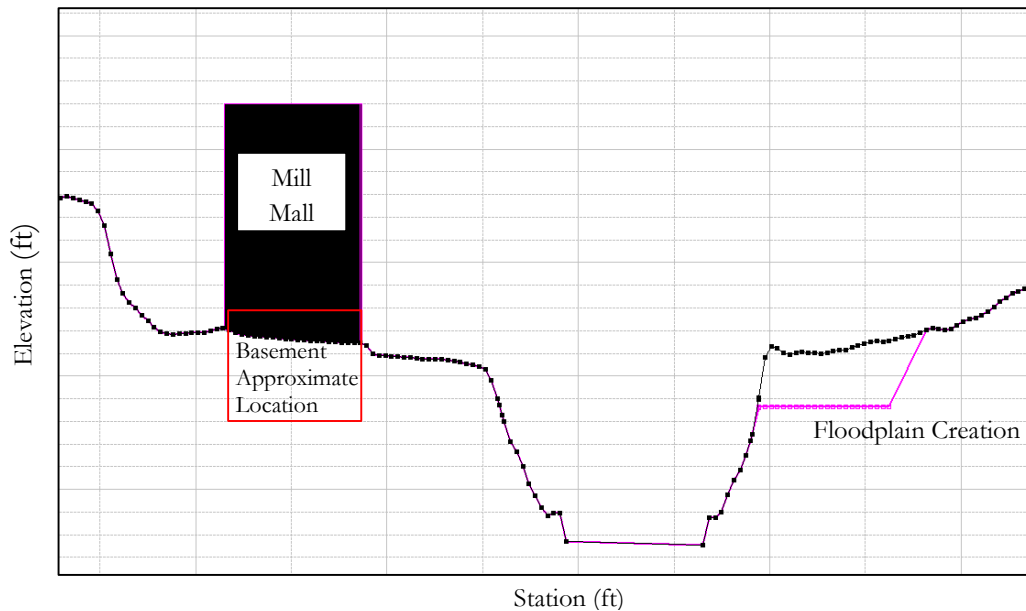


Figure 15: Section showing possible floodplain creation project across the river from Mill Mall

The floodplain creation as modeled requires 2.5 acres of land and involves the excavation of approximately 17,900 cubic yards of material. Lowering 2.5 acres of floodplain would be expensive due to excavation and land acquisition costs, and would likely exceed \$200,000. The Vermont Ecosystem Restoration Program is one possible source of funding for the project.

Steps for Project Implementation

The team recommends that the community further advance the conceptual project design and decide whether the relatively minor projected reduction in the 100-year flood level at the Mall justifies the scope and cost of the project. Advancement of the design would include borings or test pits to determine the quality of gravel at the site and initial discussions to assess the interest of the current owner. Assuming the community is interested in moving forward, next steps would include: topographic survey, detailed hydraulic modeling to confirm the benefits and state and federal permitting.

Projects Benefits

Although the primary project benefit would be to reduce flood risk at the Bridgewater Mill Mall, there are other potential benefits including:

- Storage of floodwaters and sediment to benefit downstream properties;
- One-time supply of gravel for municipal use; and
- Improved channel and floodplain function.

Upgrade Municipal Sewer

Project Overview and Objectives

The team developed two conceptual designs to help the town prepare the sewer system for the next major flood. The first conceptual design provides details for encasing the sewer line under Elm Street in Woodstock Village. The second project is a redesign for the US Route 4 sewer pump station, which is located across from the White Cottage in West Woodstock.

Data Analysis and Results

Sewer Line Encasement near Elm Street

The sewer lines under the Elm Street Bridge were destroyed during Tropical Storm Irene when erosion of the streambed and banks exposed the six inch and eight inch lines. Both lines were replaced at approximately the same position following the storm. Approximately 80 feet of the replacement lines at the downstream side of the Elm Street Bridge were encased in concrete. Using a crane on the bridge, large rocks were placed around the remaining portion of the replacement pipes to help to protect them. The portion of the replacement lines without the concrete encasement remains vulnerable to damage during another major flood.

The conceptual design drawings provided in Appendix F include encasing an additional 185 feet of the existing six inch and eight inch sewer line with concrete. If anecdotal reports of shallow ledge under the pipes are confirmed during the design, then the concrete encasement can be doweled to the ledge to provide an extremely strong solution that is not vulnerable to undermining. The conceptual design also shows an optional third conduit encased in concrete. This conduit could be used in the future for other utilities, such as town water supply (currently owned and managed by the Woodstock Aqueduct Company) should those utilities be damaged in a future flood. This would allow utilities to bounce back quicker following a flood, thereby keeping businesses open.

US Route 4 Sewer Pump Station Redesign

The electrical supply, control system, and pumps of the US Route 4 sewer pump station were severely damaged during Tropical Storm Irene. When repaired, the electrical supply and pump controls were elevated approximately four feet above grade on a four-legged wooden platform, which considerably reduces the risk of damage due to inundation. The pumps were reportedly replaced with submersible models.

Access to the below ground pump chamber remains only a few inches above grade as it was prior to the storm and does not have a water-tight cover. It is therefore at risk of again being swamped during a flood. If the new submersible pumps continue to operate during a future flood, they would run continuously to purge floodwater rather than conveying incoming sewage.

As a minimum flood resiliency measure, a water-tight cover should be added to the pump chamber to prevent floodwaters from entering. However, since these covers can fail due to debris and

sediment impacts during a storm, it would be prudent to go a step further and elevate the access to the pump chamber in addition to installing a water-tight cover.

The conceptual design included in Appendix F shows a four-wall concrete collar around the existing access. It would be recessed into the ground and would extend vertically to above the 100-year flood elevation. Space constraints would appear to prevent placement of earth around the collar, so permanent ladders would be necessary to climb up the collar and down into the chamber. The collar itself would be equipped with a water-tight cover, removing the need for such a cover on the existing access. During a final design phase, modifications and additions to the conceptual design can be evaluated including such things as a metal collar as an alternative to the concrete collar shown, as well as the addition of an earthen or concrete barrier at the upstream side of the pump station that would serve to deflect floating debris during a major flood.

Steps for Project Implementation

There are a number of recommended steps to upgrade the municipal sewer. First, a civil engineer should be hired to provide further project design. Both the sewer line encasement project and the pump station redesign would require a topographic survey, or at a minimum field measurements, to move the projects toward a final design. The evaluation of an additional conduit for future use would require coordination with the civil engineer and the sewer and water utilities. Based on a rough estimate, the sewer line encasement project would cost in the range of \$100,000 - \$200,000, while the sewer pump station retrofit may be more on the order of \$50,000 - \$100,000. A possible source of funding for the project is FEMA Hazard Mitigation Grant Program (HMGP).

Project Benefits

Improving the resiliency of the sewer system in Woodstock would benefit 925 customers, including more than 25 Woodstock businesses that were without municipal sewer service for about one week following Tropical Storm Irene. The sewer line encasement project would have the added benefit of reducing the chance that raw sewage would be released in to the Ottauquechee River during the next flood. The third conduit would provide similar resiliency for the private water system and its customers. Retrofitting the sewer pump station would have the obvious benefit of reducing the need for the Town of Woodstock sewer department to have to pump and haul untreated sewage to the Woodstock Wastewater Treatment Facility.

Next Steps

On April 23, 2015 the team hosted the second community forum to share the list of policy and project recommendations to decrease flood risk for Woodstock. At the forum, community members asked questions, provided input and helped rank the proposed list of priority recommendations.

The projects that the forum attendees most supported included relocating mobile homes located in hazardous areas, investing to improve the reliability of the water supply (Woodstock Aqueduct Company) and working to shore up the bank armoring on US Route 4. The top policy change was updating regulations to discourage development in flood-prone areas. One attendee expressed concern that this project focused on efforts to minimize floods, despite the fact that there are numerous other natural disasters that pose significant threats to Woodstock and other communities. It was noted that flood is the top risk in Vermont and strategies to address other risks are outlined more extensively in both the state and local Hazard Mitigation Plan documents. See Appendix G for the complete meeting notes from the first and second community forums.

The tables included in Appendices D and E provides a comprehensive list of recommended high priority projects for the Town of Woodstock to further discuss, explore, and advance as resources permit. The conceptual designs summarized above and in Appendix F are intended to provide examples for how to advance high priority projects to the next level and acquire funding for final design and implementation. As part of the ongoing community discussion regarding the VERI effort, the team recommends the following steps to incorporate the community's input into the final prioritization and advance the projects over time:

- Solicit input from individuals and businesses at future community meetings regarding specific projects and overall project prioritization;
- Prioritize one to two projects to pursue each year with assistance from DEC and TRORC staff to identify appropriate funding sources and partners;
- Apply for one to two grants each year to advance project development and/or designs;
- Implement projects as funding allows; and
- Monitor project success.

Implementing these projects and updating related flood policies will, over time, help Woodstock become safer and more resilient to future floods and there are a number of organizations and programs that can help. For example, the TRORC can help gather and review sample bylaws, capital plans and hazard mitigation plans and help draft town specific language for review and local adoption. DHCD's Municipal Planning Grants

http://accd.vermont.gov/strong_communities/opportunities/funding/overview/municipal_planning_grants , the Vermont Rivers Program <http://www.anr.state.vt.us/dec/waterq/rivers.htm> and www.floodready.vermont.gov can help support these efforts. The Vermont Land Trust <http://www.vlt.org/> can assist landowner's protection of critical floodplain with easements. The State's Hazard Mitigation Grant Program <http://vem.vermont.gov/mitigation> can help implement projects identified in Woodstock's Hazard Mitigation Plan. The Vermont Small Business

Development Center <http://www.vtsbdc.org/> has offered extensive disaster assistance to businesses as well as compiling a great guide for owners to navigate these programs. And several federal and state programs can assist in funding the recommendations outlined in the report. Working together we can reduce the risk and financial burden of future flooding events.

Education and Outreach

Vermont has a long tradition of managing its rivers to limit or prevent flood damage including armoring riverbanks with rocks, moving or straightening river channels and building dams and berms. Despite these efforts, flooding is the most common natural disaster in Vermont (ANR). Tropical Storm Irene showed Vermonters that rivers and streams are powerful and tend to make their own way during a flood. Because we cannot reliably control flooding, educating citizens, business and property owners about rivers and potential flood risks within their communities is critical.

“We all have short memories when it comes to flooding. It’s just human nature to think it couldn’t happen here again anytime soon.”

Chris Company, Executive
Director Windham Regional Commission

Ongoing community education and outreach is an important part of any effort to promote flood safety and to protect local business and economies. Ultimately, the better informed everyone in the community is about the behavior of local rivers and streams, the more likely it is that they will make sound decisions.

Make Information Readily Available: Easy access to river and floodplain information is an essential way to help citizens and businesses incorporate flood risks into decisions they make. Most communities offer printed information at the town office or library as well as on town webpages.

Common Handouts or Webpage Information Includes:

- Maps of the local flood hazard areas and the permitting requirements in the floodplain.
- Information about flood insurance and floodproofing buildings.
- Information about how rivers, streams and watersheds work.
- Benefits of green infrastructure and conservation of existing floodplain.

Actively Engage: Many communities work to increase the understanding of rivers and risks via email or by posting information on their local Front Porch Forum. Communities often include flood maps and permitting information in their town meeting reports and other municipal mailings like sewer and water bills. Others promote awareness of flood history and risk by placing high water lines on prominent buildings in the community.

However, education and outreach efforts should not be the sole responsibility of local governments, and community groups like chambers of commerce, downtown business associations, neighborhood

groups, and watershed organizations are encouraged to partner with state, regional and local groups to offer local workshops and education sessions.

Potential Workshop Topics and Partners or Presenters:

- Flood Insurance and What You Need to Know (Department of Finance Regulation, Division of Emergency Management and Homeland Security, Vermont League of Cities and Towns)
- Developing a Continuity of Operations Plan (Small Business Development Centers, Regional Planning Commissions, Regional Development Corporations)
- Resilient Road Designs to Reduce Recurring Damage and Improve Water Quality (Agency of Natural Resources, Agency of Transportation)
- Planning for Resilience (Regional Planning Commissions)
- Flood Risk, Preparedness and Safety (Division of Emergency Management and Homeland Security, Regional Planning Commissions)
- Extreme Weather and Climate Change (Agency of Natural Resources, Vermont Natural Resources Council)
- How Rivers, Streams and Watersheds Work (Agency of Natural Resources, Vermont Natural Resources Council, Vermont Land Trust)
- Low Cost Techniques to Reduce Flooding and Improve Water Quality (Agency of Natural Resources, Vermont Natural Resources Council, Regional Planning Commissions, Vermont League of Cities and Towns)

Invest in Staff Training and Certification: In many of Vermont's cities and towns, floodplain management is just one of many responsibilities of the local planning office or zoning administrator. Yet, administration of a floodplain ordinance is quite complex and the consequences of limited staff time and understanding of the regulations can easily allow inappropriate development in dangerous areas. The consequences of granting improper variances and not enforcing against violations may preclude the community from participating in the federal flood insurance program. Therefore, local government officials are strongly encouraged to support staff training and certification in floodplain management.

What Can Individuals Do to Reduce Their Risks?

Most of us remember to annually change the batteries in our smoke alarms to reduce the risk of fire, but few of us prepare for floods or disasters. Since 2000, Vermont has had more than one federally-declared disaster per year and floods have occurred nearly everywhere in the state (ANR, 2015). Buildings located in a 100-year floodplain have 1% chance of being flooded every year. In other words, over a 30 year period (length of most home mortgages), there is a 26% chance of a 100-year flood (USGS, 2010).

The good news is that there are many steps that individuals can take to reduce the risks, loss, disruption and costs associated with flooding. Understanding what the risks of flooding are for your home and family will help you:

- Make sure that you have the right amount of insurance coverage;
- Protect your home and take steps to limit potential damage;
- Prepare plans detailing how your family will respond if flooding looks likely; and
- Practice so family members know what actions to take in the event of a flood or upon receiving a flood warning.

Steps to Reduce Risks

- **Identify Flood Risk.** The first step is to identify your risk so you can plan appropriately. Floodplain maps are available at most town offices or click this link http://floodready.vermont.gov/assessment/vt_floodready_atlas to find out if your home or apartment is in an area where floods could potentially happen. Once you have assessed your flood risk, review your insurance coverage.
- **Review Insurance Policies.** Homeowners' or renters' insurance helps pay to repair or rebuild your home and replace personal property due to a covered loss, however it does not cover any damages caused by floods or your rent and living expenses while your home is rebuilt. All insurance policies have overall policy limits and specific limits for different types of coverage. Your insurance agent can help you determine what is covered and what is excluded and check to make sure your coverage is adequate for your needs. However, insurance is complicated and it's a good idea to have your lawyer review your policy, consider various scenarios and help you identify any gaps in your insurance coverage.
- **Fill Gaps in Your Insurance Coverage.** If your home is underinsured at the time of a loss, there is frequently a penalty or reduction in the amount the insurance company will pay for the loss. Property insurance also does not cover flood damages or your expenses if you cannot live in your home due to flood damages. All homeowners who live in flood-prone areas should carry flood insurance. Flood insurance is available for your home and personal property and can be obtained from your local agent.
- **Floodproof and Elevate Utilities.** The cost of flood insurance may be reduced with building modifications. Contact your planning and zoning office to learn more about building and construction techniques that can both reduce risks and save money. Examples of the various approaches to reduce flooding in buildings are available here http://accd.vermont.gov/sites/accd/files/Flood_Mitigation_Case_Studies_Final.pdf
- **Plan Ahead.** Draft an emergency response and communications plan (family phone numbers) for your home and family. Use the process as an opportunity to bring family members together to discuss the roles needed during an emergency and how best to assign responsibilities. Make sure you have a designated place to meet other family members in the

event of an emergency. Also, don't forget to plan for individuals with special needs like prescription medication and for your pets as many public shelters or hotels do not allow animals.

- Pack an emergency kit and make sure family members know where it is located.
 - Keep copies of your insurance policy, computer data and other important documents like tax returns and financial information safe from flooding on upper floors or stored offsite.
 - Document your home and possessions with photos or video to help simplify the insurance claims process. Generally, the more detailed documentation (receipts, serial numbers, etc.) you can supply during the claims process, the fewer problems you will experience.
- **Train and Practice.** Many of us participate in fire drills at work or school, but few of us practice at home for disasters. Training and practicing your emergency response and communications plan will help assure the plan is workable and family members understand their roles and responsibilities.
- **Pay Attention to Emergency Alerts.** Listen to local news and weather reports for any potential flood warnings in your area. If you know a storm is headed your way, fill up your gas tank in case you must evacuate. (If the power is out, it is not always easy to find an operating gas station.) If you must evacuate, try to contact your employer and let them know your plans. Having a plan and a few extra minutes to evacuate can make a difference.

FEMA <http://www.ready.gov/make-a-plan> and the Vermont Division of Emergency Management and Homeland Security <http://vem.vermont.gov/preparedness/hazards/floods> both provide more detailed information on how to prepare and protect your home and family from disasters and floods.

