

# Vermont Economic Resiliency Initiative [VERI]

## Barre, 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): Barre 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.” This project, the Vermont Economic Resiliency Initiative (VERI), is designed to help meet that challenge. It is modeled after a successful project in Bennington, Vermont that minimized business interruption and saved tax payers 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 state-wide assessment, input from the team’s economic 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.

Gunners Brook in Barre City and Barre Town was selected because of the unusually high level of development adjacent to the channel, significant economic activity, and history of repeated flooding and flood damages. The communities have worked to identify and manage flood risks through adoption of floodplain regulations and hazard mitigation plans.

The team hosted two community forums, as well as smaller group meetings, and have 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 businesses and infrastructure and identified strategies and projects Barre City and Town 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 municipal policy and program recommendations and 22 site-specific projects in Barre City and Town, including the following 11 projects deemed high priority by the team.

## Municipal Policy and Program Recommendations

- **Update Policies that Currently Allow Fill in Flood Hazard Areas:** Allowing landowners to protect buildings using fill may help protect an individual property, but it can increase flood hazards to downstream property owners and reduce the land’s ability to slow and store the extra flood water. Regulations can require alternate methods to protect buildings including allowing flood waters to occupy the space beneath the structure which limits impacts to neighboring or downstream properties. Under current city bylaws, onsite filling is allowed.
- **Require Repaired and Rebuilt Structures to be Built Higher:** Owners rebuilding should raise the lowest floor two to three feet higher than the flood elevation to address the increased rainfall patterns and the actual flood heights from recent floods. Current Barre City bylaws require one foot above flood elevation and should be reviewed and considered for updates.
- **Emphasize Watershed-Wide Stormwater Planning to Reduce Flooding Impacts:** As the Barre area and neighboring communities experience growth, collaborative regulation and enhanced stormwater control measures can reduce the flooding experienced in Barre Town and City. All communities in the watershed should develop dialogue and collaborate on ways to limit stormwater run-off from development.

## High Priority Specific Project Recommendations

**Building and Site Improvements:** These are projects which lower the risk of flooding and/or erosion to specific properties through improvements to the building and/or surroundings.

- **Barre City – Floodproof Buildings from the Upper Brook Street Bridge to Stevens Branch:** Retrofits to some of the approximately 115 commercial and residential buildings located within the 100-year floodplain of Gunners Brook would reduce future flood damages when they are flooded again, reducing repair costs and ensuring businesses open quickly.

**Channel and Floodplain Improvements:** These types of projects lower the risk of flooding and/or erosion to properties along the river through the improvement of natural river and floodplain functions.

- **Barre City – Develop a Flood Resilient Design Standard for Channel Walls:** The failing channel walls that line much of Gunners Brook can be reconstructed to reduce flood risk for more than 10 businesses with 40 employees and more than 30 multi-family buildings.

- **Barre City – Remove the Now-Closed Harrington Avenue Bridge:** Removing the bridge deck could help reduce the collection of debris, but additional work to remove the bridge abutments and restore nearby floodplain would do more to reduce the flood risk for more than 10 businesses with 40 employees and more than 30 multi-family buildings
- **Barre Town and City – Develop and Implement a Debris Management Plan:** Flooding on Gunners Brook is often the result of woody debris collecting at bridges and other choke points. Better management of the debris would reduce flood risks for the 20 businesses with 188 employees and the 65 multi-family buildings in the Gunners Brook floodplain in Barre City.

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

- **Barre Town – Plainfield Brook Road: Replace Undersized Culvert:** The existing culvert is undersized and is prone to blockage that has required maintenance during past floods and could cause the road to fail, which would disrupt the flow of goods and people to and from approximately 10 businesses with 40 employees.
- **Barre Town – Plainfield Brook Road: Monitor Embankment below Ketchum Brook:** The road parallels the stream for a significant distance and there is an elevated risk of embankment failure and road damage, which would disrupt the flow of goods and people to and from approximately 10 businesses with 40 employees.
- **Barre City – Replace Undersized Bridge on Upper Brook Street:** The 1927 bridge is undersized and contributes to flooding of Farwell Street and adjacent buildings, as well as many downstream locations in the path of floodwaters before they return to the channel. If replaced, it will reduce flood risk for more than 10 businesses with 40 employees and more than 30 multi-family buildings.

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

- **Barre City – Initiate Feasibility Study to Consider Property Buyouts of High-risk Buildings Located between the Upper Brook Street Bridge and Main Street:** Working with property owners, the City should initiate a project to analyze the cost and benefits of developing a program to purchase these buildings over time. Purchasing the buildings would help reduce threats to families and businesses along this area. It will also reduce the ongoing flood risk for the nearly 20 businesses with 188 employees and approximately 55 multi-family buildings.

Two high-priority projects (property buyouts and flood resilient channel wall design) were further detailed to help Barre City and Town take the next steps and to create model project designs to help other communities learn from VERI project.

## Next Steps

As part of the ongoing community discussion regarding the VERI effort, we recommend 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 the Vermont Department of Environmental Conservation and Central Vermont Regional Planning 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.

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 Barre City and Town will require partnerships, funding and time to implement. The Agency of Commerce and Community Development, its sister agencies and the Central Vermont Regional Planning Commission are committed to help Barre City and Town 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 for Disaster Recovery

**CVRPC** – Central Vermont Regional Planning Commission

**DEC** – Vermont Department of Environmental Conservation

**DEMHS** – Vermont Division of Emergency Management and Homeland Security

**DHCD** – Vermont Department of Housing and Community Development

**EDA** – US Economic Development Administration (EDA)

**EPA** – United States Environmental Protection Agency

**ERAF** – Emergency Relief Assistance Fund

**FEMA** – Federal Emergency Management Agency

**HMGP** – Hazard Mitigation Grant Program

**NFIP** – National Flood Insurance Program

**RLP** – Repetitive Loss Property

**SFHA** – Special Flood Hazard Area

**V-DAT** – Vermont Downtown Action Team

**VERI** – Vermont Economic Resiliency Initiative

**VTrans** – Vermont Agency of Transportation

# 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.

**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.

**Tributary** – A stream that flows into another, larger stream.

# Project Overview

In May 2013, the Vermont Agency of Commerce and Community Development (ACCD) 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 Vermont's 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 avoid, minimize or reduce their flood risk and thus ensure businesses stay open and communities minimize costs.

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

VERI is led by ACCD's Department of Housing and Community Development (DHCD) in partnership with the Agency of Natural Resources (ANR), Agency of Transportation (VTtrans), and Vermont's Regional Planning Commissions, which for this study area is the Central Vermont Regional Planning Commission. Early in the process, the agencies mapped where flood hazard risks intersect with areas of economic activity and

**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.**

infrastructure. Five priority communities were selected for a detailed assessment of those risks and include: Barre City and Town, Brandon, Brattleboro, Enosburgh Town and Village, and Woodstock. A river scientist 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., were hired to analyze the river and assist in developing recommendations to reduce the vulnerability of infrastructure and businesses to flood damage.

A number of factors played a role in the selection of the five areas chosen for more detailed assessments. First, the project team ranked towns across the state by flood risk, economic activity and infrastructure at-risk. Then, the team looked at the 20 highest ranking communities and removed any that had undergone or had funding for similar analysis (i.e., Bennington and Waterbury). Next, the team strived to select five pilot communities that represented different economic profiles (i.e., 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 Barre Selected?

Barre Town and City was selected as one of the pilot communities for the following reasons:

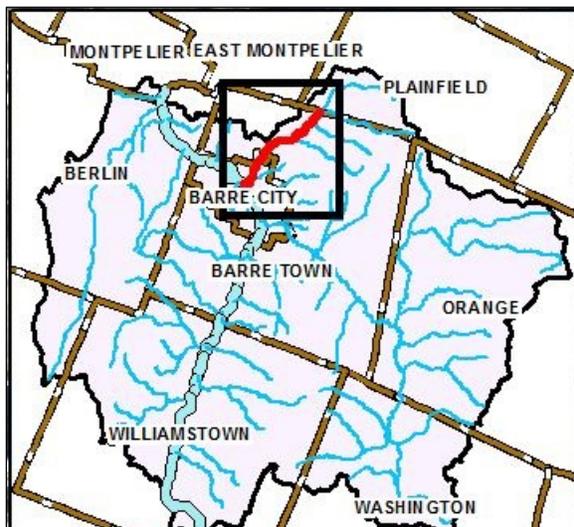
- The area has significant economic activity and it is a state-designated downtown;
- Critical transportation infrastructure was identified to be at-risk that, if closed, would impact employees and customers trying to get to businesses and the flow of goods and services;
- Numerous buildings were identified to be at-risk near the Gunners Brook;
- Barre City has a history of repeated flooding and flood damages.

## Study Area

Just over three miles of Gunners Brook are included in the VERI study area, which begins at the Barre/Plainfield town line and continues downstream through Barre City to where the brook flows into the Stevens Branch of the Winooski River. Figure 1 shows the Gunners Brook study area in red in relation to surrounding towns.

Barre Town and Barre City are located in northern central Vermont in Washington County. Barre Town covers nearly 31 square miles and lies between Plainfield and East Montpelier to the north, Berlin and Barre City to the west, Williamstown to the south, and Orange to the east. In 2010, the population of Barre Town was approximately 8,000 people (Town of Barre, 2014).

In contrast, Barre City encompasses only four square miles and is home to just over 9,000 people according to the 2010 census. It is the largest city in terms of population in Washington County and the fourth largest in the state of Vermont. It serves as a commercial and residential hub for the area (Barre City, 2014).



**Figure 1:** Map of Gunners Brook study area in red in relation to surrounding towns



**Figure 2:** Map of Gunners Brook study area in red in relation to the Stevens Branch of the Winooski River

The Gunners Brook drainage area is approximately eight square miles, including a relatively small portion in Plainfield. It is a **tributary** to the larger Stevens Branch of the Winooski River (Figure 2). The brook flows through forested, agricultural, and residential lands in Plainfield and along Plainfield Brook Road throughout most of Barre Town. A few houses and businesses are along the brook in the Town, but otherwise surrounding land is primarily forested. In Barre City, the land surrounding Gunners Brook transitions to densely developed residential and commercial area. Gunners Brook within the study area can be broken into the following zones:

- The most upstream portion in Barre Town drains forested, agricultural, and sparsely developed residential lands. Only a few houses and businesses are near the brook; the adjacent **floodplain** is primarily forested. The river valley is generally relatively wide and the channel has ample access to its floodplain. This zone has a high number of bank and slope failures and gullies (Figure 3), likely the result of unusually frequent recent flood events.
- Below Ketchum Brook in Barre Town, the valley width narrows and the brook frequently parallels Plainfield Brook Road. Bedrock outcrops hold the streambed at a vertical grade, as pictured in Figure 4.
- Toward the downstream end of Barre Town, the valley widens again and the brook has good floodplain access. A photo of this area is shown below in Figure 5. There are significant deposits of trees, smaller woody debris, and gravel in this zone. Much of this material likely originated from upstream slope and bank failures.
- In the vicinity of Hope Cemetery (the upstream part of Barre City), the river valley narrows again (Figure 6) and there is little available floodplain. The floodplain here has been filled in over the years, most notably at the former landfill that is now home to ball fields. A bedrock grade control



**Figure 3:** Slope failures are common on upper Gunners Brook in Barre Town



**Figure 4:** Bedrock keeps the brook vertically stable in Barre Town below Ketchum Brook



**Figure 5:** Good floodplain near the downstream limit of Barre Town that promotes sediment and debris deposition

is present at the downstream end of this zone, which helps keep the channel stable. In spite of a narrow valley and minimal floodplain, there is significant sediment deposition in this zone. This suggests an unnaturally high supply of upstream sediments.