What Can Businesses Do to Reduce Their Risks?

According to FEMA, nearly 40% of businesses do not reopen after a disaster and data from the US Small Business Administration indicates that over 90% of businesses fail within two years after being struck by a disaster.

It can take years to repair the damage to the building, furnishings, equipment and inventory. Disasters can also require businesses to relocate or cease operation temporarily, which may lead to canceled contracts and customers going elsewhere for goods or services. Even if the event does not impact the business directly, severe weather from snow or rain or even extended power outages can strand employees at home and complicate deliveries.

Identifying your risk can significantly reduce potential damages and business recovery costs. Understanding what the risks of flooding are for your business will help you:

- Make sure that you have the right insurance coverage for business interruption.

- Plan ahead and take steps like developing a continuity of operations plan to limit potential damage.
- Train employees so they know what actions to take in the event of a disaster or after receiving a flood warning.

Steps to Reduce Risks

- **Identify Flood Risk.** Since 2000, Vermont has had more than one federally-declared disaster per year and floods have occurred nearly everywhere in the state (ANR). Identifying your risk is a good place to start. Floodplain maps are available at most town offices or click here http://floodready.vermont.gov/assessment/vt_floodready_atlas to find out if your business is in an area where floods could potentially happen. Once you have assessed your flood risk, review your insurance coverage.
- **Review Insurance Policies.** Many types of disasters are not covered under normal insurance policies and funding or loans from government agencies is often too little and too late. All insurance policies have overall policy limits and specific limits for different types of coverage and any business located in a flood-prone area should carry flood insurance. Also check to make sure your insurance includes business interruption coverage and that it reimburses other unexpected costs (like service interruptions from lost power or Internet access, law suits and unemployment compensation claims filed by employees). Business interruption insurance compensates a business for lost income, expenses and profits if a disaster, such as a flood, closes your doors. Your insurance agent can help you determine what is covered and what is excluded and check to make sure your coverage is adequate for your needs. However, insurance is complicated and it's a good idea to have your lawyer review your policy, consider various scenarios and help you identify any gaps in your insurance coverage.
- **Floodproof and Elevate Utilities.** The cost of flood insurance may be reduced with building modifications. Contact your planning and zoning office to learn more about building and construction techniques that can both reduce risks and save money. Examples of the various approaches to reduce flooding in buildings are available here http://accd.vermont.gov/sites/accd/files/Flood_Mitigation_Case_Studies_Final.pdf
- **Plan Ahead.** There are also a number of low-cost steps you can take to reduce the impacts of a flood. At a minimum, regularly back up computer data and store important tax and financial records and information such as your insurance policy details in a flood safe place. Documenting your building, furnishings, equipment and inventory with photos or video can speed the insurance claims process.

All businesses should have a continuity of operations plan. A continuity of operations plan is a written document that outlines how your business will respond and recover from a flood or other disaster. At a minimum, your plan should include:

- A list of important contacts including your insurance company, key customers and vendors and evacuation contacts for staff.
- A map showing locations of important equipment to relocate (computers and servers) and where to shut off electricity, gas and other services.
- Procedures to protect your property and minimize business disruption – e.g. remote back up of computer files, a plan to relocate inventory or livestock.
- A back up location to conduct business while the building is being repaired.

Having a continuity of operations plan will help you identify and assign essential tasks that will help minimize the damage caused by flooding. Training and practice will help assure the plan is workable and employees are properly trained.

The Vermont Small Business Development Center <http://www.vtsbdc.org> and many of Vermont's Regional Development Corporations <http://accd.vermont.gov/business/partners/rdc> and Regional Planning Commissions <http://www.vapda.org> can also provide training and one-on-one assistance to help your business develop a continuity of operations plan.

CERF+ (Craft Emergency Relief Fund + Artists' Emergency Resources) offers tailored disaster guidance and recourses for artists (<http://studioprotector.org/OnlineGuide/DisasterPlanning/DisasterSpecificPlanningResources.aspx>).

- **Train and Practice.** Employees need to understand flood warnings and what to do when they get one. This includes understanding the dangers of flooding and how to evacuate the building safely. Train all staff on procedures to shut down the business and how to deploy loss reduction measures like relocating equipment and inventory to upper floors and deploying door and window dams reduce flooding. Finally, remember that flooding can also affect employees' ability to work, as their priority may be to protect their home and family first.
- **Pay Attention to Emergency Alerts.** Listen to local news and weather reports for any potential flood warnings in your area. Having a continuity of operations plan and a few extra minutes to evacuate can save lives and your business.

The US Small Business Administration <https://www.sba.gov/content/disaster-preparedness> offers more detailed information on how to prepare and protect your employees and business and from disasters and floods.

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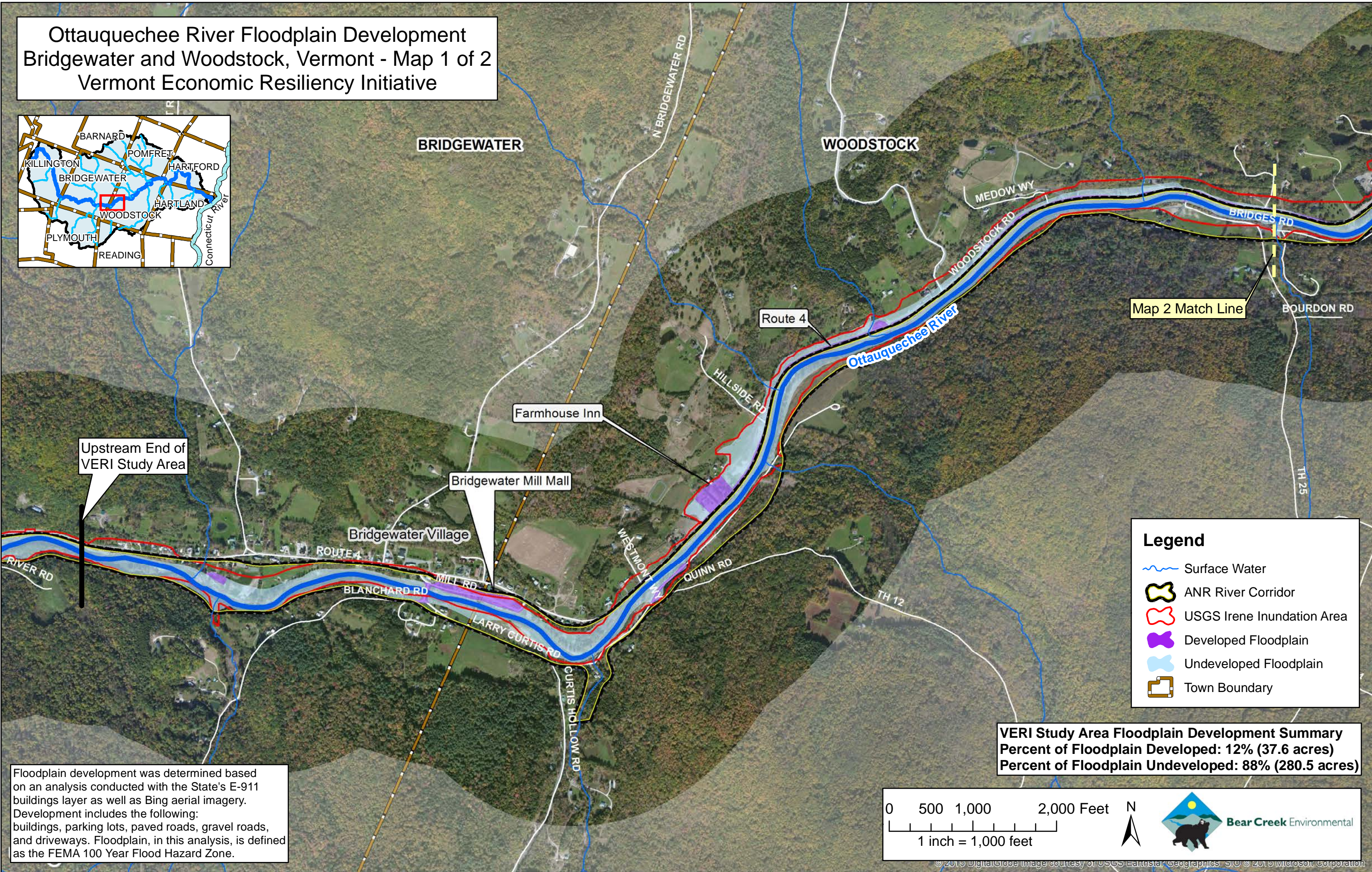
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Appendix A:

Floodplain Development Maps

Ottauquechee River Floodplain Development
Bridgewater and Woodstock, Vermont - Map 1 of 2
Vermont Economic Resiliency Initiative



Floodplain development was determined based on an analysis conducted with the State's E-911 buildings layer as well as Bing aerial imagery. Development includes the following: buildings, parking lots, paved roads, gravel roads, and driveways. Floodplain, in this analysis, is defined as the FEMA 100 Year Flood Hazard Zone.

VERI Study Area Floodplain Development Summary
Percent of Floodplain Developed: 12% (37.6 acres)
Percent of Floodplain Undeveloped: 88% (280.5 acres)

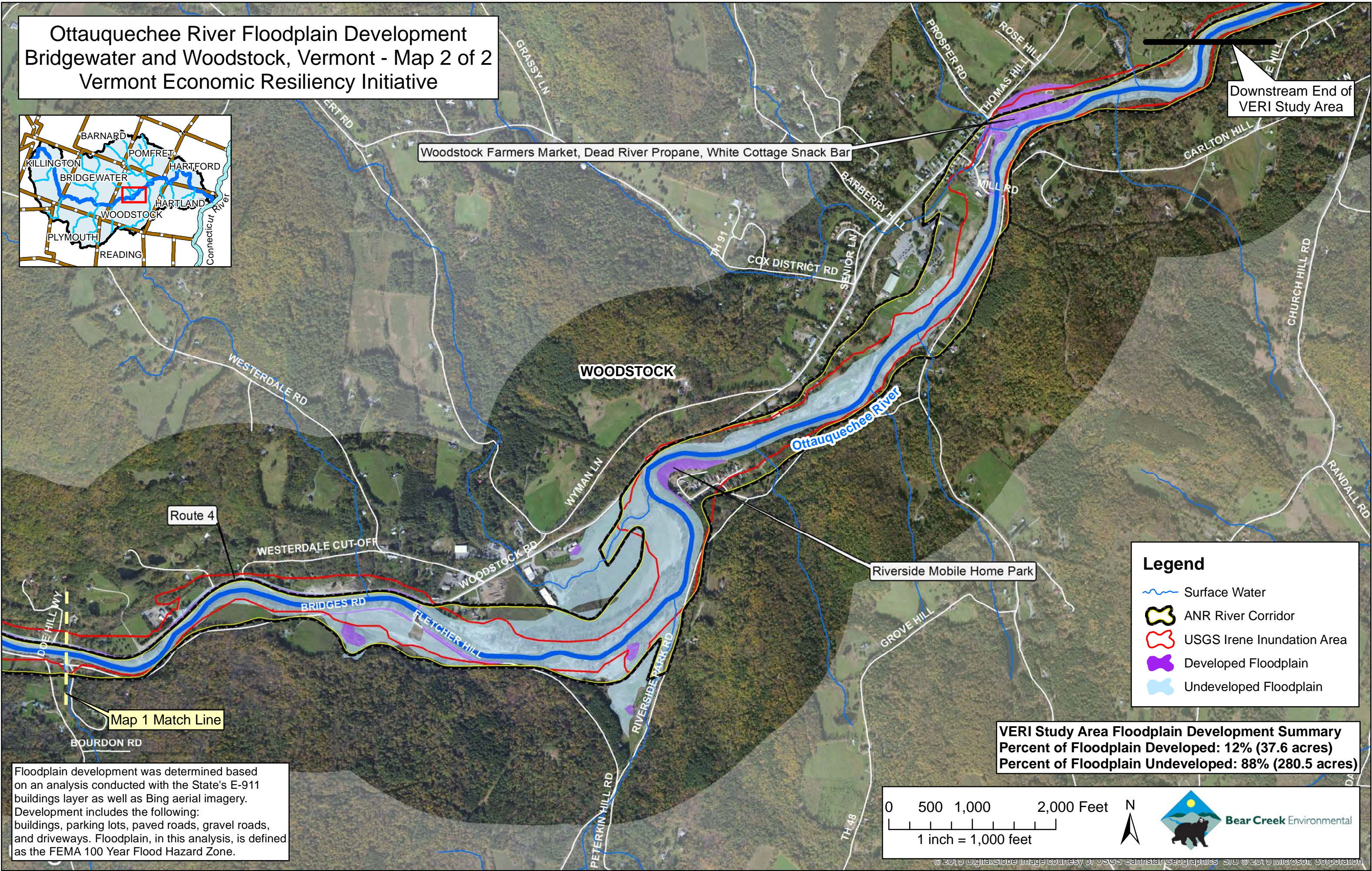
05001,0002,000 Feet

1 inch = 1,000 feet

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Bear Creek Environmental

Ottauquechee River Floodplain Development
Bridgewater and Woodstock, Vermont - Map 2 of 2
Vermont Economic Resiliency Initiative



Legend

- Surface Water
- ANR River Corridor
- USGS Irene Inundation Area
- Developed Floodplain
- Undeveloped Floodplain

VERI Study Area Floodplain Development Summary
Percent of Floodplain Developed: 12% (37.6 acres)
Percent of Floodplain Undeveloped: 88% (280.5 acres)

Floodplain development was determined based on an analysis conducted with the State's E-911 buildings layer as well as Bing aerial imagery. Development includes the following: buildings, parking lots, paved roads, gravel roads, and driveways. Floodplain, in this analysis, is defined as the FEMA 100 Year Flood Hazard Zone.

0 500 1,000 2,000 Feet
1 inch = 1,000 feet

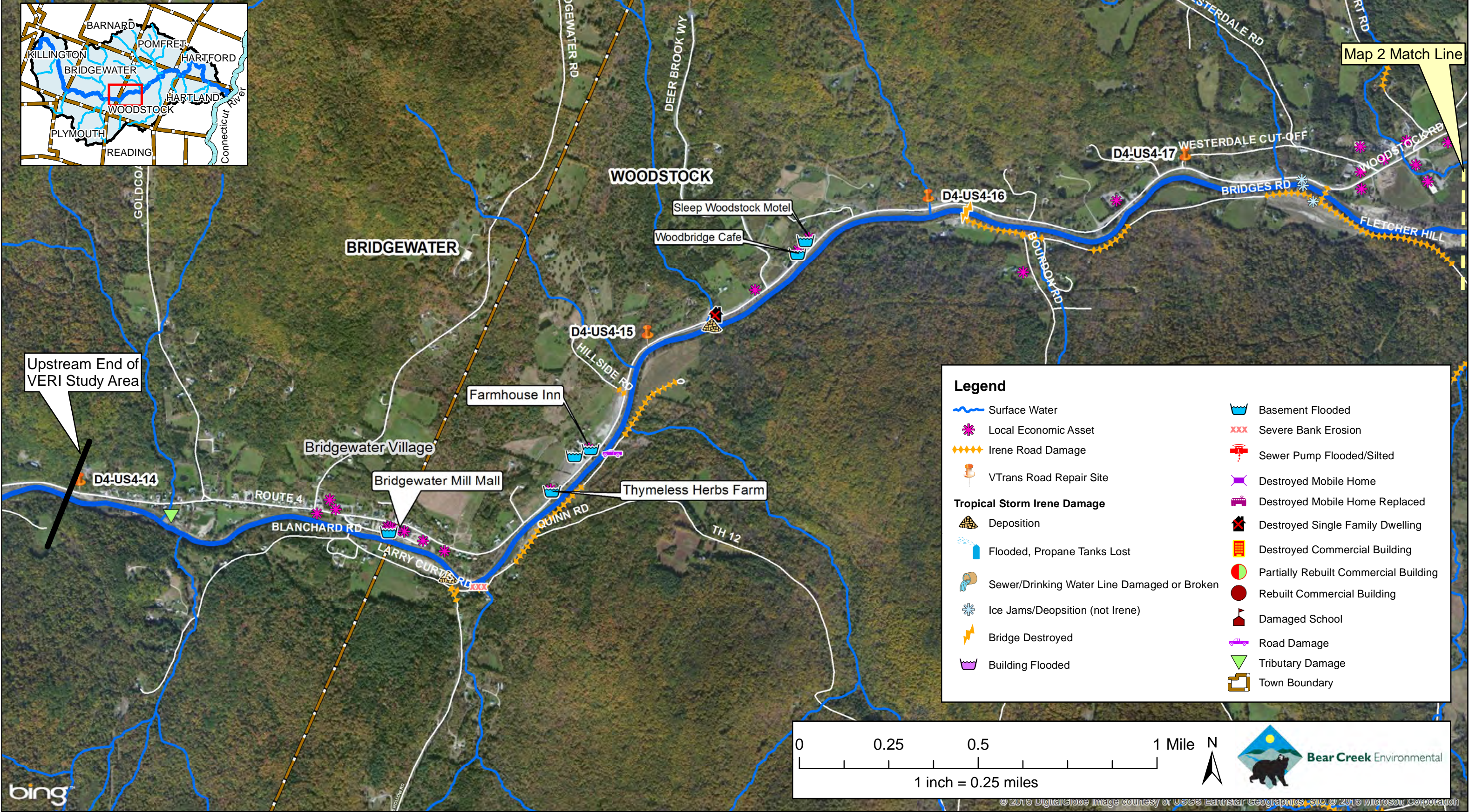
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Bear Creek Environmental

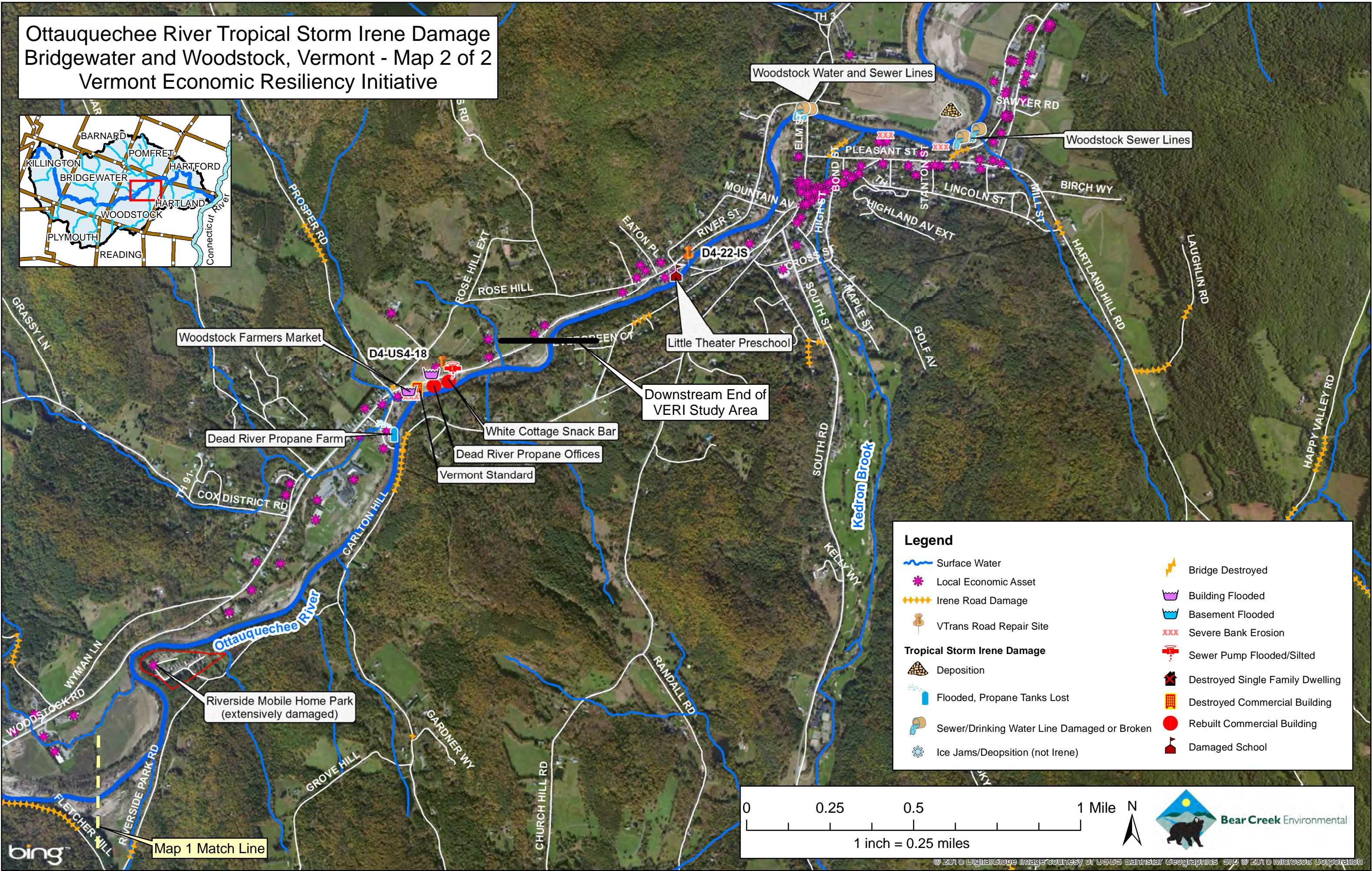
Appendix B:

Flood Hazard and Flood Damage Maps and Table

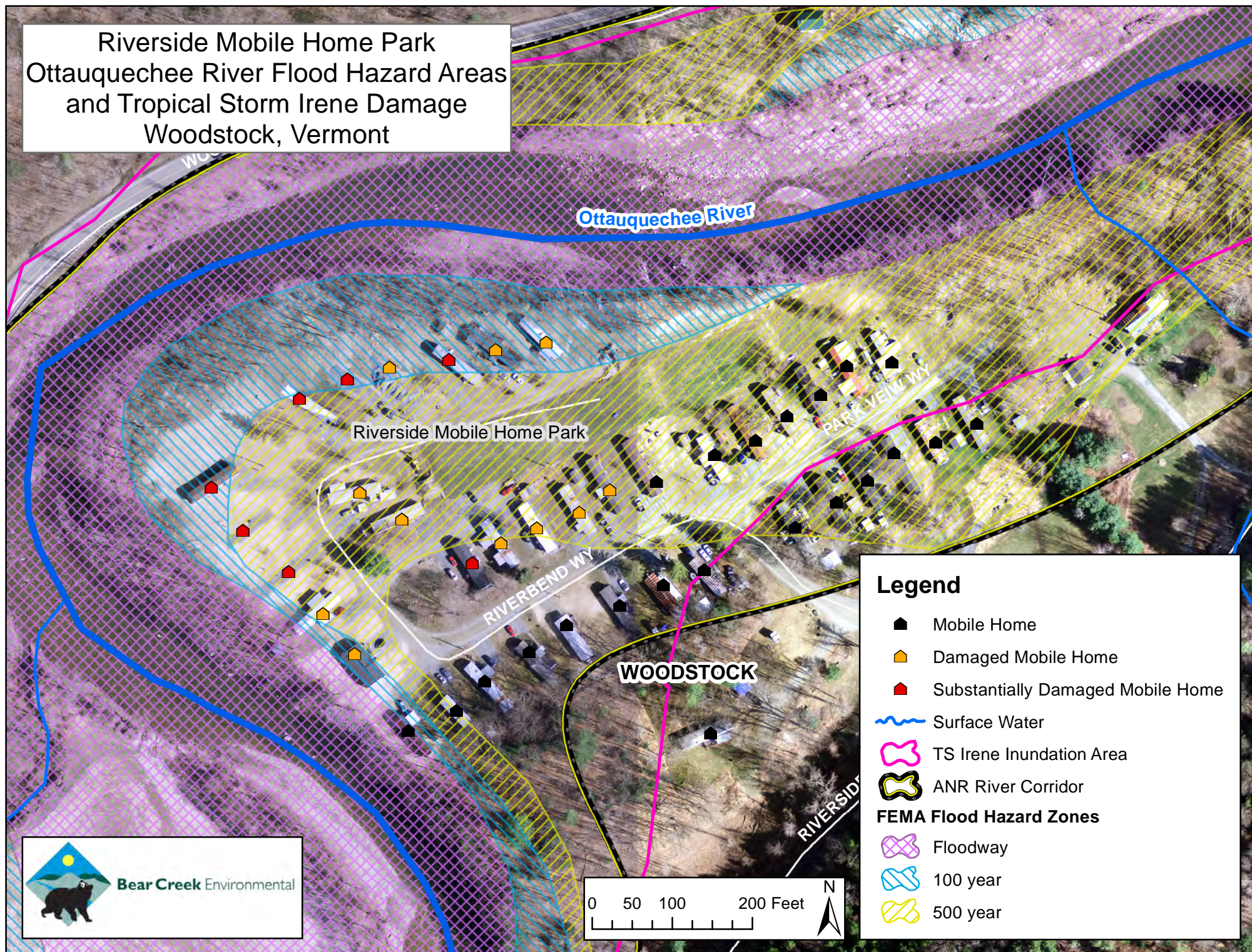
Ottauquechee River Tropical Storm Irene Damage
Bridgewater and Woodstock, Vermont - Map 1 of 2
Vermont Economic Resiliency Initiative



Ottauquechee River Tropical Storm Irene Damage
Bridgewater and Woodstock, Vermont - Map 2 of 2
Vermont Economic Resiliency Initiative



Riverside Mobile Home Park Ottauquechee River Flood Hazard Areas and Tropical Storm Irene Damage Woodstock, Vermont



Legend

- Mobile Home
- Damaged Mobile Home
- Substantially Damaged Mobile Home

Surface Water

TS Irene Inundation Area

ANR River Corridor

FEMA Flood Hazard Zones

Floodway

100 year

500 year

Businesses in Flood Hazard Zones in Study Area
Bridgewater and Woodstock, Vermont
Vermont Economic Resiliency Initiative (VERI)
February 25, 2015

Business Name	E911 Business Address	Town	Number of Employees	FEMA Floodway	FEMA 100 Year Flood Zone	FEMA 500 Year Flood Zone	ANR River Corridor	TSI Inundation Area
Audsley Plumbing & Heating	90 Mill Road	Woodstock	---			X	X	X
Bridgewater Volunteer Fire Department	7284 US Route 4	Bridgewater	Municipal				X	X
Bridgewater Wastewater Treatment Facility	52 Woolen Mill Drive	Woodstock	Municipal		X	X	X	X
BSEF Thrift Store	102 Woolen Mill Drive	Bridgewater	6		X	X	X	
Charles Shackleton Furniture	102 Woolen Mill Drive	Bridgewater	15		X	X	X	
David Crandall Jewelry	102 Woolen Mill Drive	Bridgewater	1		X	X	X	
Deerbrook Inn	4548 West Woodstock Road	Woodstock	2		X	X		X
Donna's Hair Studio	102 Woolen Mill Drive	Bridgewater	2		X	X	X	
DR Propane Farm	59 Mill Road	Woodstock	---			X	X	X
DR Propane Offices	909 West Woodstock Road	Woodstock	21	X	X	X	X	X
Ellaway Property Service	738 West Woodstock Road	Woodstock	10					X
Farmhouse Inn	5250 West Woodstock Road	Woodstock	2		X	X		X
Farmhouse Pottery	1837 West Woodstock Road	Woodstock	4			X	X	X
Kedron Valley Veterinary Clinic	1205 West Woodstock Road	Woodstock	9			X	X	
Lake Sunapee Bank Drive-Up	906 West Woodstock Road	Woodstock	1		X	X		X
Lincoln Inn and Restaurant	2709 West Woodstock Road	Woodstock	4				X	
Mill Mall	102 Woolen Mill Drive	Woodstock	44		X	X	X	X
Miranda Thomas Pottery	102 Woolen Mill Drive	Bridgewater	3		X	X	X	
Old Mill Marketplace	102 Woolen Mill Drive	Bridgewater	2		X	X	X	
On the River Inn	1653 West Woodstock Road	Woodstock	4				X	
Ramuntos Pizza	102 Woolen Mill Drive	Bridgewater	12		X	X	X	
Riverside Mobile Home Park	Park View Way	Woodstock	Residential	X	X	X	X	X
Schultz Excavation	2457 West Woodstock Road	Woodstock	2		X	X		
Sleep Woodstock Motel	4324 West Woodstock Road	Woodstock	2					X
Thymeless Herbs Farm	5394 West Woodstock Road	Woodstock	2					
Union Arena	80 Amsden Way	Woodstock	4			X		
USPO Bridgewater Village	102 Woolen Mill Drive	Bridgewater	3		X	X	X	
Vtrans Woodstock Garage	3396 West Woodstock Road	Woodstock	State					X
Welch's Woodstock Hardware	2517 West Woodstock Road	Woodstock	11				X	
West Woodstock Sewer Pump Station	Between 447 & 449 West Woodstock Road	Woodstock	Utility			X		X
White Cottage Restaurant	863 West Woodstock Road	Woodstock	10		X	X	X	X
Wild Apple Graphics	2513 West Woodstock Road	Woodstock	35			X	X	
Woodbridge Café	4374 West Woodstock Road	Woodstock	4					X
Woodbridge Inn	5763 West Woodstock Road	Woodstock	1				X	X
Woodstock Community Care Home	1087 West Woodstock Road	Woodstock	6				X	
Woodstock Farmer's Market	979 West Woodstock Road	Woodstock	40	X	X	X	X	X
Woodstock Glassworks	1007 West Woodstock Road	Woodstock	3		X	X	X	X
Woodstock Union High School & Middle School	100 Amsden Way	Woodstock	130			X	X	
TOTAL NUMBER OF BUSINESSES			32	3	19	26	26	19
TOTAL NUMBER OF EMPLOYEES			395	61	169	351	366	144

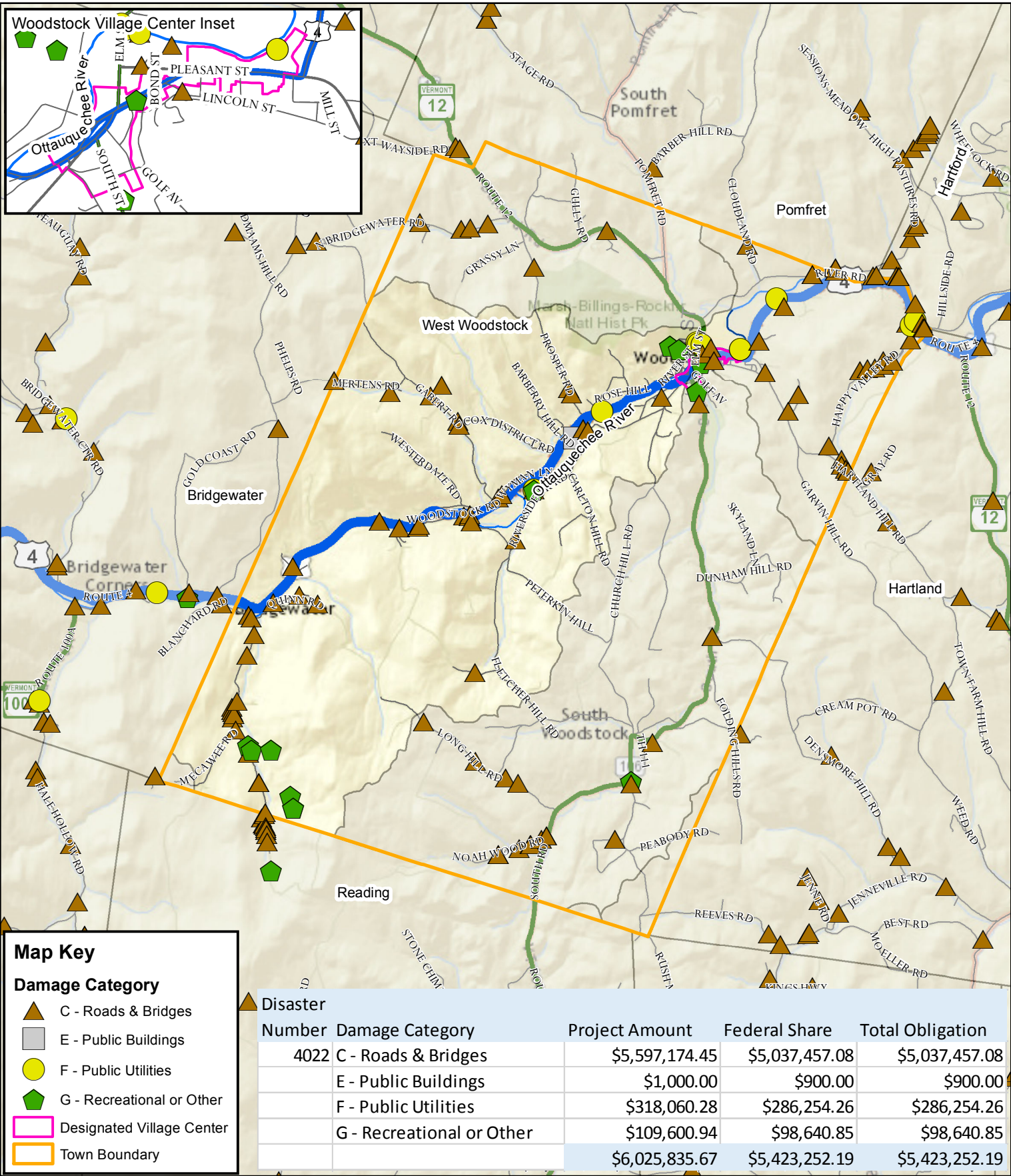
--- = Storage facility

Analysis involved the intersection of Vermont E-911 building points with flood hazard zones in ArcGIS. Results were further modified using Fall 2011 (post-Irene) aerial imagery. If any portion of a building is within a flood hazard zone, as determined visually with aerial imagery, building is considered to be within the zone.