- In the most downstream zone, Gunners Brook flows through the heart of Barre City. Here the brook has been extensively channelized with concrete and granite block retaining walls built to keep the channel from moving laterally (Figure 7). Residential and commercial buildings in close proximity to the channel are common with some buildings built directly on the retaining walls or even overhanging the channel.

The five bridges in this downstream zone are narrower than the natural channel, which restricts the flow of water and catches debris. The valley walls fan out as Gunners Brook joins with the Stevens Branch, and the slope of Gunners Brook becomes flatter. The existing retaining walls along the Gunners Brook prevent the channel from moving, as it would have done naturally. The management of the channel has reduced out of the channel floods from one or more per year to once every five to 10 years, on long-term average. However, when the water overflows, the channel tends to spread out, causing widespread shallow flooding that can accumulate and flow down roads at some distance from the channel. Approximately 83% of the **100-year floodplain** in Barre City (43 of 52 acres) is developed (occupied by buildings, roads, parking lots, driveways, and railroads). That is an unusually high degree of development in a location prone to frequent flooding. A map showing floodplain development is included in Appendix A. More development means higher recovery costs, safety concerns, and faster moving flood waters. Protecting the existing development and infrastructures requires a combination of upstream protection and retrofitting existing development.



**Figure 6:** Narrow valley above Barre City



**Figure 7:** Retaining walls and typical small bridge opening in the downstream portion of Barre City

**83% of the Gunners Brook 100-year floodplain in Barre City is developed, including 20 businesses, 65 multifamily homes, and many residences. This is an unusually high level of development in a location so prone to flooding.**

## Research and Outreach

The team kicked off the project in August 2014 at a meeting with staff from the Town and City to share information about flood risk reduction strategies for businesses and the recent floods along Gunners Brook. DHCD Commissioner Noelle MacKay emphasized the overall objective of helping businesses bounce back rather than break after disasters. Following this meeting, the team reviewed existing information about the City and Town, Gunners Brook, and associated community hazard planning (see table of data sources in Appendix B).

Following the kick off meeting, DHCD and the Central Vermont Regional Planning Commission (CVRPC) hosted a community Forum on October 24<sup>th</sup>, 2014 at the Aldrich Public Library in Barre City (Figure 8).

Community members, town officials, business owners and homeowners from the region attended and learned more about the background of the VERI study from DHCD Commissioner Mackay. Matt Murawski from DuBois & King provided an overview of the Gunners Brook from the relatively undeveloped channel and floodplain in the upper watershed to the channelized brook and heavily developed floodplain in the lower portion. Then, the floor was open for ideas and questions from the community members.



**Figure 8:** Barre Community Forum

At that forum, participants highlighted successfully completed and ongoing **flood resiliency** projects, including:

- Improved emergency preparedness and response planning, such as staging backhoes in problem spots and public works crews inspecting debris collection locations in advance of big storms.
- Enhanced understanding of the extent of flooding and damage based on mapping.
- Ongoing implementation of city regulations to reduce run-off and risky development.
- Improved preparedness by businesses and property owners including removal of inventory from flood-prone basements.
- Upgraded infrastructure such as Barre City stormwater system improvements with additional capacity.
- Required a City permit for any change in grade of a property.
- Improved City warning system to alert people to inspect and clean drainage infrastructure when storms are pending.

Community members identified factors contributing to flooding and risk in the study area including:

- Woody debris clogging the now-closed Harrington Avenue Bridge and causing out of bank flooding.
- Woody debris clogging and causing flooding at the North Main Street Bridge.
- Dumping of fill into the floodplain near the Hope Cemetery.
- Failing retaining walls along the channel throughout Barre City.
- Clogging of stormwater system due to leaves raked into the streets and streams.
- Filling of stream channels and associated loss of fish habitat (Sterling Hill Brook in south Barre cited as example).
- Run-off from rural roads carrying extra sediment into the rivers.

There were numerous suggestions from the community on potential projects and ideas to improve public safety and reduce future flood risks:

- Install trash racks upstream to capture debris before they get to Barre City bridges.
- Establish a grant or loan program to help repair the retaining walls along the Gunners Brook.
- Remove waste granite dumped in river.
- Work to increase channel and floodplain capacity.
- Expand cooperation with upstream neighbors like Barre Town, Plainfield and Williamstown.
- Schedule biannual river inspections with state river engineers and other regulatory partners.
- Increase floodwater storage capacity upstream of and within the City.
- Develop policies to manage the salt/snow/sand mixture on the roads and snow storage.
- Provide individual landowner education (how to reduce run-off, the risks of putting woody debris or vegetation in the waterway, impacts of snow pack being pushed into the river, etc.).
- Establish a local fund to help businesses recover after storm events (i.e., revolving loan funds).
- Create a regional stormwater management district, mirroring the structure of solid waste districts.
- Develop a buyout program to purchase threatened properties along Gunners Brook- roughly 30-40 properties.

The river scientists on the team also completed field surveys and walked the length of Gunners Brook from the Plainfield Town line to its mouth at the Stevens Branch of the Winooski River to observe current conditions of the river and floodplain and near-by development, and to identify opportunities to reduce flood risks. Team members along with participants from the Town, City, and CVRPC visited a number of Gunners Brook sites in Barre City. Local community insight gained at the community forum helped guide this fieldwork. The team visited the watershed on several occasions between August and December, 2014 and made the following observations:

- Locations and dimensions of bank **erosion** and riprap
- Conditions of retaining walls
- Locations of significant wood debris accumulation in the channel
- Bridge and **culvert** dimensions and conditions
- **Riparian buffer** conditions
- Areas of severe river channel instability

A second community forum occurred on April 16, 2015. At this meeting, community members provided feedback and helped prioritize the projects the team identified to protect businesses and infrastructure.

Input gathered at the workshops and meetings, along with the research completed by the VERI team were used to develop the recommendations to help the community prepare for, manage, and decrease risk, and reduce the economic costs of future losses due to flooding. In the sections that follow, the team has outlined specific projects as well as plan and bylaw updates that can help ensure businesses remain open and infrastructure continues to function. Estimated costs, funding sources and impacts associated with recommended projects are included.

## Flood History and Town Accomplishments

Barre City and Town have experienced severe property and infrastructure damage from flooding along the Gunners Brook since the 1920s. With input from the CVRPC and the community, the team has identified key flood risks in the region.

### Flood History and Risks

The Gunners Brook has flooded Barre City and Town numerous times in the past century. One of the most severe accounts was the Flood of 1927 that caused the worst flood damages on record throughout much of Central

Vermont. A photo of Barre City during the 1927 flood is shown above in Figure 9. Another major flood event occurred in 1973, though did not impact Barre to the degree of the 1927 flood.

Since then, damage from flooding, **flash flooding**, tropical storms, and hurricanes was recorded on eight occasions within a period of twenty years in Barre City and Barre Town. The most damaging of these events were the flash floods that occurred in July 2007 and May 2011.



**Figure 9:** Flooding of Main Street in Barre City during the Flood of 1927. Photo from <http://barrequest.com/27-flood-bonus/>



**Figure 10:** The Bates and Murray building in Barre Town was flooded in May 2011

In July 2007, four to six inches of rain fell over Barre within 24 hours. Barre Town experienced widespread damage to roads and infrastructure totaling over \$690,000. Much of this damage cost was due to culvert and road washouts (Town of Barre, 2012). In Barre City, the 2007 flood left two to five feet of water in parts of the City. This inundation caused a loss of access to the City's emergency facilities, and prevented emergency vehicles from responding to calls (City of Barre, 2012).

In May of 2011, flash flooding caused damage at many of the same locations in Barre Town that were damaged in 2007. Culverts and roads washed out, and flooding was noted in basements and storage sheds along Route 14. Damages in Barre Town totaled upwards of \$300,000 for the 2011 storm (Town of Barre, 2012). Within the VERI study area, only one commercial business – Bates and Murray Inc., at 103 Plainfield Road was damaged (Figure 10).

Downstream in Barre City, damages from the May 2011 flood were widespread. Water was over five feet in some places, and damage to roads, buildings, and other infrastructure exceeded one million dollars (City of Barre, 2012). Flooding from Stevens Branch, in addition to Gunners Brook, contributed to the damage in the lower portion of Gunners Brook. CVRPC catalogued and mapped Barre City flood damages following this flood (Appendix C). The damage included multiple locations of road damage and sediment deposition (Figure 11), flooding of houses, businesses, and roads, damaged stormwater infrastructure, and collapse of some streambank retaining walls. Debris clogging at bridges (Figure 12) contributed significantly to the flooding by forcing water to spill out of the channel.



**Figure 11:** Road damage and sediment deposits following the May 2011 Flood



**Figure 12:** Debris at bridges compounded the May 2011 Flood

Tropical Storm Irene in August 2011, which caused devastation to many communities in central and southern Vermont, was not particularly significant in Barre Town and Barre City. Damage from Tropical Storm Irene in Barre Town totaled only \$15,000, and Barre City recorded minimal flooding in its floodprone areas (Town of Barre, 2012).

Analysis identified 20 at-risk businesses and 65 at-risk multi-family residences located within the Gunners Brook 100-year floodplain in Barre City (Table 1 and Appendix D). This analysis was not conducted for Barre Town because there is no mapped **floodway** or 100-year flood hazard zone for Gunners Brook and development in this area of the brook is limited.

Table 1 below provides a breakdown of the number of businesses and employees that work in the buildings within these three flood/erosion hazard zones. These data only show if buildings are within the boundaries of the floodplain and do not show the elevation of the building relative to the floodplain elevation. Single and multi-family rental properties are also included because they are income-producing and damage to them has a significant potential to disrupt business and impact people getting to work.

	<b>Floodway</b>	<b>100-year Floodplain</b>	<b>State River Corridor</b>
Number of Businesses	11	20	9
Number of Employees	101	188	56
Single-Family Residences	14	30	25
Multi-Family Residences	28	65	45

Along Gunners Brook, two properties are designated as Repetitive Loss Properties (RLPs) by the Federal Emergency Management Agency (FEMA). A RLP is any building for which two or more insurance claims greater than \$1,000 were paid in a 10 year period. These properties are located on Harrington Avenue, directly to the east of Gunners Brook (FEMA, 2013).

## City and Town Accomplishments

Barre Town and Barre City have worked hard developing and implementing projects to reduce the risk of flooding to local businesses, infrastructure, and residences – including adopting floodplain regulations and preparing local **hazard mitigation plans** that address community flood risks.

### *Floodplain Regulations*

Barre Town has adopted regulations that exceed the minimum **National Flood Insurance Program (NFIP)** guidelines. The City of Barre has enacted similar zoning regulations to protect the community from future flood damage and losses. Zoning regulations that both Barre Town and Barre City have adopted include:

- All new buildings built within the FEMA 100-year floodplain (outside of the floodway) must have lowest floor elevations (including the basement) constructed at least 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 allow for the entry and exit of floodwaters.

### **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 floodplain shown on FEMA maps.

### **What is the State River Corridor?**

The River Corridor is the area mapped by the State of Vermont adjacent to rivers and streams that are often at higher risk of erosion and/or flooding.

Barre City has also enacted regulations that go above the minimum NFIP guidelines for new and substantially improved manufactured homes, storage of hazardous materials in the **special flood hazard area** (SFHA), and the construction of accessory buildings. New FEMA floodplain maps adopted in 2014 puts additional restrictions on existing development close to the Gunners Brook and largely prohibits any new development. Barre City and Barre Town were involved in the assessment and writing of the Stevens Branch River Corridor Management Plan that included recommendations to help maintain or restore the natural condition and function of the river corridors (Friends of the Winooski River, et. al., 2009) and these recommendations were reviewed as part of the VERI project.