Summary of Flood Damage and Economic Data Sources

<i>Resource</i>	<i>Reference</i>
Ottawaquechee River Stream Geomorphic Assessment	Bear Creek Environmental, LLC (2013)
Flood Damage Information	TRORC (2014a)
Town & Village of Woodstock Plan, Hazard Mitigation Plan	Woodstock (2014 & 2015)
FEMA Flood Maps	FEMA (2007)
State River Corridor	Vermont Agency of Natural Resources (2015)
Business Assets	TRORC (2014a)
USGS Tropical Storm Irene Inundation and Flood Analysis	USGS (2014)

Ottauquechee River - Woodstock, VT



Appendix C:

Results of EPA's Flood Resilience Checklist for Woodstock

Flood Resilience Checklist

Is your community prepared for a possible flood? Completing this flood resilience checklist can help you begin to answer that question. This checklist was developed as part of the U.S. Environmental Protection Agency's Smart Growth Implementation Assistance project in the state of Vermont. More information about the project can be found by reading the full report, *Planning for Flood Recovery and Long-Term Resilience in Vermont*, found online at www.epa.gov/smartgrowth/sgia_communities.htm#rec1.

What is the Flood Resilience Checklist?

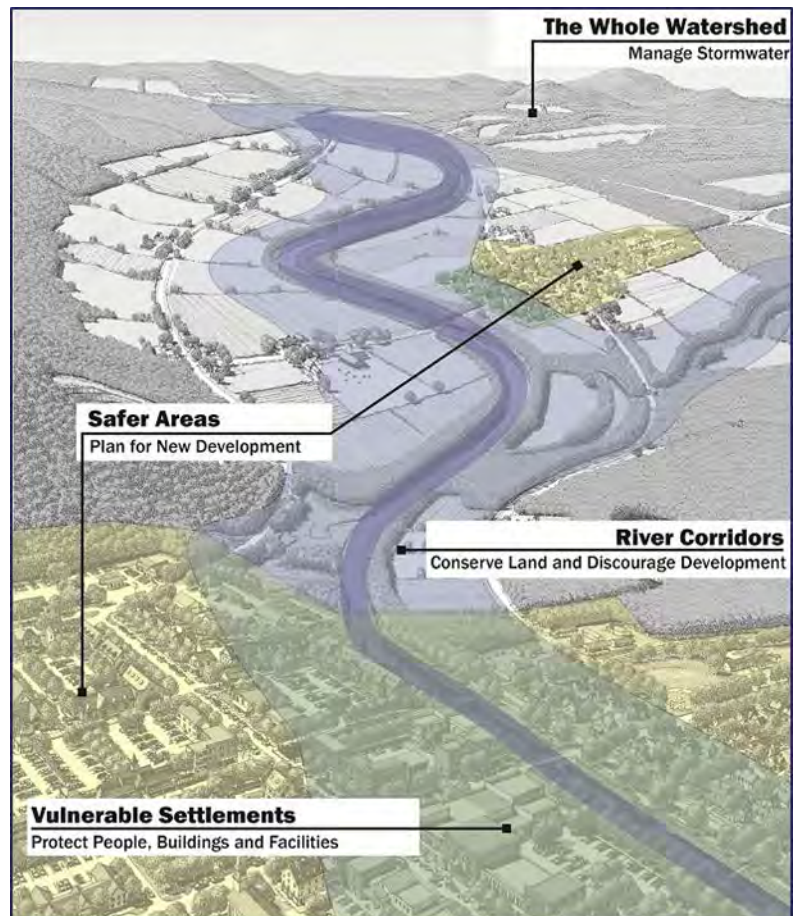
This checklist includes overall strategies to improve flood resilience as well as specific strategies to conserve land and discourage development in river corridors; to protect people, businesses, and facilities in vulnerable settlements; to direct development to safer areas; and to implement and coordinate stormwater management practices throughout the whole watershed.

Who should use it?

This checklist can help communities identify opportunities to improve their resilience to future floods through policy and regulatory tools, including comprehensive plans, Hazard Mitigation Plans, local land use codes and regulations, and non-regulatory programs implemented at the local level. Local government departments such as community planning, public works, and emergency services; elected and appointed local officials; and other community organizations and nonprofits can use the checklist to assess their community's readiness to prepare for, deal with, and recover from floods.

Why is it important?

Completing this checklist is the first step in assessing how well a community is positioned to avoid and/or reduce flood damage and to recover from floods. If a community is not yet using some of the strategies listed in the checklist and would like to, the policy options and resources listed in the [Planning for Flood Recovery and Long-Term Resilience in Vermont](#) report can provide ideas for how to begin implementing these approaches.



This graphic illustrates the four categories of approaches to enhance resilience to future floods. Credit: Vermont Agency of Commerce and Community Development.

WOODSTOCK FLOOD RESILIENCE CHECKLIST

Overall Strategies to Enhance Flood Resilience

Woodstock, Vermont

(Learn more in Section 2, pp. 9-11 of

[Planning for Flood Recovery and Long-Term Resilience in Vermont](#))

1. Does the community's comprehensive plan have a hazard element or flood planning section?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
a. Does the comprehensive plan cross-reference the local Hazard Mitigation Plan and any disaster recovery plans?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
b. Does the comprehensive plan identify flood- and erosion-prone areas, including river corridor and fluvial erosion hazard areas, if applicable?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
c. Did the local government emergency response personnel, flood plain manager, and department of public works participate in developing/updating the comprehensive plan?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
2. Does the community have a local Hazard Mitigation Plan approved by the Federal Emergency Management Agency (FEMA) and the state emergency management agency?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
a. Does the Hazard Mitigation Plan cross-reference the local comprehensive plan?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
b. Was the local government planner or zoning administrator involved in developing/updating the Hazard Mitigation Plan?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
c. Were groups such as local businesses, schools, hospitals/medical facilities, agricultural landowners, and others who could be affected by floods involved in the Hazard Mitigation Plan drafting process?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
d. Were other local governments in the watershed involved to coordinate responses and strategies?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
e. Does the Hazard Mitigation Plan emphasize non-structural pre-disaster mitigation measures such as acquiring flood-prone lands and adopting No Adverse Impact flood plain regulations?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
f. Does the Hazard Mitigation Plan encourage using green infrastructure techniques to help prevent flooding?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
g. Does the Hazard Mitigation Plan identify projects that could be included in pre-disaster grant applications and does it expedite the application process for post-disaster Hazard Mitigation Grant Program acquisitions?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
3. Do other community plans (e.g., open space or parks plans) require or encourage green infrastructure techniques?	<input type="checkbox"/> Yes	<input type="checkbox"/> No

WOODSTOCK FLOOD RESILIENCE CHECKLIST	
4. Do all community plans consider possible impacts of climate change on areas that are likely to be flooded?	<input type="checkbox"/> Yes <input type="checkbox"/> No
5. Are structural flood mitigation approaches (such as repairing bridges, culverts, and levees) and non-structural approaches (such as green infrastructure) that require significant investment of resources coordinated with local capital improvement plans and prioritized in the budget?	<input type="checkbox"/> Yes <input type="checkbox"/> No
6. Does the community participate in the National Flood Insurance Program Community Rating System?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Conserve Land and Discourage Development in River Corridors (Learn more in Section 3.A, pp. 14-19 of Planning for Flood Recovery and Long-Term Resilience in Vermont)	
1. Has the community implemented non-regulatory strategies to conserve land in river corridors, such as:	
a. Acquisition of land (or conservation easements on land) to allow for stormwater absorption, river channel adjustment, or other flood resilience benefits?	<input type="checkbox"/> Yes <input type="checkbox"/> No
b. Buyouts of properties that are frequently flooded?	<input type="checkbox"/> Yes <input type="checkbox"/> No
c. Transfer of development rights program that targets flood-prone areas as sending areas and safer areas as receiving areas?	<input type="checkbox"/> Yes <input type="checkbox"/> No
d. Tax incentives for conserving vulnerable land?	<input type="checkbox"/> Yes <input type="checkbox"/> No
e. Incentives for restoring riparian and wetland vegetation in areas subject to erosion and flooding?	<input type="checkbox"/> Yes <input type="checkbox"/> No
2. Has the community encouraged agricultural and other landowners to implement pre-disaster mitigation measures, such as:	
a. Storing hay bales and equipment in areas less likely to be flooded?	<input type="checkbox"/> Yes <input type="checkbox"/> No
b. Installing ponds or swales to capture stormwater?	<input type="checkbox"/> Yes <input type="checkbox"/> No
c. Planting vegetation that can tolerate inundation?	<input type="checkbox"/> Yes <input type="checkbox"/> No
d. Using land management practices to improve the capability of the soil on their lands to retain water?	<input type="checkbox"/> Yes <input type="checkbox"/> No
3. Has the community adopted flood plain development limits that go beyond FEMA's minimum standards for Special Flood Hazard Areas and also prohibit or reduce any new encroachment and fill in river corridors and Fluvial Erosion Hazard areas?	<input type="checkbox"/> Yes <input type="checkbox"/> No

WOODSTOCK FLOOD RESILIENCE CHECKLIST		
4. Has the community implemented development regulations that incorporate approaches and standards to protect land in vulnerable areas, including:		
a. Fluvial erosion hazard zoning?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
b. Agricultural or open space zoning?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
c. Conservation or cluster subdivision ordinances, where appropriate?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
d. Other zoning or regulatory tools that limit development in areas subject to flooding, including river corridors and Special Flood Hazard Areas?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Protect People, Buildings, and Facilities in Vulnerable Settlements (Learn more in Section 3.B, pp. 19-26 of <i>Planning for Flood Recovery and Long-Term Resilience in Vermont</i>)		
1. Do the local comprehensive plan and Hazard Mitigation Plan identify developed areas that have been or are likely to be flooded?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
a. If so, does the comprehensive plan discourage development in those areas or require strategies to reduce damage to buildings during floods (such as elevating heating, ventilation, and air conditioning (HVAC) systems and flood-proofing basements)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
b. Does the Hazard Mitigation Plan identify critical facilities and infrastructure that are located in vulnerable areas and should be protected, repaired, or relocated (e.g., town facilities, bridges, roads, and wastewater facilities)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
2. Do land development regulations and building codes promote safer building and rebuilding in flood-prone areas? Specifically:		
a. Do zoning or flood plain regulations require elevation of two or more feet above base flood elevation?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
b. Does the community have the ability to establish a temporary post-disaster building moratorium on all new development?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
c. Have non-conforming use and structure standards been revised to encourage safer rebuilding in flood-prone areas?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
d. Has the community adopted the International Building Code or American Society of Civil Engineers (ASCE) standards that promote flood-resistant building?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
e. Does the community plan for costs associated with follow-up inspection and enforcement of land development regulations and building codes?	<input type="checkbox"/> Yes	<input type="checkbox"/> No

WOODSTOCK FLOOD RESILIENCE CHECKLIST	
3. Does the community require developers who are rebuilding in flood-prone locations to add additional flood storage capacity in any new redevelopment projects such as adding new parks and open space and allowing space along the river's edge for the river to move during high-water events?	<input type="checkbox"/> Yes <input type="checkbox"/> No
4. Is the community planning for development (e.g., parks, river-based recreation) along the river's edge that will help connect people to the river AND accommodate water during floods?	<input type="checkbox"/> Yes <input type="checkbox"/> No
5. Does the comprehensive plan or Hazard Mitigation Plan discuss strategies to determine whether to relocate structures that have been repeatedly flooded, including identifying an equitable approach for community involvement in relocation decisions and potential funding sources (e.g., funds from FEMA, stormwater utility, or special assessment district)?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Plan for and Encourage New Development in Safer Areas (Learn more in Section 3.C, pp. 26-27 of <i>Planning for Flood Recovery and Long-Term Resilience in Vermont</i>)	
1. Does the local comprehensive plan or Hazard Mitigation Plan clearly identify safer growth areas in the community?	<input type="checkbox"/> Yes <input type="checkbox"/> No
2. Has the community adopted policies to encourage development in these areas?	<input type="checkbox"/> Yes <input type="checkbox"/> No
3. Has the community planned for new development in safer areas to ensure that it is compact, walkable, and has a variety of uses?	<input type="checkbox"/> Yes <input type="checkbox"/> No
4. Has the community changed their land use codes and regulations to allow for this type of development?	<input type="checkbox"/> Yes <input type="checkbox"/> No
5. Have land development regulations been audited to ensure that development in safer areas meets the community's needs for off-street parking requirements, building height and density, front-yard setbacks and that these regulations do not unintentionally inhibit development in these areas?	<input type="checkbox"/> Yes <input type="checkbox"/> No
6. Do capital improvement plans and budgets support development in preferred safer growth areas (e.g., through investment in wastewater treatment facilities and roads)?	<input type="checkbox"/> Yes <input type="checkbox"/> No
7. Have building codes been upgraded to promote more flood-resistant building in safer locations?	<input type="checkbox"/> Yes <input type="checkbox"/> No

WOODSTOCK FLOOD RESILIENCE CHECKLIST

Implement Stormwater Management Techniques throughout the Whole Watershed

(Learn more in Section 3.D, pp. 27-31 of

[*Planning for Flood Recovery and Long-Term Resilience in Vermont*](#))

1. Has the community coordinated with neighboring jurisdictions to explore a watershed-wide approach to stormwater management?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
2. Has the community developed a stormwater utility to serve as a funding source for stormwater management activities?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
3. Has the community implemented strategies to reduce stormwater runoff from roads, driveways, and parking lots?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
4. Do stormwater management regulations apply to areas beyond those that are regulated by federal or state stormwater regulations?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
5. Do stormwater management regulations encourage the use of green infrastructure techniques?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
6. Has the community adopted tree protection measures?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
7. Has the community adopted steep slope development regulations?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
8. Has the community adopted riparian and wetland buffer requirements?	<input type="checkbox"/> Yes	<input type="checkbox"/> No

Appendix D:

Table of Municipal Policy and Program Recommendations

Woodstock

Town-wide Policy and Program Options

Vermont Economic Resiliency Initiative

(VERI)

Legend		
	Effective	
		Limited
		
		Ineffective

Appendix D: Page 1 of 2

* Priority rating based on degree of community benefit

Recommendation	Priority*	OBJECTIVES			FEASIBILITY		Potential Partners	Potential Grants	Explanation	Next Steps
		Reduces Flood Risk	Reduces Erosion Risk	Protects Businesses, Infrastructure, and Property	Ease of Implementation	Cost Range				
Land Use Regulations										
Encourage development outside of the floodway.	High	●	●	●	Easy	< \$10K	RPC, VLCT, Consultant	MPG	The floodway is the fastest moving part of the river during a flood. Buildings and other objects in a floodway can be washed downstream, and cause culverts and bridges to clog with debris resulting in significant property damage. In the village zoning bylaw, consider prohibiting all new development from the mapped floodway.	Contact Town Planner and Planning Commission
Encourage development outside of the flood hazard and ANR mapped river corridor areas	High	●	●	●	Moderate	< \$10K	DEC River Management Program, RPC, VLCT, Consultant	MPG	New development in the flood area and river corridor puts owners at risk and reduces available floodplain. It also puts emergency responders, the public and downstream property owners at risk. In the flood hazard portion of the town and village zoning bylaw, consider prohibiting all new development.	Contact Town Planner and Planning Commission
Require repaired and rebuilt structures to be built higher.	High	●	○	●	Easy	< \$10K	RPC, VLCT, Consultant	MPG	Owners rebuilding should raise the lowest floor 2 to 3 feet higher than the most recently recorded flood elevation in high-risk areas. These requirements can be added to the development standards portion of the flood hazard section of the town and village bylaw.	Contact Town Planner and Planning Commission
Monitor rebuilding after a disaster and keep participating in the NFIP.	High	●	●	●	Easy	< \$10K	RPC, VLCT, Consultant	MPG	People want to return to normal as quickly as possible after a disaster but local officials need to monitor rebuilding work to ensure that it does not violate town and federal regulations. Improper rebuilding may result in future federal disaster funding being unavailable for the town and its residences and businesses.	Work with Zoning Administrator.
Town Plan										
Limit new development in village floodway, town and village floodplain and river corridor	High	●	●	●	Moderate	< \$10K	RPC, VLCT, Consultant	MPG	Language in the plan that restricts development in risky locations enables adoption of corresponding regulations and policies. Likewise, the plan should identify areas safe from floods and encourage development in those areas. This can be a component of the flood resiliency chapter.	Contact Town Planner and Planning Commission
Document road, sewer, and water infrastructure vulnerabilities in municipal and capital plans.	High	○	○	●	Easy	< \$10K	RPC, VLCT, Consultant	MPG	Areas that were damaged or have vulnerabilities should be documented so the community can plan for their replacement in their long-term budgets, easing the impact on taxpayers. Capital programs and budgets are not common in smaller towns but the Selectboard may start this process with a simple capital reserve fund.	Contact Town Planner and Planning Commission
Identify areas for conservation.	Medium	●	●	●	Easy	< \$10K	Town	DEC-ERP	The Ottawaquechee River Corridor Plan identifies potential riparian easement sites. The Woodstock Conservation Commission can identify and work with willing landowners to establish conservation sites along the river to prevent future development in flood-prone locations.	Contact Conservation Commission
Document damages from flood events.	Medium	○	○	●	Easy	< \$10K	RPC, VLCT, Consultant	MPG	Disasters are easily forgotten over time and damages from the 2011 floods as well as recent rain and flood events should be documented. This will drive consideration of the implications of new investments in areas damaged by floods including Riverside Mobile Home Park, West Woodstock, and River/Elm Streets.	Contact Town Planner and Planning Commission

¹Reduces Flood Risk - The proposed project/ strategy lowers the flood level. ²Reduces Erosion Risk - The proposed project/ strategy lessens the vulnerability of a location to erosion.