### *Local Hazard Mitigation Plans*

Barre Town and Barre City wrote local hazard mitigation plans in 2012 to identify specific goals for the reduction of community flood risks. The Town increased the size of culverts damaged in the May 2011 flood, which reduced subsequent damages from Tropical Storm Irene. Barre Town outlined goals in its hazard mitigation plan to continue to upgrade undersized culverts and adopt policies to reduce stormwater run-off and minimize the impacts of future floods (Town of Barre, 2012). Barre City has also outlined specific flood **mitigation** goals to improve stormwater management and infrastructure, replace problematic culverts, and adopt road and bridge standards and floodproof buildings on Main Street (City of Barre, 2012).

### *Vermont- Downtown Action Teams (V-DAT)*

With funding from a Community Development Block Grant for Disaster Recovery (CDBG-DR), the DHCD hired a team of experts in community design and economic development and partnered with eight communities, including Barre City, to help speed recovery from Tropical Storm Irene. The Vermont-Downtown Action Teams (V-DAT) team visited Barre on a number of occasions to gather input, develop projects and build consensus on the recommendations. The final reports included short, mid and long-term recommendations to support local economic development efforts. Barre's complete report and supporting documents are available on DHCD's website ([http://accd.vermont.gov/strong\\_communities/opportunities/revitalization/vdat](http://accd.vermont.gov/strong_communities/opportunities/revitalization/vdat)). A one-page visual summary of the top recommendations is included in Appendix E. Several of the V-DAT recommendations have been completed in Barre, including:

- Implemented a consistent branding and marketing program including the installation of downtown banners, development of shopping and dining guidebook, and branding of downtown events;
- Upgraded buildings and two storefronts; and
- Broke ground on a multi-million dollar project to improve Enterprise Alley in Barre City.

# Strategies and Projects to Protect Barre

The team developed a list of recommended strategies and projects to protect Barre Town and Barre City's businesses and infrastructure during future floods. Based on data collection and analysis, review of previous reports and community input, the team developed a list of flood mitigation objectives for Gunners Brook to address specific flood damages. These objectives include:

1. Reduce flood risks in the densely developed Barre City;
2. Keep major roadways open during floods; and
3. Protect businesses and residences from flooding and erosion.

Strategy and project recommendations are summarized below, including municipal policy and program suggestions first, followed by site-specific project options.

## 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 Barre City and Town'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 check list review found that Barre City currently employs 10 of 56 items on the checklist including the discussion of strategies to determine whether to relocate structures that have been repeatedly flooded (Appendix F). Barre Town currently employs 17 of 56 items on the checklist including the implementation of non-regulatory strategies to conserve land in river corridors through easements, buyouts, and the transfer of development rights (Appendix F).

The results of both reviews identified 17 planning or policy opportunities in Barre City and 19 in Barre Town that were then organized into four groups: Regulations, Community Planning, Emergency Planning, and Education and Outreach. The distribution of opportunities to improve policy and program is show in Table 2.

<b>Category</b>	<b>Description/Overview</b>	<b>Barre City Policies or Programs</b>	<b>Barre Town Policies or Program</b>
Land Use Regulations	Avoid and minimize land use conflicts around watershed resources that help lower the risk of flooding and/or erosion to properties	5	6
Community Planning	Develop long term goals, recommendations and budgets to improve flood resilience	4	5
Emergency Planning	Specific projects for supporting mitigation and recovery actions for flooding and other hazards	5	5
Education and Outreach	Programs targeted at critical businesses and vulnerable populations to educate them about flood risk, mitigation and recovery	3	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 G.

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

- **Update policies allowing fill in flood hazard areas:** Allowing landowners to protect buildings using fill may help protect an individual property, but it can increase flood hazards to downstream property owners and reduce the land’s ability to slow and store the extra flood water. Regulations can require alternate methods to protect buildings including allowing flood waters to occupy the space beneath the structure, which limits impacts to neighboring or downstream properties. Under current city bylaws, onsite filling is allowed.
- **Require repaired and rebuilt structures to be built higher:** Owners rebuilding should raise the lowest floor two to three feet higher than the flood elevation to address the increased rainfall patterns and the actual flood heights from recent floods. Current city bylaws require one foot above flood elevation and should be reviewed and considered for updates.

- **Emphasize watershed-wide stormwater planning to reduce flooding impacts:** As the Barre area and neighboring communities experience growth, collaborative regulation and enhanced stormwater control measures can reduce the flooding experienced in Barre Town and City. All communities in the watershed should develop dialogue and collaborate on ways to limit stormwater run-off from development.

Local stakeholders (residents, businesses, planning commission, Selectboard, etc.) are encouraged to review these recommendations and seek assistance from the identified partners and programs and take these steps to reduce flood risk over time.

### *Emergency Relief Assistance Fund (ERAF)*

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 could receive as a match to federal aid for post-disaster recovery. Certain damage costs from federally declared disasters are reimbursed 75% by federal money. The State of Vermont contributes an additional 7.5% of the total cost, but will increase that up to 17.5% if towns adopt certain plans, policies, and programs to reduce the risk of floods (State of Vermont, 2015). Currently, Barre Town and Barre City qualify for 12.5% and 7.5% in state aid, respectively and Table 3 summarizes the ERAF ratings.

<b>Table 3: How Barre Town and City Met its ERAF Match</b>		
<b>Town</b>	<b>Barre Town</b>	<b>Barre City</b>
<b>Steps to increase State aid to 12.5%</b>		
Participation in the National Flood Insurance Program	Yes	Yes
Adoption of 2013 State Road & Bridge Standards	Yes	No
Adoption of Local Emergency Operations Plan	Yes	Yes
Adoption of Local Hazard Mitigation Plan	Yes	Yes
<b>Steps to increase State aid to 17.5% (need one to qualify)</b>		
Adopt no new development in a River Corridor	No	No
Adoption of a River Corridor or Flood Hazard Protection areas and Participation in the Federal <b>Community Rating System</b> Program	No	No
<b>ERAF Match</b>	<b>12.5%</b>	<b>7.5%</b>

In order to maximize state and federal funding after a federally declared disaster, Barre City and Town should review Table 3 and consider implementing those steps not currently in place in the municipality. CVRPC, the Vermont Division of Emergency Management and Homeland Security (DEMHS) and VTrans can help with these suggested updates.

## Specific Project Recommendations

The team identified a number of projects to protect businesses and infrastructure within the study area based on the objectives above, field data collection, review of flood history and stakeholder input. The specific projects identified are presented in the maps and tables located in Appendix H. High priority projects are described below, and conceptual designs for some are presented in the following section.

The projects fall into the four primary categories shown in Table 4.

<b>Category</b>	<b>Description</b>	<b>Number of Projects</b>
Building and Site Improvements	Improvements to buildings and/or surroundings including relocating heating and electrical systems out of basements and improving onsite drainage	2
Channel and Floodplain Management	Improvements to river and floodplain function, which may include physical measures such as planting trees to stabilize river bank and non-structural measures such as Town or City regulations or policies.	6
Infrastructure Improvements	Upgrades of roads, stream crossings, and utilities to more flood resilient design standards	10
Public Safety Improvements	Avoidance of future risk including the purchase of buildings at high risk to future floods	4

The priority of each project was based on the project's effectiveness in addressing each of 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.

Each project received a score of one (ineffective), three (limited), or five (effective) for the each objective. The three scores were added to provide a total score, which was then weighted based on the economic benefits of the project. Projects that would have regional or Town-wide or City-wide economic benefits were weighted higher than those that would offer more limited economic benefit (e.g., benefits a single business).

Project partners and stakeholders, including representatives from DHCD, ANR, CVRPC, and the City and Town of Barre, 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. Below are brief descriptions of the high priority projects from each of the project categories described in Table 4. A summary of efforts to develop conceptual designs for two of the high priority projects follows, with additional supporting information provided in Appendices I and J.

## *Building and Site Improvements*

**Floodproof Buildings from the Upper Brook Street Bridge to Stevens Branch:** There are approximately 115 commercial and residential buildings located within the 100-year floodplain of Gunners Brook, and many are at-risk of damage due to flooding ranging from water in the basement, to flooding of first floor living space, to building damage and collapse due to flowing water. While selection of a specific floodproofing strategy is building specific, several are widely applicable in the Gunners Brook floodplain:

- **Elevate buildings:** For buildings prone to first floor flooding, raising the structure (by temporarily jacking it up and replacing it on top of an elevated foundation) can reduce flood damages. Utilities such as furnaces and electrical panels are also relocated to a higher floor, above the flood elevation, as part of the project.
- **Fill in Basements:** Filling basements with clean fill material, along with the relocation of utilities to higher floors above the flood elevation, can also reduce damages and save money.
- **Dry floodproofing:** When elevation is not possible or feasible walls can be made watertight. Openings are in-filled and the walls and floors covered with waterproof materials. Typically the foundation and walls must be strengthened to withstand pressure and energy of the water on the building. This approach likely has limited applicability due to the age and construction methods of many buildings in the floodplain. However, it may be suitable for heavy masonry buildings constructed of block, brick or reinforced concrete.
- **Wet floodproofing:** This option is used in situations where elevation and dry floodproofing are not viable. Floodwaters are allowed into the building with combination of flood vents/openings. Durable building materials that can withstand water, mud, and other pollutants are installed and cleaned up after the flood. This, along with the relocation of furnaces and electrical panels out of harm's way, can reduce losses and recovery costs.
- **Retrofitting flood vents in outbuildings:** Particularly in buildings with limited use, installing flood vents that allow water to readily enter and exit the structure can significantly reduce flood damages.

The cost of floodproofing varies widely depending on the specific approach selected. Addition of flood vents on outbuildings could be completed for less than \$1,000, while raising a structure and utilities is considerably more expensive.

These approaches are among the requirements of the City's flood hazard area regulations for new construction or when a building is "substantially" improved or repaired, meaning the improvement or repair cost is 50% or more of the value of the building. While not required for less than "substantial" improvement or repair, the FEMA Hazard Mitigation Grant Program (HMGP) can help offset these initial costs and reduced future flood insurance premiums.

## *Channel and Floodplain Management*

**Barre City – Develop a Flood Resilient Design Standard for Channel Walls:** Nearly the entire length of Gunners Brook in Barre City is walled. Developing a plan to build a wider channel with at least one bank slope where debris can collect would help reduce flooding and property damages for more than 10 businesses with 40 employees and for more than 30 multi-family buildings. It would require property owners to give up some land to the brook, but incremental progress toward a larger, safer channel would reduce flood risk over time and may even qualify for grant funding. The new channel design would be developed in coordination with property owners, the City, ANR river engineers and federal regulators. The cost of the design would range from \$10,000 to \$50,000 depending on the degree of analysis and detail. Implementation of the upgrade could happen over many years at a cost of greater than \$200,000. The FEMA Hazard Mitigation Program is a potential source of funding. A conceptual design is presented in the next section of the report.

**Barre City – Remove the Now-Closed Harrington Avenue Bridge:** The Harrington Avenue Bridge span is narrow, catches debris and has contributed to four floods since 1998. Each flood impacted businesses, municipal infrastructure, and residences, and each required public and private funds to recover. The bridge was heavily damaged in the May 2011 flood and is now closed to traffic. Removing the bridge deck could reduce the risk of debris collection and associated flooding; however, a more comprehensive project to consider includes removal of some of the channel walls and restoring a floodplain on the left bank (looking downstream). This would both lower flood levels and provide a location for woody debris to collect before reaching the next downstream bridge. The latter approach is more costly and may require easements. This project would help keep roads open and reduce flood risk for more than 10 businesses with 40 employees and more than 30 multi-family buildings. The cost of the project is expected to range from \$50,000 to \$100,000. FEMA Hazard Mitigation Grant Program is a potential source of funding.

**Barre Town and City – Develop and Implement a Debris Management Plan:** The flooding on Gunners Brook is often the result of woody debris collecting at bridges and other choke points. Numerous upstream landslides have created a large supply of wood that will continue to increase flood risk to Barre City. Developing a state-approved Management Plan that provides specific direction to public works staff would allow more efficient and active reduction of this risk. Improved management of debris would reduce flood risks for the 20 businesses with 188 employees and the 65 multi-family buildings in the Gunners Brook floodplain in Barre City. Developing this plan would cost \$10,000 to \$50,000. The FEMA Hazard Mitigation Program is a potential source of funding.

## *Infrastructure Improvements*

### **Barre Town – Plainfield Brook Road**

Plainfield Brook Road is the primary north-south route for Barre Town (and beyond) and Barre City. The suggested projects below will help keep Plainfield Brook Road open during a flood and thereby maintain the flow of goods and people between Barre City and Barre Town.

**Barre Town – Replace Undersized Culvert:** The existing corrugated metal culvert is undersized (approximately 40% of channel width) and is prone to blockage that has required maintenance during past floods and could cause the Plainfield Brook Road to wash out. The cost to increase the size of this culvert would range from \$100,000 to \$200,000. VTrans Structures Grant is a potential source of funding.

**Barre Town – Monitor Embankment below Ketchum Brook:** Because the road parallels the stream for a significant distance, there is an elevated risk of embankment failure and road damage. While bedrock on the channel bottom helps stabilize the embankment, its long-term stability is uncertain. Procedures should be adopted to visually inspect the embankment following significant storm events. Monitoring and proactive repairs can ensure the road remains open during a flood and avoids more costly repairs.

**Barre City – Replace Undersized Bridge on Upper Brook Street:** The Bridge was constructed in 1927. The opening is undersized and contributes to flooding on Farwell Street and adjacent buildings as well as many downstream locations in the path of floodwaters before they return to the channel. If replaced it will reduce flood risk for more than 10 businesses with 40 employees and more than 30 multi-family buildings. The cost to replace this bridge is greater than \$200,000. A VTrans Structures Grants and FEMA Hazard Mitigation Grant Program are potential funding sources.

## *Public Safety Improvements*

### **Barre City – Feasibility Study to Consider Property Buyouts of High-Risk Buildings**

**Located between the Upper Brook Street Bridge and Main Street:** Working with property owners, the City should initiate a project to analyze the cost and benefits of developing a program to purchase these buildings over time. Purchasing the buildings would help reduce threats to families and business along this area. Restoring floodplain along this area would help reduce downstream flooding and allow public access to the brook. The cost of the buyouts would be greater than \$1,000,000 and would include the purchase of the properties, demolition of the buildings, reshaping of the floodplain, creating public open space and the associated legal and administrative fees. The FEMA Hazard Mitigation Grant Program is potential source of funding. A conceptual design is included in the next section of the report.

## Conceptual Project Designs to Protect Barre

Using community input and the team’s professional judgment of priority flood mitigation projects, two projects were selected to advance to the conceptual design stage. These projects include developing a flood resilient channel wall design standard and the relocation of the most at-risk buildings between upper Brook Street Bridge and Main Street. The conceptual designs require additional design and engineering work to advance toward implementation. Should the community wish to advance the projects, the designs include sufficient detail to include as part of grant applications.

### Develop Flood Resilient Channel Wall Design Standard

#### *Overview and Objectives*

Nearly the entire length of Gunners Brook in Barre City has been walled for many years and currently are failing in many locations (Figure 13). The walls belong to the adjacent landowner, and unless the walls are integral to a bridge or other infrastructure, the City does not take responsibility for maintaining them. Collapse of the walls into the channel leads to unpredictable erosion and loss of land that may threaten adjacent buildings. In extreme cases, the presence of fallen wall rocks in the channel may reduce flood capacity, as well as lead to collection of woody debris.



**Figure 13:** Failing walls typical in Barre City

Landowners interested in reconstructing their walls must receive a state stream alteration permit from the Agency of Natural Resources and are generally permitted to reconstruct walls provided they are built no closer to the channel and no higher than the original walls. The owners are responsible for designing and permitting any wall repair and must cover the full cost of design and construction of the repairs. Currently no public funds are available to help cover these costs.

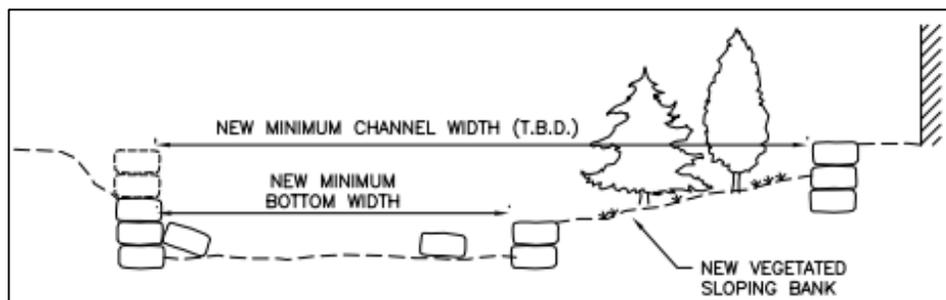
The “Flood Resilient Wall Design Standard” would create a wider channel with at least one bank slope where debris can collect and help reduce property damages and culvert failures. It would require property owners to give up some land to the brook, but incremental progress toward a larger, safer channel would reduce flood risk over time and may qualify for grant funding. The new channel design would be developed in coordination property owners, the City, ANR river engineers and federal regulators.

## Data Analysis and Results

Components of a successful flood resilient wall design standard would include:

- Increased size to provide more flow capacity than was provided with the original walls. This would be accomplished by specifying minimum channel bottom and top widths that are at least as wide as the original walls and wider if possible.
- Designed to provide opportunities for trees and floating debris to collect on the channel margins to reduce the potential for debris clogging within the channel and at bridge openings. This would mean creating a floodplain on at least one bank, which may in many cases require owners return some land to the brook to reduce their flood risks. The floodplain would be vegetated.
- Designed to provide effective transport of sediment so that there is neither excessive scour nor deposition in the channel, and it remains stable in the long-term. Based on field observations of both relatively stable and unstable portions of the channel, a channel bottom width of approximately 20 feet and a vegetated sloping bank on at least one side appears to provide the desired channel stability.

A schematic of an initial design concept for the flood resilient walls is shown in Figure 14. Additional detail is included in Appendix J.



**Figure 14:** Drawing of flood resilient channel concept

The team conducted a hydraulic analysis of the brook using the computer program on which the FEMA Flood Insurance Study is based to evaluate the hydraulic benefits of larger channel dimensions. In general, the degree of channel enlargement possible given the presence of existing buildings and infrastructure will only provide a modest reduction in flood levels.

The more significant benefit of the conceptual design is the potential for debris collection on the restored floodplain. The flood history of Gunners Brook indicates that flooding frequently occurs because of the debris that catches at the bridges. Without debris, the channel could otherwise pass the flood flows; however, the vertical walls lining the existing channel provides no opportunity for the debris to deposit, and it is instead transported downstream where it can jam at the bridges. Even a small area of restored floodplain as part of a new wall design standard would help reduced velocity and provide an opportunity for debris to settle out for easy removal after the flood. That in turn

reduces flooding at bridges and other known choke points that impacts businesses, City roads, and homes.

### *Steps for Project Implementation*

The City should pursue the design and regulatory approval of a flood resilient channel design. Development of the standard would include all or most of the following:

- Inventory and mapping of existing walls.
- Hydraulic and geomorphic justification for standard wall design(s).
- Engineering drawings for standard design (two to three variations to be applied depending on the specific location and space constraints).
- City-wide plan showing preferred locations for design variations.
- Coordination with regulators and regulatory approval.
- Pursuit of grant funding for implementation.

The cost of developing an approved design standard is expected to range from \$10,000 to \$50,000 depending on the degree of analysis and level of detail included in the plan and the level of effort invested in pursuing grant funding for implementation. Implementation of the plan would likely be done over the course of many years at a cost of greater than \$200,000.

### *Project Benefits*

Implementation of a flood resilient channel design would reduce flood risk and flood damages throughout the Gunners Brook floodplain, including the 20 businesses with 188 employees and the 65 multi-family buildings. It would also reduce flooding of City streets and the associated repair and cleanup costs.

## **Purchase the Most At-risk Buildings between Upper Brook Street Bridge and Main Street**

### *Project Overview and Objectives*

Purchasing and removing the most at-risk buildings would prevent repeated damages and allow the floodplain to be restored to promote deposition of woody debris in the floodplain instead of at bridge openings. A buyout program for these properties has the obvious effect of eliminating potential for future damages, but would also provide space that could be used to restore a channel and natural floodplain that reduces the frequency of out-of-bank flooding and provides locations other than bridges for debris to collect. The restored floodplain could conceivably also serve as a park.

It is worth noting that many of the buildings that would be candidates for buyouts are located within the 2014 update of the mapped FEMA Floodway. This floodway designation brings new restrictions

on repairs and improvements to the buildings, markedly higher flood insurance premiums and a likelihood of reduced marketability due in part to those higher premiums.

Buyouts are frequently funded by FEMA Hazard Mitigation Grant Program. General elements of the buyout program include:

- A municipality applies for the funding.
- Buyouts are voluntary.
- The community sponsors a buyout project on behalf of the property owner.
- 75 % of the buyout project is funded by FEMA.
- Buyout property must remain as open space.
- Communities can offer the property owner up to the fair market value of the structure pre-disaster.

### *Data Analysis and Results*

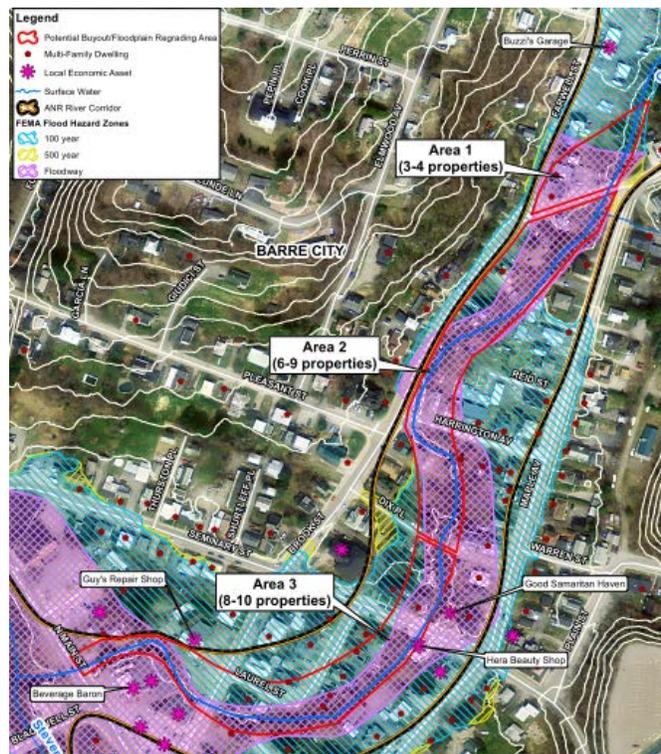
Potential buyouts in the Gunners Brook study area have been identified in three adjacent zones between upper Brook Street Bridge and Main Street, as described below and shown in Figure 15. A larger scale map of the potential buyout areas is included in Appendix K.

#### **Area 1: Three to four at-risk buildings on right bank above upper Brook Street Bridge**

Purchasing and removing buildings in this upstream zone would provide an important location for debris collection upstream of the major areas of development. It would also allow portions of Brook Street to be raised to keep floodwaters off it, which cannot currently be done without negatively impacting the existing buildings.

#### **Area 2: Six to nine of the most at-risk buildings between upper Brook Street Bridge and Dix Place**

In this zone, the buildings on the right bank (looking downstream) are generally subject to the greatest flood depths and speeds. Purchasing and removing them would allow restoration of the floodplain to promote deposition of woody debris in this zone instead of at bridge openings. It would also help reduce the amount of flood waters flowing down Brook Street.