Woodstock

Town-wide Policy and Program Options

Vermont Economic Resiliency Initiative

(VERI)

Legend



Effective



Limited



Ineffective

Appendix D: Page 2 of 2

* Priority rating based on degree of community benefit

Recommendation	Priority*	OBJECTIVES			FEASIBILITY		Potential Partners	Potential Grants	Explanation	Next Steps
		Reduces Flood Risk	Reduces Erosion Risk	Protects Businesses, Infrastructure, and Property	Ease of Implementation	Cost Range				
Emergency Planning										
Develop a local recovery and building retrofit fund.	High	○	○	●	Difficult	??	Chamber, local churches, committees	VT Community Foundation	Towns will recover much more quickly after a disaster if they create a local fund to address urgent needs as federal and state money are slow to arrive. Establishing a local household and business small grant or loan fund is proven to speed recovery efforts. Towns could offer mini grants for backflow preventers and barriers for doors.	Work with local committee
Include the VERI municipal infrastructure projects in the local Hazard Mitigation Plan.	High	●	●	●	Easy	< \$10K	RPC, town	HMGP grants	Towns can also add the projects listed in this report to the strategies portion of the plan to improve eligibility for future grants.	Work with town Emergency Management Director.
Educate people about the causes, risks and warning signs of floods.	Low	●	●	●	Easy Moderate Difficult	< \$10K	Schools, RPC, Town	HMGP grants	Schools can include flood awareness and preparedness in spring and fall science and history programs. Schools and towns and other local groups such as the Rotary or the senior center can publicize flood risk areas, warning signs and evacuation plans.	Reach out to schools and community groups.
Develop evacuation plans.	Medium	○	○	●	Moderate	< \$10K	Homeowners Associations	HMGP grants	Municipal facilities and schools as well as private facilities such as mobile home parks, senior centers, nursing homes and workplaces should all have evacuation plans.	Work with town Emergency Management Director.
Education and Outreach										
Promote and educate property owners on the value of flood insurance.	High	○	○	●	Easy	< \$10K	Chamber, Homeowners Associations	HMGP grants	Homeowners’ insurance does not pay for any flood related damage. Only flood insurance through the National Flood Insurance Program does. In Woodstock, only 35% of buildings in the flood hazard area have flood insurance.	Gather NFIP informational materials for distribution, and reach out to real estate agents.
Help businesses plan for disasters.	Medium	○	○	●	Easy	< \$10K	Chamber, Rotary	EDA grants	If a home is damaged or washed away, occupants can go stay in a hotel, with friend or family, or find a rental. When a business is flooded, it is much harder to relocate. Continuity of operations plans outlines the steps business can take during and after a disaster to reduce disruption and losses.	Offer continuity of operations planning training for businesses.
Educate landlords and contractors about local regulations.	High	○	○	●	Moderate	< \$10K	Realtors	HMGP grants	Many landlords and contractors may not understand the requirements for rebuilding after a flood. Specific standards must be met to maintain eligibility for flood insurance and other federal grants.	Reach out to landlords and contractors.

¹Reduces Flood Risk - The proposed project/ strategy lowers the flood level.

²Reduces Erosion Risk - The proposed project/ strategy lessens the vulnerability of a location to erosion.

Appendix E:

Maps and Tables of Projects to Protect Woodstock

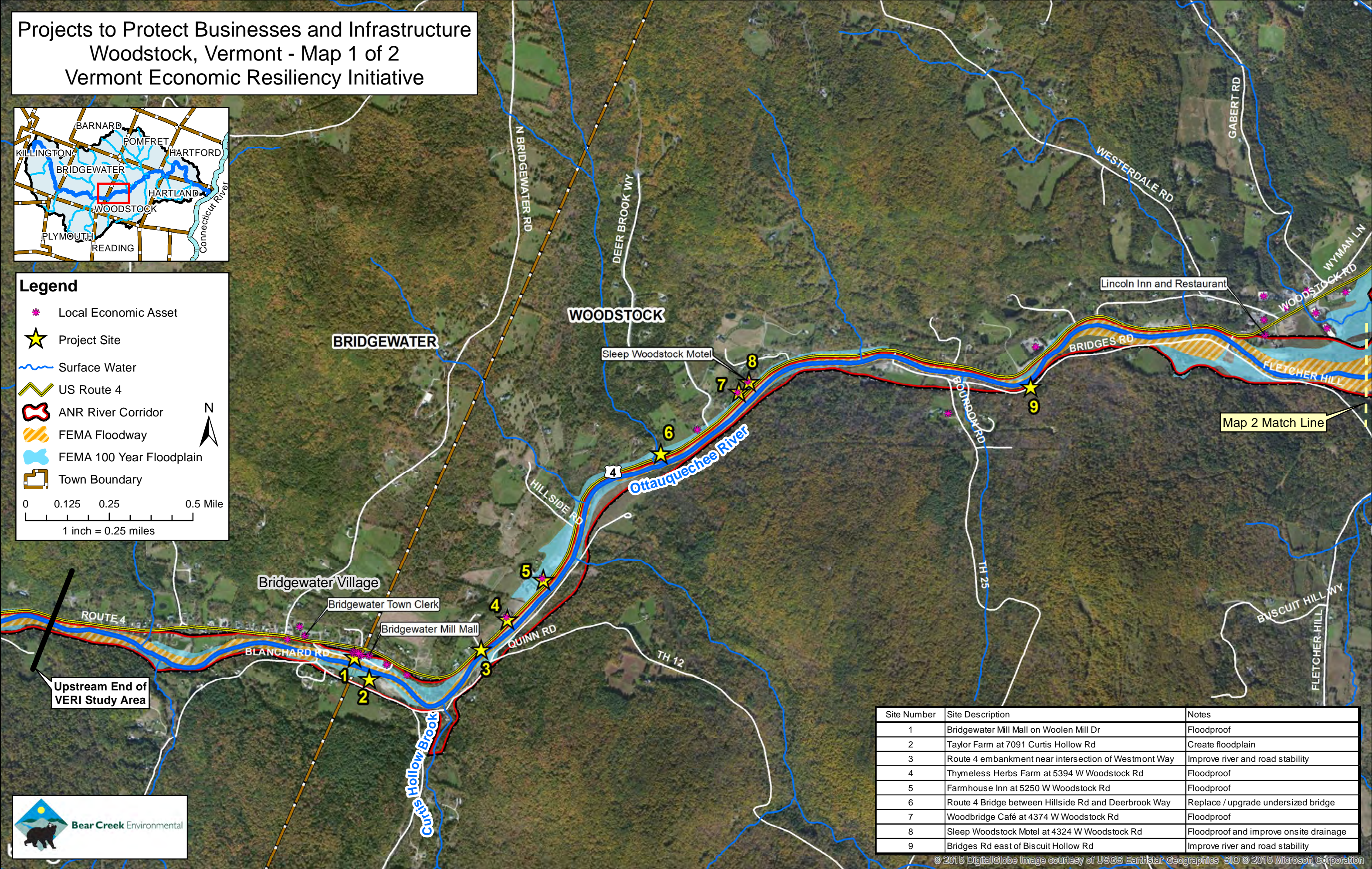
Projects to Protect Businesses and Infrastructure
Woodstock, Vermont - Map 1 of 2
Vermont Economic Resiliency Initiative



Legend

- Local Economic Asset
- Project Site
- Surface Water
- US Route 4
- ANR River Corridor
- FEMA Floodway
- FEMA 100 Year Floodplain
- Town Boundary

0 0.125 0.25 0.5 Mile
1 inch = 0.25 miles



Site Number	Site Description	Notes
1	Bridgewater Mill Mall on Woolen Mill Dr	Floodproof
2	Taylor Farm at 7091 Curtis Hollow Rd	Create floodplain
3	Route 4 embankment near intersection of Westmont Way	Improve river and road stability
4	Thymeless Herbs Farm at 5394 W Woodstock Rd	Floodproof
5	Farmhouse Inn at 5250 W Woodstock Rd	Floodproof
6	Route 4 Bridge between Hillside Rd and Deerbrook Way	Replace / upgrade undersized bridge
7	Woodbridge Café at 4374 W Woodstock Rd	Floodproof
8	Sleep Woodstock Motel at 4324 W Woodstock Rd	Floodproof and improve onsite drainage
9	Bridges Rd east of Biscuit Hollow Rd	Improve river and road stability



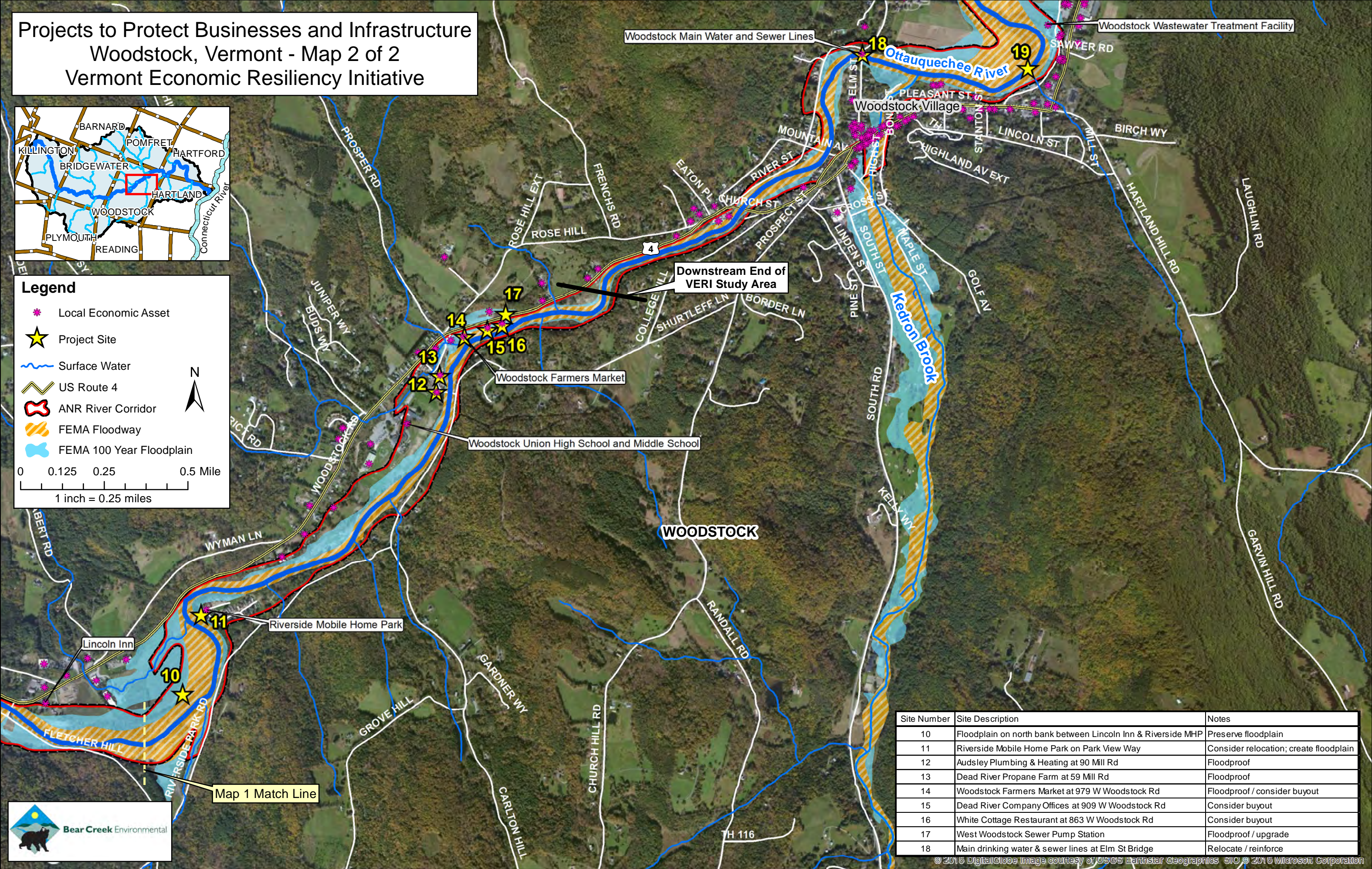
Projects to Protect Businesses and Infrastructure
Woodstock, Vermont - Map 2 of 2
Vermont Economic Resiliency Initiative



Legend

- Local Economic Asset
- Project Site
- Surface Water
- US Route 4
- ANR River Corridor
- FEMA Floodway
- FEMA 100 Year Floodplain

0 0.125 0.25 0.5 Mile
1 inch = 0.25 miles



Site Number	Site Description	Notes
10	Floodplain on north bank between Lincoln Inn & Riverside MHP	Preserve floodplain
11	Riverside Mobile Home Park on Park View Way	Consider relocation; create floodplain
12	Audsley Plumbing & Heating at 90 Mill Rd	Floodproof
13	Dead River Propane Farm at 59 Mill Rd	Floodproof
14	Woodstock Farmers Market at 979 W Woodstock Rd	Floodproof / consider buyout
15	Dead River Company Offices at 909 W Woodstock Rd	Consider buyout
16	White Cottage Restaurant at 863 W Woodstock Rd	Consider buyout
17	West Woodstock Sewer Pump Station	Floodproof / upgrade
18	Main drinking water & sewer lines at Elm St Bridge	Relocate / reinforce



Woodstock

Recommended Projects to Protect Businesses and Infrastructure Vermont Economic Resiliency Initiative (VERI) April 1, 2015

























Legend

Effective

Limited

Ineffective

* Priority rating based on objectives and potential business impact (refer to *Specific Project Recommendations* section of the report)

				OBJECTIVES			FEASIBILITY			Comments
Project	What is At Risk?	Potential Business Impacts	Priority*	Reduces Flood Risk ¹	Reduces Erosion Risk ²	Protects Businesses, Infrastructure, and Property	Ease of Implementation	Cost Range	Estimated Time for Implementation	
Building and Site Improvements										
Flood proof in West Woodstock in at Farmer's Market (see site 14 on map 2)	Businesses	1 businesses with a total of 40 employees	High				Moderate	\$10K-\$50K	1-2 years	The building flooded (water 5 feet up) resulting in a complete loss of merchandise at Woodstock Farmer's Market. Floodproofing may be best accomplished by elevating the building or using dry floodproofing techniques. A site specific assessment by a engineer and/or architect to determine the best method is recommended.
Flood proof at the Bridgewater Mill Mall (see site 1 on map 1)	Commercial buildings	8 businesses with a total of 44 employees	Medium				Moderate	\$10K-\$50K	1-2 years	Basements flooded at Bridgewater Mill Mall during Tropical Storm Irene. Wet floodproofing may be an option for this historic building. Elevating utilities is recommended.
Flood proof the businesses across Route 4 in vicinity of Thymeless Herbs Farm and Farmhouse Inn (See sites 4 and 5 on map 1)	Businesses and private homes	2 businesses with a total of 4 employees	Medium				Moderate	<\$10K per building	1-2 years	Thymeless Herbs Farm and Farmhouse Inn reported having flooding in basements across US Route 4. Animals died (chickens buried in the mud) and land contaminated with floodwaters at Thymeless Herbs Farm.
Flood proof and improve onsite drainage at businesses across from US Route 4 near Deerbrook Way (see sites 7 and 8 on map 1)	Businesses	2 businesses with a total of 6 employees	Medium				Moderate	<\$10K per building	1-2 years	Foundation wall collapsed at Woodbridge Café; Sleep Woodstock Motel owner reported issues with onsite drainage.
Flood proof businesses located along Mill Road (see sites 12 and 13 on map 2)	Businesses	2 businesses (equipment storage only)	Medium				Moderate	<\$10K per building	1-2 years	Audsley Plumbing and Heating was flooded, but was prepared. Dead River propane farm (Leonard's Gas & Elec.) was flooded; propane tanks washed into the Ottauquechee River and the fence was lost. A floodproofing best practice is to secure fuel tanks to avoid loose debris in the river.
Channel and Floodplain Management										
Preserve floodplain along the Ottauquechee River between the Lincoln Inn & Riverside Mobile Home Park (see site 10 on map 2)	Riverside Mobile Home Park and other downstream infrastructure	>25 businesses and 100 employees	High				Moderate	\$100-\$200K	1-2 years	Protect the largest undeveloped floodplain within the VERI study area through an easement. The floodplain is an important location for storage of floodwaters and sediment.
Create floodplain on the Taylor Farm, located across from the Mill Mall (see site 2 on map 1)	Commercial buildings	8 businesses with a total of 44 employees	Medium				Difficult	>\$200K	>5 years	Flooding in basements at Mill Mall (Shackleton Thomas Furniture, BSEF Thrift Store, Donna's Hair Studio, Miranda Thomas Pottery, Old Mill Marketplace, Ramuntos Pizza, David Crandall Jewelry, and USPO Bridgewater Village).
Create floodplain on inside bend of Riverside Mobile Home Park (see site 11 on map 2)	Riverside Mobile Home Park	At least 18 units are at risk; the land is rented & there are 40 units within the mobile home park	Low				Difficult	\$50K-\$100K	>5 years	Following relocation of several mobile homes, create floodplain on inside bend to reduce flood and erosion risk.

¹Reduces Flood Risk - The proposed project/ strategy lowers the flood level. ²Reduces Erosion Risk - The proposed project/ strategy lessens the vulnerability of a location to erosion.

Woodstock

Recommended Projects to Protect Businesses and Infrastructure
Vermont Economic Resiliency Initiative (VERI)
April 1, 2015

Legend

Effective

Limited

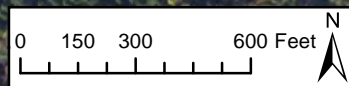
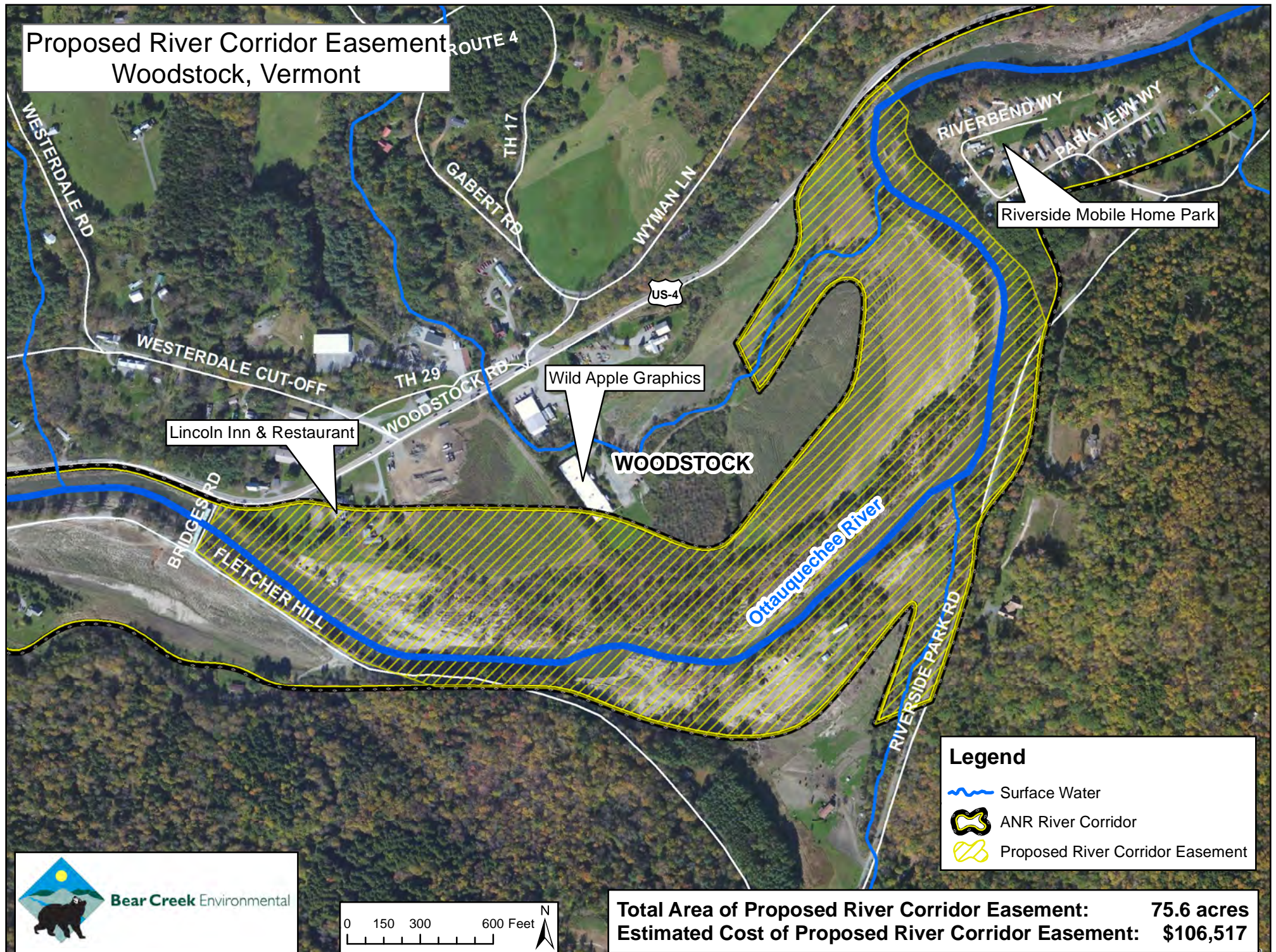
Ineffective

* Priority rating based on objectives and potential business impact (refer to *Specific Project Recommendations* section of the report)

				OBJECTIVES			FEASIBILITY			
Project	What is At Risk?	Potential Business Impacts	Priority*	Reduces Flood Risk ¹	Reduces Erosion Risk ²	Protects Businesses, Infrastructure, and Property	Ease of Implementation	Cost Range	Estimated Time for Implementation	Comments
Infrastructure Improvements										
Replace undersized bridge on US Route 4 (see site 6 on map 1)	Federal highway	>25 businesses and 100 employees	High	●	●	●	Moderate	>\$200K	2-5 years	The bridge opening completely clogged with sediment and debris during Tropical Storm Irene, resulting in single lane damage and destruction of a single family home. Replacing the bridge with a larger opening (higher clearance) designed to better pass sediment and debris would reduce future flood damage.
Improve river and road stability along Route 4 (see site 3 on map 1)	Federal highway	>25 businesses and 100 employees	High	◯	◐	●	Moderate	>\$200K	1-2 years	The road embankments along US Route 4 blew out in multiple locations during Tropical Storm Irene, resulting in road wash outs.
Relocate or reinforce drinking water line owned by Woodstock Aqueduct Company under Elm St. Bridge (see site 18 on map 2)	Businesses and residents of Woodstock Village and West Woodstock	>25 businesses and 100 employees	High	◯	◯	●	Moderate	>\$200K	1-2 years	Main water supply line at Elm Street Bridge ruptured leaving 1600 customers without drinking water following Tropical Storm Irene for 5 days.
Relocate or reinforce sanitary sewer line for Town of Woodstock under Elm St. Bridge and along the southern bank of the river in the Village (see sites 18 and 19 on map 2)	Businesses and residents of Woodstock Village and West Woodstock	>25 businesses and 100 employees	High	◯	◯	●	Moderate	\$100K-\$200K	2-5 years	Main sewer line crossing at Elm Street Bridge ruptured leaving 925 customers without sewer service following Tropical Storm Irene for one week. The sewer line was also damaged along the southern bank of the river between the bridge and Woodstock Wastewater Treatment Facility.
Upgrade West Woodstock Sewer Pump Station to keep water and silt out during future flood event (see site 17 on map 2)	Businesses and residents of Woodstock Village and West Woodstock	>25 businesses and 100 employees	High	◯	◯	●	Easy	\$50K-\$100K	1-2 years	Sewer pump station across from White's Cottage was flooded and silted over during Tropical Storm Irene. Subsequently, all the electrical wiring has been replaced and elevated. Additional work is needed to keep water and silt out during future flood events.
Improve river and road stability along Bridges Road (see site 9 on map 1)	Town Road	Residential	Medium	◯	◐	●	Moderate	\$50K-\$100K	1-2 years	The ends of the roadway embankment were repaired following Tropical Storm Irene with FEMA funding. The middle section that was not repaired is at risk of failure.
Public Safety Improvements										
Consider buyouts for at- risk properties in West Woodstock (see sites 14, 15 and 16 on map 2)	Businesses	3 businesses with a total of 71 employees	High	◯	◯	●	Difficult	>\$200K	>5 years	Several businesses in West Woodstock experienced losses from flooding during the 1973 flood and Tropical Storm Irene. Buyouts would reduce future risk of losses, and would protect public safety.
Consider relocating mobile homes in flood and erosion hazard areas to higher ground (see site 11 on map 2)	Riverside Mobile Home Park	At least eighteen units are at risk; the land is rented and there are 40 units within the mobile home park	Medium	◯	◯	●	Difficult	\$100K-\$200K	>5 years	Nine mobile homes were reported to be "uninhabitable" following Tropical Storm Irene. A total of 18 units were noted to be damaged, with 7 units having damage greater than 50 percent of the value of the building. The bank eroded at the bend in the river, and was stabilized following Tropical Storm Irene using rock. Four of the mobile homes were relocated following Tropical Storm Irene. The vacant lots could be conserved with easements to reduce future risk of losses.

¹Reduces Flood Risk - The proposed project/ strategy lowers the flood level. ²Reduces Erosion Risk - The proposed project/ strategy lessens the vulnerability of a location to erosion.

Proposed River Corridor Easement Woodstock, Vermont



Woodstock Aqueduct Company – Additional Needs

Pete Fellows of Two Rivers Ottauquechee Regional Commission provided an update on the Woodstock Aqueduct Company after speaking with Eric Wegner, Vice President.

Damages during Irene

The main water supply line at the Elm Street Bridge ruptured during Tropical Storm Irene in August 2011, leaving 1600 customers in Woodstock without water for about five days. A number of water supply lines were damaged during Irene including:

1. An 8 inch supply line under the Ottauquechee River in the vicinity of the Elm Street Bridge. Prior to Tropical Storm Irene the pipe was encased in concrete. The concrete snapped when undermined during high flows.
2. A 4 inch supply line under Barnard Brook to the Woodstock Foundation Building downstream of the access bridge.
3. Three 1 inch individual lines that carry water over to College Hill Road from US Route 4 near the Dead River Company.

Replacements following Tropical Storm Irene

The water supply lines were repaired as follows:

1. The 8 inch supply line at Elm Street was upgraded from schedule 40 to schedule 80 with a collar that allows segments to flex. The line was buried about 2 feet into clay and then covered with two to three feet of progressively larger material.
2. The 4 inch supply line to the Woodstock Foundation building was bored into clay substrate.
3. Customers that received potable water through the one inch supply line that ruptured during Irene went to wells for their potable water source.

Needs

The Woodstock Aqueduct Company requires the following to be ready for an emergency:

1. Potable water temporary line package.
2. Redundant supply line from wells on Stimets Road and VT 12 to the reservoir on Cox District Road.
3. Solar backup for wells

Appendix F:

Conceptual Project Designs to Protect Woodstock



Cross Section Locations for Conceptual
Design of Floodplain Creation at the
Bridgewater Mill Mall
Bridgewater & Woodstock, Vermont
Vermont Economic Resiliency Initiative

Legend

- Cross Section
 - Proposed Floodplain Creation Area
 - Town Boundary
 - Major Road
 - ~ 1 Meter Contour
- 0 125 250 500 Feet



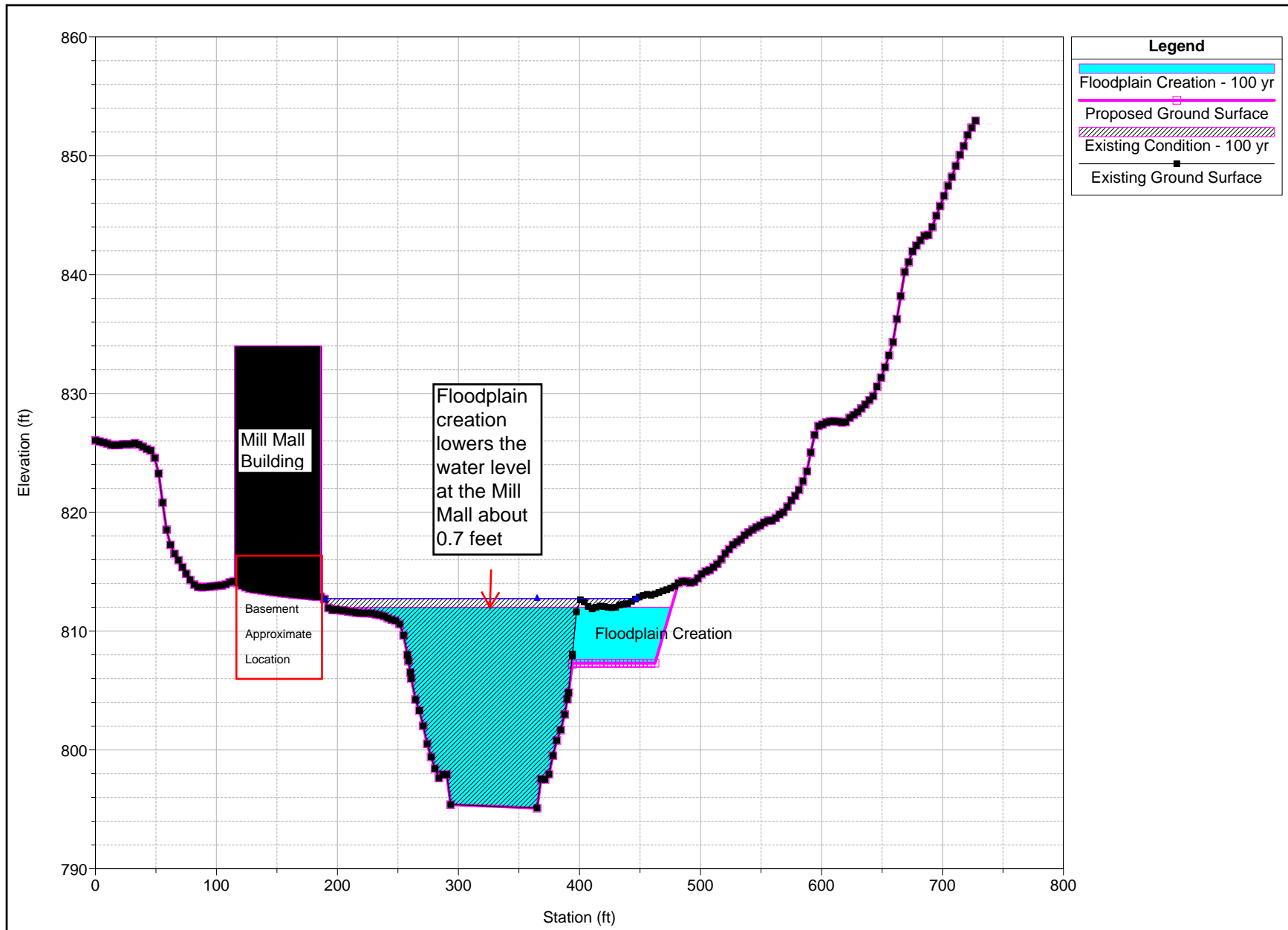
Floodplain creation surface area is approximately 2.5 acres. About 17,900 cubic yards of material would need to be excavated.

Background is Bing Imagery. Map composed on February 27, 2015.