**Figure 15:** Three areas outlined in red identified for possible property buyouts

### **Area 3: Eight to ten of the most at-risk buildings between Dix Place and Main Street**

Properties in this downstream zone are subject to flooding from both Gunners Brook and from Stevens Branch. In combination with buyouts in the two upstream zones, floodplain restoration in this area would help create a largely unobstructed floodway throughout the City.

#### ***Steps to Project Implementation***

The team recommends that the City further study the feasibility of property buyouts. The study would include identification of specific buildings and an evaluation of the pros and cons including direct and indirect flood damage reductions, impact on housing stock, cost, and funding sources. Robust public participation, meetings with individual property owners and smaller neighborhood meetings are a critical part of the evaluation because these buyouts represent peoples' lives, history, family memories and neighborhood cohesion.

#### ***Project Benefits***

This project would eliminate the risk of flood damage to the removed buildings, which are likely to include at least one business and on the order of 10 single and multifamily buildings. The project would reduce the flood risk for the remaining properties in the floodplain, which include nearly 20 businesses with 188 employees and approximately 55 multi-family buildings.

## Next Steps

On April 16, 2015 the team hosted the second community forum to share the list of policy and project recommendations to decrease flood risk for Barre Town and Barre City. At the forum, community members asked questions, provided input and helped rank the proposed list of priority recommendations (see Appendix L).

The projects with the most support included replacing the undersized bridge on Upper Brook Street, considering voluntary buy-outs for the most at-risk buildings between Upper Brook Street and Dix Place and removing the Harrington Avenue Bridge. Top polices included the development of a debris management plan, updated polices regarding filling land in the floodplain and creating watershed-wide stormwater management plans.

The tables included in Appendix G and I provide a comprehensive list of high priority projects for Barre Town and City to further discuss, explore and advance as resources permit. The conceptual designs summarized in the section above and in Appendices J and K 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, we recommend 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;

On the evening of July 19, 2015, as much as six inches of rain fell on parts of central Vermont causing serious flash flooding and damage to 80 homes and apartments along Gunners Brook. While touring the damage in the Harrington Avenue neighborhood, Governor Shumlin and Barre's Mayor Thom Lauzon noted VERI's recommendations to reduce flood impacts with a long-term strategy to buyout homes and restore floodplains along the brook. The Governor said, "Implementing the recommendations could give water, mud and debris more space to spill, reducing the impacts on homes and businesses." He also noted that this areas was affected by similar flooding in 2011 and that carrying out these changes would help break the cycle of repetitive loss. The Vermont Division of Emergency Management and Homeland Security collected damage information from communities impacted and determined there was not enough damage to qualify for federal disaster aid. While Vermont businesses and homeowners have access to state flood assistance programs, there was no program to help repair flood damaged rental properties. Mayor Lauzon noted that "Many of these properties will require significant repairs and clean-up in order to put them back to pre-flood condition." For this reason, the Mayor worked closely with the Governor and the Vermont Economic Development Authority (VEDA) to create a new loan program to fill this gap, help the neighborhood recover and provide the community the time it needs to develop a long-term solution.

- Prioritize one to two projects to pursue each year with assistance from the Vermont Department of Environmental Conservation (DEC) and CVRPC 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.

The City and Town of Barre, its businesses and homeowners are not alone in implementing the recommendations outlined in this report. For example, the CVRPC 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](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](http://www.floodready.vermont.gov) can help support these efforts. The State’s Hazard Mitigation Grant Program <http://vem.vermont.gov/mitigation> can help implement projects within Barre Town and City’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. 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 Campany, 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, 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). Buildings located in a 100-year floodplain have 1% chance of being flooded every year. Over a 30 year period (length of most home mortgages), there is a 26% chance of a 100-year flood.

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.
- 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](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](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](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](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.

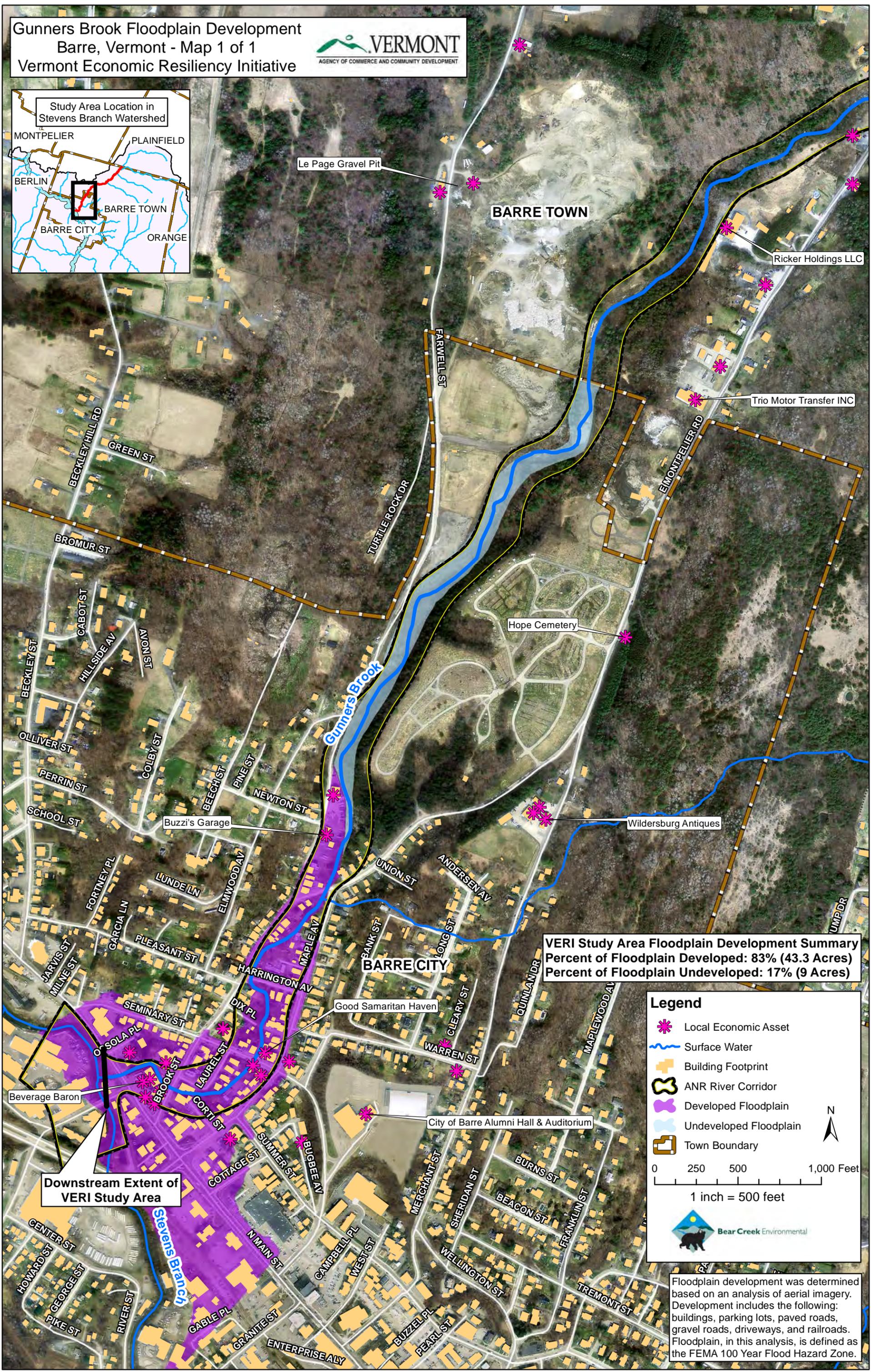
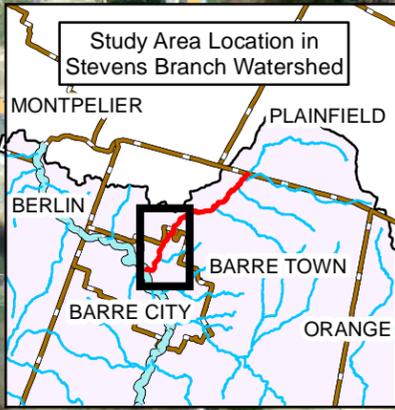
The US Small Business Administration <https://www.sba.gov/content/disaster-preparedness> offers more detailed information on how to prepare and protect your employees and business and from disasters and floods.

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**Appendix A:**  
**Map of Gunners Brook Floodplain Development**

**Gunners Brook Floodplain Development**  
**Barre, Vermont - Map 1 of 1**  
**Vermont Economic Resiliency Initiative**



**VERI Study Area Floodplain Development Summary**  
 Percent of Floodplain Developed: 83% (43.3 Acres)  
 Percent of Floodplain Undeveloped: 17% (9 Acres)

**Legend**

- Local Economic Asset
- Surface Water
- Building Footprint
- ANR River Corridor
- Developed Floodplain
- Undeveloped Floodplain
- Town Boundary

0 250 500 1,000 Feet

1 inch = 500 feet

N

Bear Creek Environmental

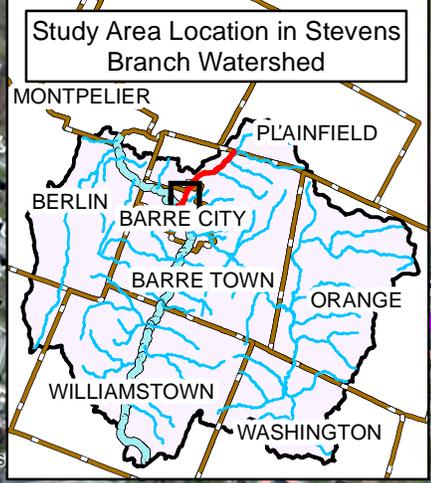
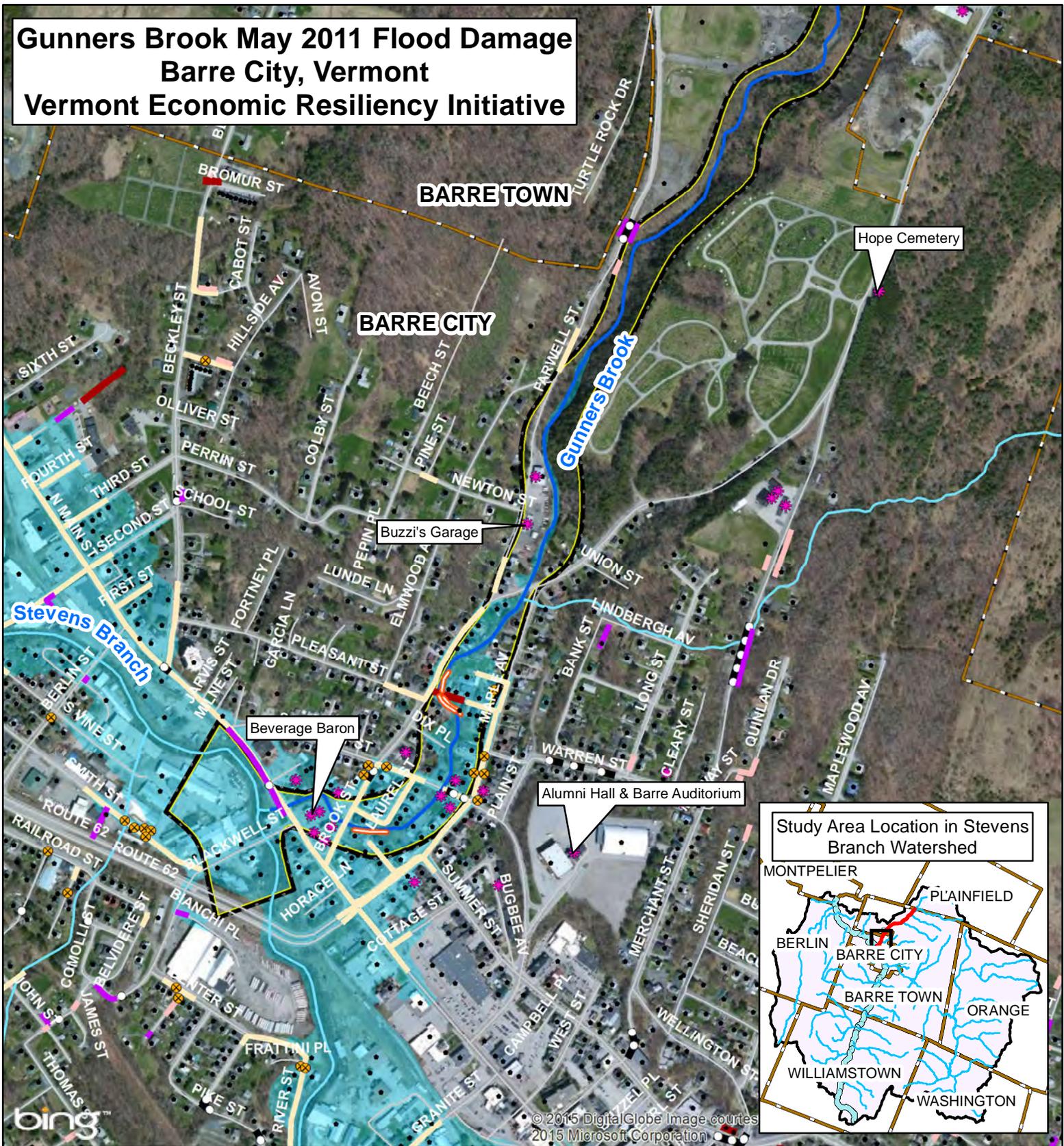
Floodplain development was determined based on an analysis of aerial imagery. Development includes the following: buildings, parking lots, paved roads, gravel roads, driveways, and railroads. Floodplain, in this analysis, is defined as the FEMA 100 Year Flood Hazard Zone.