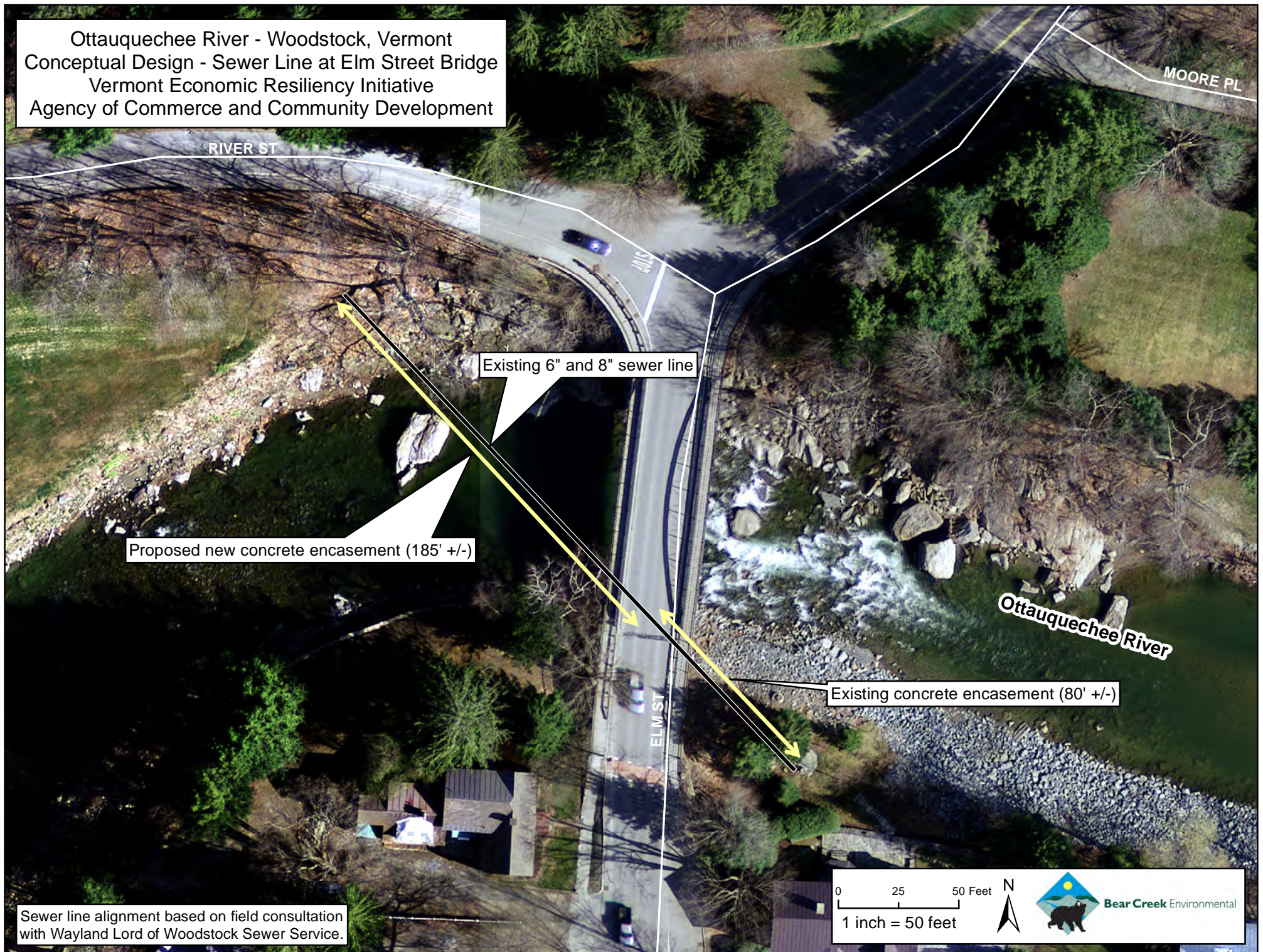


Bear Creek Environmental

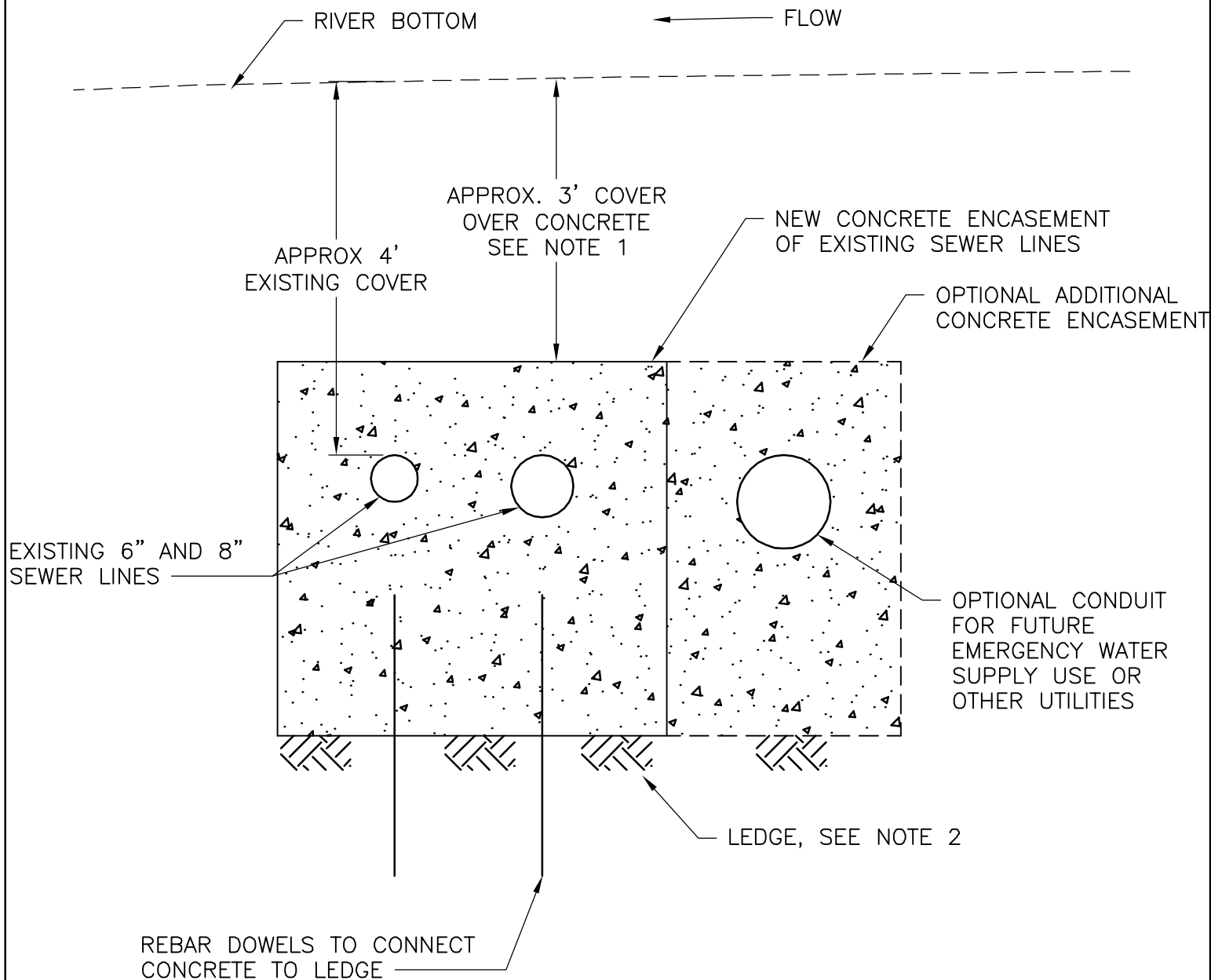
100 Year Flood Event - Section 786
HEC-RAS Model Output



Ottauquechee River - Woodstock, Vermont
Conceptual Design - Sewer Line at Elm Street Bridge
Vermont Economic Resiliency Initiative
Agency of Commerce and Community Development




Sewer line alignment based on field consultation
with Wayland Lord of Woodstock Sewer Service.

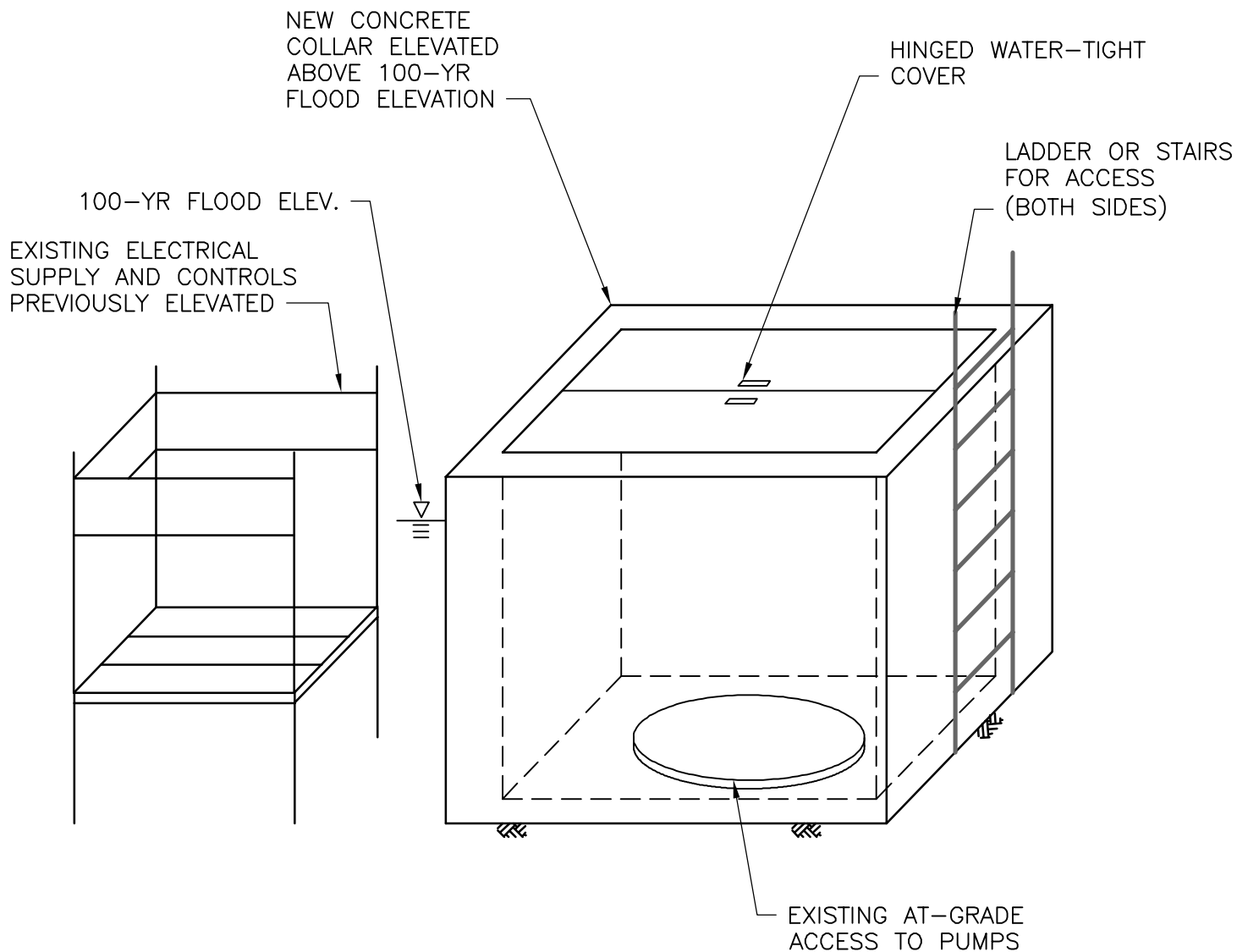


NOTES:

1. AS PART OF DESIGN PHASE, EVALUATE VERTICAL RIVER STABILITY. IF NECESSARY, REPLACE SEWER LINES AT DEEPER DEPTH TO PREVENT EXPOSURE OF CONCRETE DUE TO SCOUR.
2. TOWN SEWER SERVICE STAFF REPORT LEDGE. CONFIRM PRESENCE AND EXTENT DURING DESIGN PHASE.

ELM ST. SEWER LINE ENCASEMENT – CROSS SECTION

 <p>ENGINEERING • PLANNING • MANAGEMENT • DEVELOPMENT</p>	<p>VERI-WOODSTOCK OTTAUQUECHEE RIVER ELM STREET SEWER LINE CONCRETE ENCASEMENT</p>	DRAWN BY	DATE	FIGURE
		ZDC	FEB. 2015	
		CHECKED BY	D&K PROJECT #	
		MTM	122618L	
		PROJ. ENG.	SCALE	
		MTM	N.T.S.	



FLOOD COLLAR RETROFIT

DuBois & King inc.

ENGINEERING • PLANNING •
MANAGEMENT • DEVELOPMENT

VERI-WOODSTOCK
OTTAUQUECHEE RIVER
ROUTE 4 SEWAGE LIFT STATION
FLOOD COLLAR RETROFIT

DRAWN BY

ZDC

DATE

FEB. 2015

CHECKED BY

MTM

D&K PROJECT #

122618L

PROJ. ENG.

MTM

SCALE

N.T.S.

FIGURE

Appendix G:

Community Forum Meeting Notes

Vermont Economic Resiliency Initiative (VERI)

Community Forum - Village of Woodstock

MEETING NOTES

October 2, 2014 – 6:30 - 8:30 PM

Project Overview

With funding from the [US Economic Development Administration](#) (EDA), the Vermont Department of Housing and Community Development, working with the Agencies of Natural Resources and Transportation and the Regional Planning Commissions, launched the Vermont Economic Resiliency Initiative (VERI) to help ensure Vermont remains open for business when disaster strikes.

VERI will help the state and local communities by evaluating local flood risk to business and infrastructure, and identify the steps communities and the state can take to minimize rebuilding and recovery costs and ensure businesses stay open – saving jobs and maintaining our economy.

For More Information

http://accd.vermont.gov/strong_communities/opportunities/planning/resiliency/VERI

Meeting Summary

19 community members, business owners, and homeowners from the Ottauquechee River catchment area in Woodstock attended the Vermont Economic Resiliency Community Forum. The community identified two major flood hazard risks in Woodstock – repeat flooding of Morgan Hill Road businesses due to the elevation of the road and perceived flooding risk along Kedron Brook. Successful mitigation projects in the Woodstock have included restoring riparian buffers, maintaining undeveloped parcels of land in the flood plain, and upgrading aged or insufficient infrastructure, such as culverts. Further analysis and technical assistance needs of the community emphasized changes to flood insurance policies, hardening or retrofitting waste water treatment and electrical utility services, improving access to capital soon after a disaster, and augmenting the capacity of the State of Vermont river engineers to analyze and mitigate risk.

Present

- Residents and Business Owners: Bill Emmons (Cloudland Farm), Laura Spittle, Barry Milstone (Farmhouse Inn), Molly Hutchins (Green Mountain Horse Association), Patrick Cowl (Woodstock Farmer's Market), Ray Bates, Beth Finalyson (Woodstock Chamber of Commerce), Sally Miller

(Sustainable Woodstock)

- Technical Assistance: Mary Nealon (Bear Creek Environmental)
- Town of Woodstock: Mary Riley, Michael Brands, Phil Swanson, Nick Scheu, Don Bourdon, Chris Miller
- Regional Planning Commission: Pete Fellows (TRORC), Ellie Ray (TRORC)
- Woodstock Foundation: David Donath, Marian Koetsier, Susan Plump
- State of Vermont: Noelle MacKay (DHCD), Chris Cochran (DHCD), Marie Caduto (ANR), Todd Menees (ANR), Allison Clarkson (VT House of Representatives)
- Media and Press: Phil Camp and Curt Peterson (The VT Standard)

Introduction

David Donath, President of the Woodstock Foundation, convened the Vermont Economic Resiliency Initiative (VERI) Community Forum in Woodstock and he introduced Commissioner Mackay from the Vermont Department of Housing and Community Development. Commissioner MacKay welcomed everyone and thanked people for participating in a second round of community meetings presently being held in five Vermont communities state-wide. The Commissioner explained that the community forums are examining ways to improve economic resiliency for natural disaster impacted communities in the aftermath of Tropical Storm Irene. Through the Vermont Economic Resiliency Initiative, the State will analyze risks to public infrastructure, alongside economic activity, river corridor and flood data, to better mitigate future flood hazards and to improve overall resiliency. The Commissioner provided the audience with a VERI project overview and the findings of the first two phases of the project. After her introductory remarks, the Commissioner explained that the purpose of the meeting was to collect information about risks to infrastructure and economic activity observed during Irene, subsequent risk reduction, and suggested improvements for long-term resiliency.

Overview of the Riverine Study Area

The Vermont Agency of Natural Resources has designated a river scientist to review the geomorphology, flood hazard risks, sediment deposition potential, and impacts to the built environment of select rivers and tributaries within each targeted VERI community. The scientists presented their initial findings of the river corridors at each of the community forums and provided technical assistance to the respective community throughout the meeting.

Notes

- Bear Creek Environmental has completed a baseline study of the Ottauquechee River and its tributaries. Initial studies analyzed the river geomorphology and flow dynamics. Current evaluations are identifying flood resiliency opportunities and conflicts between businesses, infrastructure and the river.
- VTrans is working with river engineers and scientists to analyze river instability which may impact the integrity of public infrastructure, including roads. There is a Roads and Rivers Training for transportation officials and contractors to address flood resiliency in road design and construction.
- The community is invited to share their priorities and concerns with the extended VERI team.

Public Input

The DHCD Commissioner solicited input from forum participants with regard to flood risk and mitigation opportunities in Woodstock. The questions posed were:

- 1) What are the hazards and risk areas in the town?
- 2) What worked structurally and what has already been done since Irene to protect infrastructure and to reduce risk to businesses?
- 3) What still needs to be addressed in the interests of long-term security and sustainability?
- 4) What information should the final report include and how should this information be presented?

Identified hazards and risks will be further analyzed in Phases 3 and 4 of VERI.

Identified Natural Disaster Hazards and Business Risks

What are the hazards and risk areas in the town?

Notes

- The Green Mountain Horse Association (GMHA) and an adjacent business flood repeatedly, although the road is reasonably unaffected. The repeated flooding results from the raising of the Morgan Hill Road bed, which created a dam on the flood plain. The increased elevation of the road caused the flooding to go above the floodproofing on the Vermont Horse Country Store building, which did not occur in the 1973 flood. Additionally, the bridge at the foot of Morgan Hill is a debris catcher, which increases back-flooding risk. Flooding from Tropical Storm Irene caused \$60,000 in physical losses and \$130,000 business loss (mixed direct and

indirect TS Irene) to GMHA. This risk may be mitigated by reducing the elevation of Morgan Hill Rd. bed by half a foot.