**Appendix B:  
City and Town of Barre and Gunners Brook Data  
Sources**

Resource	Reference
Flood Damage Information	CVRPC
Town of Barre Local Hazard Mitigation Plan	Town of Barre and CVRPC (2012)
City of Barre Local Hazard Mitigation Plan	City of Barre and CVRPC (2012)
FEMA Flood Insurance Study	FEMA (2014)
State River Corridor	Vermont Agency of Natural Resources
Business Assets	CVRPC

**Appendix C:  
Maps of May 2011 Flood Damage near Gunners  
Brook**

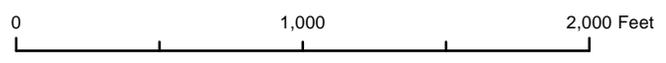
# Gunners Brook May 2011 Flood Damage Barre City, Vermont Vermont Economic Resiliency Initiative



## Legend

- |                                   |                                   |
|-----------------------------------|-----------------------------------|
| <b>Flood Damage 2011</b>          | May 2011 Approximate Flood Extent |
| Sand and Debris on Site           | Local Economic Asset              |
| Minor Washouts on side of Streets | Building                          |
| Major Washouts on side of Streets | VERI Study Area                   |
| Pavement Missing/Pothole          | Surface Water                     |
| Critical/Urgent Repair            | ANR River Corridor                |
| Stream Wall Failure               | Roads                             |
| Damage to Stormwater Catch Basin  | Town Boundary                     |

Background is Bing Imagery. Damage and flood extent information from Central Vermont Regional Planning Commission.



**Appendix D:  
Table of Businesses in Flood Hazard Zones**

Businesses Name	E911 Business Address	Number of Employees	FEMA Floodway	FEMA 100-Year Flood Hazard Zone	FEMA 500-Year Flood Hazard Zone	ANR River Corridor	May 2011 Flood Inundation Area
Ayers Auto	32 Maple Avenue	3	X	X	X	X	X
Beverage Baron	411 North Main Street	24	X	X	X	X	X
Brook Street School	45 Brook Street	6		X	X	X	
Busy Bubble Laundromat	425 North Main Street	2	X	X	X		X
Buzzi's Garage	25-35 Farwell Street	7		X	X	X	
Church of God of Prophecy	10 Brook Street	2	X	X	X	X	X
Dente's Market	406 North Main Street	1	X	X	X		X
Energy Safe Homes, LLC	9 Brook Street	1	X	X	X	X	X
Fastop Stores	377 North Main Street	5		X	X		X
Good Samaritan Haven	105 Seminary Street	7	X	X	X	X	X
Guy's Repair Shop	16 Brook Street	3		X	X	X	X
Mister Z's Italian Restaurant	379 North Main Street	30		X	X		X
Mulligans Irish Pub	9 Maple Avenue	25		X	X		X
Nationwide Insurance	3 Maple Avenue	3		X	X		X
Norway & Sons, Inc.	393 North Main Street	47	X	X	X		X
Reflecting Beauty	415 North Main Street	2		X	X		X
Richard Venmar Dental Office	20 Maple Avenue	6		X	X		X
SixString Station	4 Blackwell Street	1-4			X		X
Trade Winds Hair Styling	102 Seminary Street	3	X	X	X	X	X
Videovision Production Company	386 North Main Street	6	X	X	X		X
Yipes Auto Detailing	439 North Main Street	5-9	X	X	X		X
<b>TOTAL NUMBER OF BUSINESSES</b>		<b>21</b>	<b>11</b>	<b>20</b>	<b>21</b>	<b>9</b>	<b>19</b>
<b>TOTAL NUMBER OF EMPLOYEES</b>		<b>189</b>	<b>101</b>	<b>188</b>	<b>189</b>	<b>56</b>	<b>176</b>

Analysis involved the intersection of Vermont E-911 building points with flood hazard zones in ArcGIS. Results were further modified using 2013 aerial imagery from VCGI. If any portion of a building is within a flood hazard zone, as determined visually with aerial imagery, the building is considered to be within the zone. Inclusion of a building within these zones is based solely on the location of the building and does not reflect the building's elevation.

Number of Single and Multi-Family Dwellings in Flood Hazard Zones along Gunners Brook  
Barre City, Vermont  
Vermont Economic Resiliency Initiative (VERI)  
March 18, 2015

<b>Dwelling Type</b>	<b>FEMA Floodway</b>	<b>FEMA 100-Year Flood Hazard Zone</b>	<b>FEMA 500-Year Flood Hazard Zone</b>	<b>ANR River Corridor</b>	<b>May 2011 Flood Inundation Area</b>
Single Family Dwelling	14	30	30	25	16
Multi-Family Dwelling	28	65	67	45	51

Analysis involved the intersection of Vermont E-911 building points with flood hazard zones in ArcGIS. Results were further modified using 2013 aerial imagery from VCGI. If any portion of a building is within a flood hazard zone, as determined visually with aerial imagery, the building is considered to be within the zone. Inclusion of a building within these zones is based solely on the location of the building and does not reflect the building's elevation.

**Appendix E:**  
**V-DAT One-Page Visual Summary of the Top**  
**Recommendations for Barre**



**Appendix F:  
Results of EPA's Flood Resilience Checklist for Barre  
City and Town**

## 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](http://www.epa.gov/smartgrowth/sgia_communities.htm#rec1).

### What is the Flood Resilience Checklist?

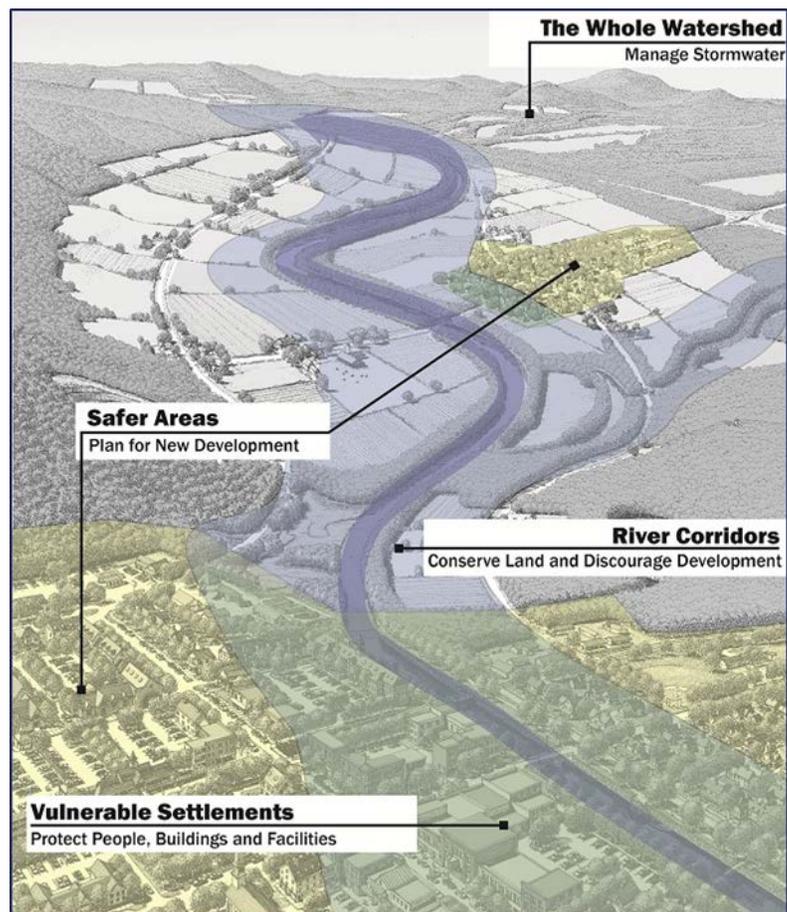
This checklist includes overall strategies to improve flood resilience as well as specific strategies to conserve land and discourage development in river corridors; to protect people, businesses, and facilities in vulnerable settlements; to direct development to safer areas; and to implement and coordinate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

# BARRE CITY FLOOD RESILIENCE CHECKLIST

## Overall Strategies to Enhance Flood Resilience

(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

# BARRE CITY 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
<b>Conserve Land and Discourage Development in River Corridors</b> (Learn more in Section 3.A, pp. 14-19 of <a href="#">Planning for Flood Recovery and Long-Term Resilience in Vermont</a> )		
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

# BARRE CITY FLOOD RESILIENCE CHECKLIST

<b>BARRE CITY FLOOD RESILIENCE CHECKLIST</b>		
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
<b>Protect People, Buildings, and Facilities in Vulnerable Settlements</b> (Learn more in Section 3.B, pp. 19-26 of <a href="#">Planning for Flood Recovery and Long-Term Resilience in Vermont</a> )		
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

# BARRE CITY FLOOD RESILIENCE CHECKLIST

<p>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?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>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?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>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)?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p><b>Plan for and Encourage New Development in Safer Areas</b>            (Learn more in Section 3.C, pp. 26-27 of <a href="#"><i>Planning for Flood Recovery and Long-Term Resilience in Vermont</i></a>)</p>		
<p>1. Does the local comprehensive plan or Hazard Mitigation Plan clearly identify safer growth areas in the community?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>2. Has the community adopted policies to encourage development in these areas?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>3. Has the community planned for new development in safer areas to ensure that it is compact, walkable, and has a variety of uses?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>4. Has the community changed their land use codes and regulations to allow for this type of development?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>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?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>6. Do capital improvement plans and budgets support development in preferred safer growth areas (e.g., through investment in wastewater treatment facilities and roads)?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>7. Have building codes been upgraded to promote more flood-resistant building in safer locations?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No

# BARRE CITY 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

<b>BARRE TOWN FLOOD RESILIENCE CHECKLIST</b>		
<b>Overall Strategies to Enhance Flood Resilience</b> (Learn more in Section 2, pp. 9-11 of <a href="#">Planning for Flood Recovery and Long-Term Resilience in Vermont</a> )		
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

# BARRE TOWN 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
<b>Conserve Land and Discourage Development in River Corridors</b> (Learn more in Section 3.A, pp. 14-19 of <a href="#">Planning for Flood Recovery and Long-Term Resilience in Vermont</a> )		
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

## BARRE TOWN FLOOD RESILIENCE CHECKLIST

<b>BARRE TOWN FLOOD RESILIENCE CHECKLIST</b>		
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
<b>Protect People, Buildings, and Facilities in Vulnerable Settlements</b> (Learn more in Section 3.B, pp. 19-26 of <a href="#">Planning for Flood Recovery and Long-Term Resilience in Vermont</a> )		
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

# BARRE TOWN FLOOD RESILIENCE CHECKLIST

<p>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?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>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?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>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)?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p><b>Plan for and Encourage New Development in Safer Areas</b>            (Learn more in Section 3.C, pp. 26-27 of <a href="#"><i>Planning for Flood Recovery and Long-Term Resilience in Vermont</i></a>)</p>		
<p>1. Does the local comprehensive plan or Hazard Mitigation Plan clearly identify safer growth areas in the community?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>2. Has the community adopted policies to encourage development in these areas?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>3. Has the community planned for new development in safer areas to ensure that it is compact, walkable, and has a variety of uses?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>4. Has the community changed their land use codes and regulations to allow for this type of development?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>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?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>6. Do capital improvement plans and budgets support development in preferred safer growth areas (e.g., through investment in wastewater treatment facilities and roads)?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>7. Have building codes been upgraded to promote more flood-resistant building in safer locations?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No

# BARRE TOWN 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 G:  
Table of Municipal Policy and Program  
Recommendations**

# Barre City

## City-wide Policy and Program Options

### Vermont Economic Resiliency Initiative

(VERI)

Legend

 Effective	 Limited	 Ineffective
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\* 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				
<b>Land Use Regulations</b>										
Update policies allowing fill in flood hazard areas.	Medium				Moderate	< \$10K	RPC, DEC River Management, VLCT, Consultant	MPG	Allowing landowners to elevate buildings using fill may help protect an individual property, but it can increase flood hazards to downstream property owners and reduce the land's ability to slow and store the extra flood water. Regulations can require alternate methods of elevating structures that allow flood waters to occupy the space beneath the structure, preventing it from being pushed off to neighboring or downstream properties. Under current city bylaws, filling is allowed to elevate improvements out of the floodplain.	Contact Town Planner and Planning Commission
Require repaired and rebuilt structures to be built higher.	High				Easy	< \$10K	DEC River Management Program, RPC, VLCT, Consultant	MPG	Owners rebuilding should raise the lowest floor 2 to 3 feet higher than the flood elevation to address the new rainfall patterns and actual flood heights from recent floods. Current city bylaws require 1 foot above flood elevation and this can be revised.	Contact Town Planner and Planning Commission
Follow best practices for reconstruction after the flood.	Medium				Easy	< \$10K	RPC, DEC River Management, VLCT, Consultant	MPG	When rebuilding after a flood, property owners should utilize flood resilient re-construction methods recommended by FEMA, in consultation with the Agency of Natural Resources Floodplain Manager. This protects reconstructed property from the next flood.	Contact Town Planner and Planning Commission
Make room for rivers to flow naturally.	Lower				Moderate	< \$10K	DEC River Management Program, RPC, VLCT, Consultant	MPG	Creating more space for rivers, restoring flood plains, and wetlands and maintaining natural vegetation and forest cover is a major contribution to flood prevention and protection.	Contact Town Planner and Planning Commission
Monitor rebuilding after a disaster.	Medium				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. Without close monitoring, improper rebuilding may result in future federal disaster funding being unavailable for the town and its residences and businesses.	Work with Zoning Administrator.

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

**Barre City**  
**City-wide Policy and Program Options**  
**Vermont Economic Resiliency Initiative**

(VERI)

Legend		
 Effective	 Limited	 Ineffective

\* 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				
<b>Town Plan</b>										
Emphasize watershed-wide stormwater planning to reduce flooding impacts.	High	●	●	●	Moderate	< \$10K	ANR Basin Planning Program, RPC, VLCT, DEC Rivers Management, Consultant	MPG	As Barre City and neighboring communities, particularly Barre Town, experience growth, regulation and design of stormwater management will have direct impacts on flooding experienced in Barre City. All communities should emphasize the importance of developing dialog and collaboration regarding stormwater management within the shared watershed.	Contact Town Planner and Planning Commission
Quantify potential losses in Fluvial Erosion Hazard Zones.	Medium	●	●	●	Easy	< \$1K or In House	DEC Rivers Management, RPC, VLCT, Consultant	MPG	This information will help inform Barre City's decisions about specific provisions for the FEH Zone the city would like to adopt into the Land Use Regulations. River Corridor maps are now available from the Agency of Natural Resources, allowing a determination of which structures are at risk. With a better understanding of the nature of the risk to these structures, and future development in the River Corridors, Barre City can make the best decisions about regulatory standards. State planning law also now requires that River Corridors be addressed in flood resiliency elements of municipal plans.	Contact Town Planner and Planning Commission or Regional Planning Commission
Document damages from flood events.	High	●	●	●	Easy	< \$10K	RPC, VLCT, DEC Utilities Programs, Agency of Transportation, Vermont Local Roads, Consultant	MPG, Better Backroads	Disasters are easily forgotten over time and damages from the 2011 floods as well as other recent rain and flood events should be documented and retained. This will help the community consider the implications of new investments in areas damaged.	Work with Public Works Dept. and Administrative Staff
Document road, sewer, and water infrastructure vulnerabilities in municipal and capital plans.	Medium	○	○	●	Easy	< \$10K	VLCT, RPC, Financial Advisors	MPG	Specific areas that were damaged or have known vulnerabilities should be documented so the community can plan for their replacement in their long-term budgets, easing the impact on taxpayers. More detailed budgets and plans can be developed with the help of your RPC and financial advisors.	Work with Municipal Administration and Regional Planning Commission

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

# Barre City

## City-wide Policy and Program Options

### Vermont Economic Resiliency Initiative

(VERI)

Legend		
 Effective	 Limited	 Ineffective

\* 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				
<b>Emergency Planning</b>										
Incorporate VERI mitigation strategies into the Local Hazard Mitigation Plan.	Medium	●	●	●	Easy	< \$10K	RPC, town	HMGF grants	Evaluating recommended VERI mitigation strategies during the LHMP process will allow them to be integrated alongside Barre City's other hazard mitigation projects and line projects up to receive state and federal funding.	Contact Regional Planning Commission
Incorporate the above plan and bylaw recommendations in the local Hazard Mitigation Plan.	Medium	●	●	●	Easy	< \$10K	RPC, town	HMGF grants	Including regulatory and policy actions in the strategies section of the plan before the next disaster can help communities qualify for federal funding.	Contact Regional Planning Commission
Develop a local recovery fund.	Medium	○	○	●	Difficult	Cost of Organizing Fund & Cost of Initial Funds Raised	Chamber of Commerce, local community support orgs such as churches	VT Community Foundation	Towns will recover much more quickly after a disaster if they create a local fund to address urgent needs. Federal and state money will come, but these funds are slow to arrive. Establishing a local household and business small grant or loan fund is proven to speed recovery efforts.	Work with local committee
Develop a local building retrofit fund.	Medium	○	○	●	Difficult	Cost of Organizing Fund & Cost of Initial Funds Raised	Chamber of Commerce, local community support orgs such as churches	VT Community Foundation	Again state and federal grants take time and may not be available for small projects. As part of the recovery or pre-disaster mitigation plan and fund, towns could offer mini grants for retrofits such as backflow preventers (that keep stormwater and sewage from flooding buildings via the drainage system), elevation of exterior utilities, and flood barriers for doors.	Work with local committee
Educate people about the causes, risks and warning signs of floods.	Lower	●	●	●	Moderate	< \$10K	Schools, RPC, Towns	HMGF 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. Working with the state and the RPCs, these groups can distribute flood hazard maps so that people know where there is a risk of flooding.	Reach out to schools and community groups
<b>Education and Outreach</b>										
Promote and educate property owners on the value of flood insurance.	Medium	○	○	●	Easy	< \$10K	Chamber, Homeowners Associations	HMGF grants	Homeowners insurance does not pay for any flood related damage. Only flood insurance does. In Barre City, 53% 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 or impossible to relocate. Continuity of operations plan that outlines the steps business can take during and after a disaster.	Offer continuity of operations planning training for businesses.
Educate business owners, landlords and contractors about flood resilience.	High	○	○	●	Moderate	< \$10K	Realtors	HMGF grants	Many business owners, 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. Education programs are critical component to raising awareness.	Reach out to landlords and contractors.

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

# Barre Town

## City-wide Policy and Program Options

### Vermont Economic Resiliency Initiative

(VERI)

Legend		
	Effective	
	Limited	
	Ineffective	

\* 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				
<b>Land Use Regulations</b>										
Encourage development outside of the flood hazard area.	High	●	●	●	Moderate	< \$10K	RPC, VLCT, Consultant	MPG	New development in the floodplain puts owners at risk and reduces available floodplain. This can worsen flooding and puts emergency responders, the public and downstream property owners at risk. In the flood hazard portion of the town zoning bylaw, consider prohibiting all new development in the mapped flood areas.	Contact Town Planner and Planning Commission
Limit improvements after the flood.	High	●	●	●	Easy	< \$10K	RPC, VLCT, Consultant	MPG	When rebuilding after a flood, property owners should limit their improvements to their flood prone properties so any expansions do not create additional hazards to the community. These limits can be added to the development standards portion of the flood hazard section of the town zoning bylaw.	Contact Town Planner and Planning Commission
Update policies allowing fill in flood hazard areas.	High	●	◐	●	Moderate	< \$10K	RPC, DEC River Management, VLCT, Consultant	MPG	Allowing landowners to fill low lying areas may help protect an individual property, but it can reduce the land's ability to slow and store the extra flood water and it can increase flood hazards to downstream property owners. These policies can be added to the development standards in the flood hazard section of the town zoning bylaw.	Contact Town Planner and Planning Commission
Require repaired and rebuilt structures to be built higher.	High	●	○	●	Easy	< \$10K	DEC River Management Program, 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 in the flood hazard section of the town zoning bylaw.	Contact Town Planner and Planning Commission
Make room for rivers to flow naturally.	High	●	●	●	Moderate	< \$10K	DEC River Management Program, RPC, VLCT, Consultant	MPG	Creating more space for rivers, restoring flood plains, and wetlands and maintaining natural vegetation and forest cover is a major contribution to flood prevention and protection	Contact Town Planner and Planning Commission
Monitor rebuilding after a disaster.	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. Without close monitoring, improper rebuilding may result in future federal disaster funding being unavailable for the town and its residences and businesses.	Work with Zoning Administrator.