- Roy Bates, Irene v. Ice Jams - Compared '27 flood, to '38 flood, '73 flood and Irene
- Kedron Brook has not been adequately studied for future flood risk particularly if the waterway becomes jammed with ice or if the large trees on the bank are uprooted. If Kedron floods, it could flood Woodstock Village. The risk may be mitigated by analyzing the effects of the riparian buffer on water flow and velocity and being vigilant when the ground is saturated, as flooding could be imminent.
- Like observations for Kedron Brook, the river along Bill Emmon's Farm on Cloudland Road is lined with large trees. The property owner asked, "Can we start to log the larger trees in riparian zones so we do not have a slide?"
- Water, sewer and power Infrastructure still at risk.
- If Barnard Brook along Rte. 12 floods, it will affect more than Woodstock so there should be cooperative agreements between the affected towns to minimize risk.
- The number of propane tanks near the river is a floating debris hazard. These hazards should be moved away from river.
- Woodstock residents expressed concern over the resale of previously flooded properties.
- The flood destroyed the Elm Street water line and existing businesses couldn't operate in the village for a short period.

Effective Hazard Mitigation and Risk Reduction

What worked structurally and what has already been done since Irene to protect infrastructure and to reduce risk to businesses?

Notes

- The storms effectively inundated a series of fields above and below Woodstock including Billings Farm and the Woodstock Inn and Resort Golf Club.
- Emergency Plans were effective during Irene for those town who had them in place, practiced them in advance of a disaster, and when the emergency plan shared responsibility for implementation.
- The Town of Woodstock has upgraded culverts since Irene. Two Rivers Ottawaquechee Regional Commission (TRORC) will produce a map of where culverts have been replaced.
- Many improvements have been made to the bend in the Ottawaquechee River at foot of Billings Farm field, colloquially known as "The Jungle" in East Woodstock. Before Irene, the Town discussed re-developing "the Jungle." In Irene, the snow dump area here was lost due to

erosion, but a Community Development Block Grant Disaster Recovery (CDBG-DR) grant enabled the snow dump to be moved. The Village of Woodstock has obtained grants to make it a park, providing an economic benefit to the Town. The Town also replaced the riprap at the bend, guarding the sewer mainline to the waste water treatment facility.

- Billings Farm has planted trees along the river to reduce farm flooding, riparian buffer.
- Woodstock has a high number of senior support complexes which were hit hard because of no water and sewer. Homestead facility had a water cooled generator, now they have an air cooled generator.
- The banks gave great micro-loans and the Vermont Economic Development Authority (VEDA) was great during Tropical Storm Irene.
- Stream Alteration Engineers worked very hard.

Resiliency and Sustainability Planning

What still needs to be addressed in the interests of long-term security and sustainability?

Notes

- Electrical Systems Infrastructure:
 - o Burying the power lines will decrease electrical outages, improving local resiliency.
 - o Generators are critical to relief efforts, particularly to vulnerable populations, such as the elderly.
- Water Systems Infrastructure:
 - o The Woodstock Aqueduct Company manages the town water system and it is in need of many upgrades. The Woodstock water system is old and a risk to the village.
- Unemployment insurance for businesses:
 - o Businesses do not have special exception for laid off employees from a disaster.
 - o Adjustments the state made to reduce the cost of unemployment insurance were not enough.
- Access to capital:
 - o There were too few grants for businesses for recovery.
 - o Funding needed for debris clean up, none existed.
 - o Must make it easier for actively recovering businesses to access existing support.
 - o Communities need local foundations or funds. 'We care for our community' fund because states and federal funding will come with more strings and paperwork, which is time consuming for businesses trying to resume operations.

- Flood Insurance:
 - o Homeowners and businesses need flood insurance which help to cover business loss. These policies should be reviewed by a lawyer.
 - o Response would be better, in terms of damage, some communities have improved.
 - o The cost of insurance has increased too much and small businesses can't afford it. And without flood insurance, businesses cannot receive Hazard Mitigation Grants.
 - o Everyone needs to get elevation information for accurate insurance quotes.
- Acquisition "Buy-outs" of Risk Properties: Develop a state buyout program using conservation funds.
- River Management:
 - o The State needs more River Management Engineers to assess present risk and reserve staff for disasters/flood response.
 - o Remember tributaries of the Ottauquechee- tributary areas are risky.
- Roads: What is the town doing about Morgan Road? Reducing the road grade could have downstream affects that should be considered.
- Flood plain protection: Need to keep flooding the golf course.
- Emergency Planning:
 - o Ask businesses, even households, to have emergency plans and to do practice exercises using the plans.
 - o Better emergency management now than prior to Irene.
 - o State now has a system to track business damage.
- Continuity of Operations for Businesses:
 - o Continuity planning for businesses, now done by small business development centers

Information Sharing and Dissemination

What information should the final report include and how should this information be presented?

Notes

- Show maps of what happened, what has been done, and where we are today. Provide a geographic context.
- Who is the audience: For the town reports, the broad community within those towns, also other towns so they can replicate it.
- Need to contact other large businesses to get their input (school, inn, utilities etc.)

Next Steps and VERI Implementation

Notes

- Flood insurance reform bill
 - o VT doesn't have updated flood maps.
 - o Elevation data must be obtained privately in order to get a realistic insurance estimate.
 - o State could consider takeover of flood insurance as done in North Carolina.
- Need better mapping of Fluvial Hazard Areas, river corridor maps being released next year.
- Look more at how we can retrofit for flood resiliency.
- Additional data
 - o Water and sewer line in-stream crossings
 - o Morgan Hill Road flooding history
 - o Ray Bates study of village flood history
- Completed culvert replacements and future needs

Vermont Economic Resiliency Initiative (VERI)

Community Forum - Woodstock

MEETING NOTES

April 23, 2015 – 7:00 – 9:00 PM

VERI Project Overview

With funding from the [US Economic Development Administration](#) (EDA), the Vermont Department of Housing and Community Development, working with the Agencies of Natural Resources and Transportation and the Regional Planning Commissions, launched the Vermont Economic Resiliency Initiative (VERI) to help ensure Vermont remains open for business when disaster strikes.

VERI will help the state and local communities by evaluating local flood risk to business and infrastructure, and identify the steps communities and the state can take to minimize rebuilding and recovery costs and ensure businesses stay open – saving jobs and maintaining our economy.

For More Information

http://accd.vermont.gov/strong_communities/opportunities/planning/resiliency/VERI/Woodstock/

Summary

Twenty-two people attended – 10 project team members and 11 from the from the Woodstock area representing the town, local boards, landowners, community members and business owners. The forum showcased three overarching municipal policy and program recommendations made by Two Rivers-Ottauquechee Regional Commission (TRORC), accompanied by eight project recommendations made by Mary Nealon of Bear Creek Environmental and project-specific flood-proofing/mitigation opportunities for nine project-specific sites. Community members were given the opportunity to ask questions, provide input, and rank the proposed projects. The four projects that proved to be most popular by community and other representatives were to relocate mobile homes in flood hazard areas to higher ground, work toward Woodstock Aqueduct line improvements, improve river and road stability along Route 4, and work toward sewer pump station improvements.

Welcome and Overview

[Noelle MacKay, Commissioner of the Department of Housing and Community Development]

Commissioner MacKay began by going over the agenda for the evening and emphasized the importance of community input on the proposed flood reduction projects. Starting off with the “big picture,” Noelle said the Vermont Agency of Commerce and Community Development’s role after

Irene was post-disaster recovery and noted that while Irene impacted buildings and infrastructure, it was also a tremendous impact on the State's economy. The state applied for and received a grant from the US Economic Development Authority to help five Vermont communities build back stronger and to take steps to protect their economy from future floods.

Noelle introduced the project team members and provided background information on a successful project in [Bennington](#) that created the model for this project. She also explained the process for selecting the five towns – each with high flood risk to economic activity and infrastructure.

Woodstock was selected as a VERI pilot community for a range of reasons, including the fact that the community has a significant amount of economic activity (particularly in the tourism sector). Woodstock has been prone to commercial and infrastructural flood damage along US Route 4 and it has an engaged community with a sincere interest in floodplain protection. It was also a good fit for the project because the community has made great progress on flood resiliency planning, as evidenced by the adoption of a Local Hazard Mitigation Plan, the Ottauquechee River Corridor Management Plan and active participation in the National Flood Insurance Program.

As part of this project, a team of river scientists and engineers were hired to further assess the Ottauquechee River watershed in Woodstock and identify local threats to infrastructure and business. On the basis on this research, they made recommendations to reduce the impacts of future floods throughout the town.

The first Woodstock Community Forum was held in early October 2014 (meeting notes [here](#)), where Noelle sought input from attendees on three topics: what did they see happen during Irene, what have they done to prepare for the next flood, and what would they like state government, the Town, and other agencies and organizations to do to help the community prepare for the next flood?

The VERI team combined this information and its analysis into a draft report that contains recommended projects and town-wide policy and program options to reduce flood risks. The projects were ranked by the consultants on whether they are effective, limited, or ineffective at reducing erosion risk, flood risk, and damage to businesses, infrastructure, and property. The ease of implementation, cost, and potential partners are also factors.

Noelle stressed that this is a draft report, and that the team is eager to get comments from the public. The report will be up on the project web site until May 7th [now extended until May 12]. She believes the report can serve as a road map for the community and provide a menu of options for what can be done to help protect the community. She noted that putting these projects into the next

iteration of Woodstock's Hazard Mitigation Plan is a good way to help fund them, if they're not already addressed in the current plan. The Agency of Commerce and Community Development will work with partners to help identify funding sources once priority projects are identified.

Overview of Municipal Policies and Programs to Reduce Future Floods

[Pete Fellows, Two Rivers-Ottawaquechee Regional Commission]

Before presenting policy and program recommendations for the community, Pete first noted some of the Town's accomplishments regarding flood resiliency. Woodstock has one full-time planner on staff (who was in attendance at the forum), and he worked with him and others on a number of issues post-Irene. The town plan identifies a number of important flood and erosion hazard goals.

Both the Town and Village Woodstock have taken many steps to be eligible for 12.5% state reimbursement through the Emergency Relief and Assistance Fund (ERAF) in the event of federally declared disasters, including NFIP participation, adoption of 2013 State Road & Bridge Standards, Local Emergency Operations Plan, and a Local Hazard Mitigation Plan. As of yet, the Town has not adopted a policy that states no new development in the River Corridor or no new development in Flood Hazard areas and participation in the Federal Community Rating system (which only a few Vermont communities currently participate). Implementation of these two programs would qualify the Town for an additional 5% match through the ERAF program.

Pete then discussed specific policy and program recommendations developed by the team. Some of these recommendations are not easy, and not without controversy, and are presented to promote discussion. Three recommendations were considered high-priority by the team: prohibition of future development from Village floodway areas, making municipal infrastructure a top priority, and monitoring rebuilding/encourage floodproofing and relocation after a disaster.

Overview of Project Recommendations and Conceptual Designs

[Mary Nealon, Bear Creek Environmental, LLC]

Mary started her discussion with background on the Ottawaquechee watershed, both within and beyond Woodstock. She explained the terms floodway, floodplain, fluvial erosion hazard area and river corridor. She explained that the team identified eight specific project recommendations (with the municipal sewer upgrade projects being twofold, covering two distinct site needs). After discussing these projects, she encouraged the participants to share information on specific sites worthy of being bought out in the West Woodstock area.

Proposed projects were broken into the four categories:

- Building & Site Improvements
- Channel and Floodplain Management
- Infrastructure Improvements
- Public Safety Improvements

The following are the four top-ranked projects, as determined by voting following the forum:

Consider relocating mobile homes in hazard areas (Public Safety Improvement):

A large swath of the land upstream from the mobile home park, including the land surrounding the Lincoln Inn & Restaurant and a large portion of the Riverside Park Road, and the access road to the mobile home park, falls within the bounds of the ANR River Corridor area. Additional development in this area will be at risk of future flooding and may also worsen damage to downstream development, including the Riverside Mobile Home Park. All told, eighteen of the forty mobile homes in the park were damaged during Irene, seven of which were classed as substantially damaged properties. While one means of mitigating flood impacts to the mobile homes is to conserve a total of 75.6 acres of land along the Ottauquechee just upstream of the mobile home park through a River Corridor Easement (at a projected cost of \$106,517), a further option is to relocate the existing homes to areas outside of hazard zones. Moving them will substantially improve odds of decreased damaged in future flood events.

Improve US Route 4 river and road stability (Infrastructure Improvement):

The area along US Route 4 at the Deer Brook was damaged during Irene, leading to a loss of a travel lane along a heavily traveled corridor that residents, tourists and commercial trucks are reliant on for travel between US Route 7 and Interstate 89. Work in this area will vastly improve transportation safety and infrastructure resilience at a key confluence area along the river.

Upgrade Woodstock Aqueduct (Infrastructure Improvement):

The privately-held Woodstock Aqueduct Company sustained extensive damage to its existing water line during Irene. Following that flood disaster, the system was left with three unmet needs: a potable water temporary line package; a redundant supply line from wells on Stimets Road and VT Route 12 to the Cox District Road; and solar power back-up for wells. The projected cost for all three

projects would be an amount equal to or less than \$200,000, and could be at least partially off-set by Drinking Water Revolving Fund grant money.

Sewer pump improvements (Infrastructure Improvement):

In order to improve waste system resilience, there are two proposed projects in different areas of Woodstock: upgrading the pump station along US Route 4 and sewer line encasement work instream near Elm Street. These infrastructural enhancements will protect against environmental concerns and public health and safety, among other issues. The estimated cost for sewer line encasement upgrades is projected to be between \$100,000 and \$200,000, and may be offset with funding from FEMA's Hazard Mitigation Grant Program (HMGP). The pump station upgrades, meanwhile, are projected to cost between \$50,000 and \$100,000, and may also be funded, in part, with HMGP grant money.

Where to Get Help

[Noelle MacKay, Commissioner of the Department of Housing and Community Development]

The program and policy changes, along with the site-specific projects, are directed at the community as a whole, including town government. Following Mary's presentation, Noelle shifted the discussion to what individuals can do to address flooding.

She noted a number of case studies (available at the table beside the building entrance and online) that highlight mitigation measures on existing buildings, including historic buildings. The perception is that not much can be done to floodproof old buildings, but this isn't true. Grants for these types of projects don't commonly go to individuals, but Noelle said they will be looking into some creative funding sources for projects that involve businesses and individuals.

Noelle talked about the [Woodstock VERI web page](#), [ACCD's Flood Resiliency web page](#), and the [Flood Ready Vermont website](#). [Vermont's Small Business Development Center](#) was also mentioned, especially their disaster recovery guide for businesses. FEMA is also planning to present training on small business recovery in September, and the upcoming [Vermont downtown conference](#) will feature a session on floodproofing by engineer Bob Stevens.

Notes and Responses from the Public:

- One attendee expressed concern over the State solely concentrating mitigation efforts on flood events, despite the fact that there are numerous other natural disasters that pose significant threats to Woodstock and other communities. In response, Noelle noted that these other risks are outlined more extensively in both the state and local Hazard Mitigation Plan documents. Outlining the risks that Woodstock is most vulnerable to will ensure that the Town and Village receive prioritized funding for projects that address particular hazard issues/mitigation efforts.
- A second attendee asked if there is funding to relocate business out of flood areas. A discussion ensued regarding FEMA buy-out funding, which provides 75% of a property's value to landowners. This process requires a 25% match, which has come from the State to make property owners whole following Irene. Additional HMGP funding exists that bases relocation of commercial sites on thresholds (ex: employee-base size, location, etc.).

Project, and Policy and Program Prioritization

Sticky dots were handed out for people (six each) to place on the charts to prioritize project recommendations, and policy and program recommendations, in Woodstock. The Town's ranking of the high priority projects can help the Town advance projects. Before ending the presentation, Noelle thanked everyone for coming, especially those who participated in the VERI forum for the second time.

The results of the project prioritization and the policy and program prioritization are below, in order of popularity -

Dots	Site Number	Description
9	11	Consider relocating mobile homes in hazard areas
8	18	Upgrade Woodstock Aqueduct
5	6	Improve US Route 4 river and road stability
5	17	Upgrade Municipal Sewer (Sewer Line encasement/Pump Station)
4	11	Preserve floodplain on inside bend of Riverside Mobile Home Park
3	10	River Corridor Conservation Easement (Lincoln Inn to mobile home park)
2	2	Create floodplain across from the Bridgewater Mill Mall
2	3	US 4 general improvements
2	Municipal Policies & Programs	Floodway Village Protections in Plan/Bylaws
1	14	Floodproof Woodstock Farmers Market
1	Municipal Policies & Programs	Evacuation Plans
1	Municipal Policies & Programs	River Corridor Protections

Vermont Economic Resiliency Initiative [VERI]

Consultant Team



Fitzgerald Environmental Associates, LLC.

Applied Watershed Science & Ecology



MILONE & MACBROOM

*Engineering, Planning,
Landscape Architecture
and Environmental Science*