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

# Barre Town

## City-wide Policy and Program Options

### Vermont Economic Resiliency Initiative

(VERI)

Legend		
●	Effective	
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\* 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				
<b>Town Plan</b>										
Emphasize watershed-wide stormwater planning to reduce flooding impacts.	High	●	●	●	Moderate	< \$10K	ANR Basin Planning Program, RPC, VLCT, DEC Rivers Management, Consultant	MPG	As Barre Town and neighboring communities experience growth, regulation and design of stormwater management will have direct impacts on flooding experienced in Barre Town. All communities should emphasize the importance of developing dialog and collaboration regarding stormwater management within the shared watershed.	Contact Town Planner and Planning Commission
Document damages from flood events.	High	●	●	●	Easy	< \$10K	RPC, VLCT, DEC Utilities Programs, Agency of Transportation, Vermont Local Roads, Consultant	MPG, Better Backroads	Disasters are easily forgotten over time and damages from 2007 and 2011 floods as well as other smaller recent rain and flood events should be documented. This will help the community consider the implications of new investments in areas damaged by floods including Sterling Hill Rd. The state law now requires that a new flood resiliency chapter or element be added to all town plans and CVRPC has several templates and samples available.	Work with Public Works Dept. and Administrative Staff
Limit new development in floodplain and river corridor.	High	●	●	●	Moderate	< \$10K	RPC, VLCT, Consultant	MPG	Language in the municipal plan that restricts development in risky locations enables adoption of corresponding regulations and policies. Likewise, the municipal plan should identify areas safe from floods and encourage development in those areas. This can be a component of the new flood resiliency chapter or element in the municipal plan.	Contact Town Planner and Planning Commission
Document road, sewer, and water infrastructure vulnerabilities in municipal and capital plans.	Medium	○	○	●	Easy	< \$10K	VLCT, RPC, Financial Advisors	MPG	Specific areas that were damaged or have known 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 local Selectboard may start this process with a list and a capital reserve fund. More detailed budgets and plans can be developed with the help of your RPC and financial advisors.	Work with Municipal Administration and Regional Planning Commission
Identify areas for conservation.	Medium	●	●	●	Easy	< \$10K	Town, Conservation Commission	DEC-ERP	The Steven's Branch River Corridor Plan identifies potential riparian easement sites. The Planning 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

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

# Barre Town

## City-wide Policy and Program Options

### Vermont Economic Resiliency Initiative

(VERI)

Legend		
●	Effective	
◐	Limited	
○	Ineffective	

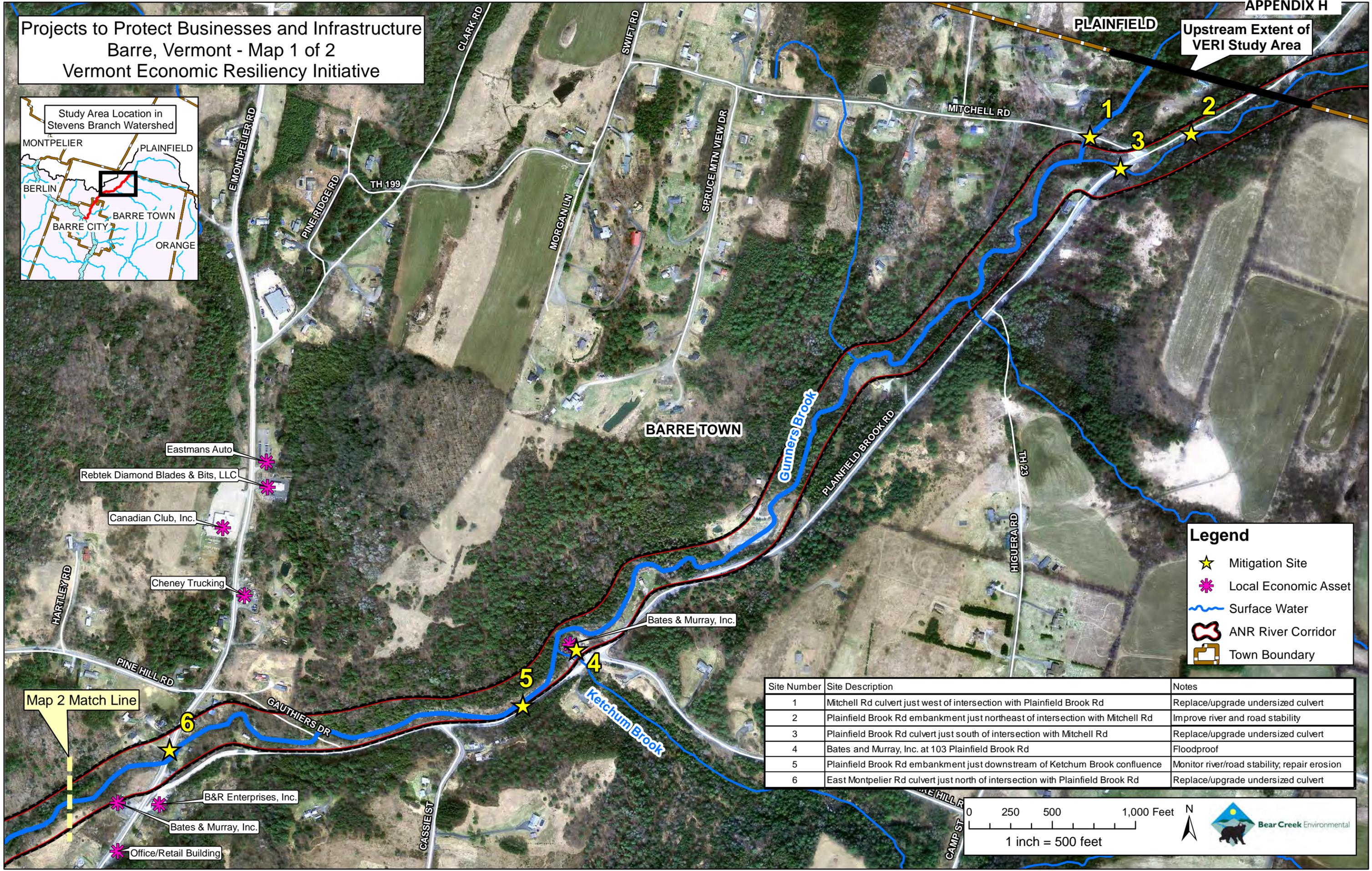
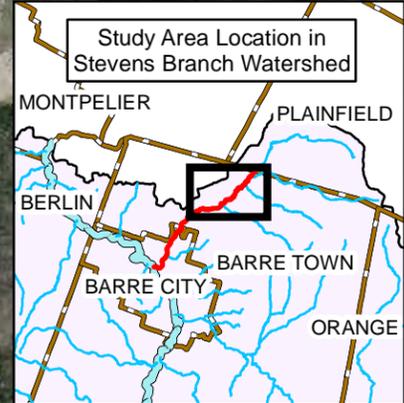
\* Priority rating based on degree of community benefit

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				
<b>Emergency Planning</b>										
Incorporate VERI mitigation strategies into the Local Hazard Mitigation Plan.	Medium	●	●	●	Easy	< \$10K	RPC, town	HMGF grants	Evaluating recommended VERI mitigation strategies during the LHMP process will allow them to be integrated alongside Barre Town's other hazard mitigation projects and line projects up to receive state and federal funding.	Contact Regional Planning Commission
Develop a local recovery fund.	Medium	○	○	●	Difficult	Cost of Organizing Fund & Cost of Initial Funds Raised	Chamber of Commerce, local community support orgs such as churches	VT Community Foundation	Towns will recover much more quickly after a disaster if they create a local fund to address urgent needs. Federal and state money will come, but these funds are slow to arrive. Establishing a local household and business small grant or loan fund is proven to speed recovery efforts.	Work with local committee
Develop a local building retrofit fund.	Medium	○	○	●	Difficult	Cost of Organizing Fund & Cost of Initial Funds Raised	Chamber of Commerce, local community support orgs such as churches	VT Community Foundation	Again state and federal grants take time and may not be available for small projects. As part of the recovery or pre-disaster mitigation plan and fund, towns could offer mini grants for retrofits such as backflow preventers (that keep stormwater and sewage from flooding buildings via the drainage system), elevation of exterior utilities, and flood barriers for doors.	Work with local committee
Develop evacuation plans.	Medium	○	○	●	Moderate	< \$10K	Homeowners Associations	HMGF 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 local Emergency Management Director and VEMHS
Educate people about the causes, risks and warning signs of floods.	Lower	●	●	●	Moderate	< \$10K	Schools, RPC, Towns	HMGF 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. Working with the state and the RPCs, these groups can distribute flood hazard maps so that people know where there is a risk of flooding.	Reach out to schools and community groups
<b>Education and Outreach</b>										
Promote and educate property owners on the value of flood insurance.	Medium	○	○	●	Easy	< \$10K	Chamber, Homeowners Associations	HMGF grants	Homeowners' insurance does not pay for any flood related damage. Only flood insurance through the National Flood Insurance Program does. In Barre Town, 67% 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 or impossible 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 business owners, landlords and contractors about flood resilience.	High	○	○	●	Moderate	< \$10K	Realtors	HMGF grants	Many business owners, 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. Education programs are critical component to raising awareness.	Reach out to landlords and contractors.

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

**Appendix H:  
Projects to Protect Businesses and Infrastructure –  
Maps**

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



**Legend**

- ★ Mitigation Site
- ✱ Local Economic Asset
- Surface Water
- ANR River Corridor
- Town Boundary

Site Number	Site Description	Notes
1	Mitchell Rd culvert just west of intersection with Plainfield Brook Rd	Replace/upgrade undersized culvert
2	Plainfield Brook Rd embankment just northeast of intersection with Mitchell Rd	Improve river and road stability
3	Plainfield Brook Rd culvert just south of intersection with Mitchell Rd	Replace/upgrade undersized culvert
4	Bates and Murray, Inc. at 103 Plainfield Brook Rd	Floodproof
5	Plainfield Brook Rd embankment just downstream of Ketchum Brook confluence	Monitor river/road stability; repair erosion
6	East Montpelier Rd culvert just north of intersection with Plainfield Brook Rd	Replace/upgrade undersized culvert

0 250 500 1,000 Feet  
 1 inch = 500 feet



**Appendix I:  
Projects to Protect Businesses and Infrastructure –  
Table**

**Barre**

**Recommended Projects to Protect Businesses and Infrastructure from Flooding  
Vermont Economic Resiliency Initiative (VERI)**

March 31, 2015



\* Priority rating based on objectives and potential business impact

Project	What is At Risk?	Potential Business Impacts	Priority*	OBJECTIVES			FEASIBILITY			Comments
				Reduces Flood Risk <sup>1</sup>	Reduces Erosion Risk <sup>2</sup>	Protects Businesses, Infrastructure, and Property	Ease of Implementation	Cost Range	Estimated Time for Implementation	
<b>Building and Site Improvements</b>										
Floodproof multiple buildings in floodplain from upper Brook Street bridge down to the Stevens Branch (see site 19 on Map 1)	Commercial Buildings, single and multi-family homes	18 local businesses and 170 employees; >65 multi-family dwellings	High	○	○	●	Moderate	<\$10K per building	2-5 years	Floodproofing would include operational measures (e.g., no storage of materials below flood level) and physical measures specific to each building (e.g., flood barriers at entrances) in accordance with FEMA floodproofing guidance. Buildings below Seminary Street are at risk of flooding from both Gunners Brook and Stevens Branch. Above Seminary Street the flood source is exclusively Gunners.
Floodproof the Bates & Murray, Inc. building (see site 4 on Map 1)	Parking lot and commercial building	1 local business with 51 employees	Medium	○	○	●	Moderate	<\$10K	1-2 years	May 2011 eroded Gunners Brook bank and a tributary (Ketchum Brook) eroded the parking lot and damaged retaining wall. The building flooded. Gunners and tributary banks have been reconstructed. With a large enough storm, the building will flood again. The building is on a concrete floor, so raising it is not practical. Floodproofing would reduce damages.
<b>Channel and Floodplain Management</b>										
Develop a Flood Resilient Design Standard for channel walls throughout the City. (see site 15 on Map 2)	Land and buildings adjacent to channel in Barre City	>10 local businesses and 40 employees; >30 multi-family dwellings	High	◐	●	●	Easy	\$10K-\$50K	1-2 years	Nearly the entire length of channel downstream of the upper Brook Street bridge is walled. The "Flood Resilient Design Standard" would provide a larger channel with at least one bank slope on which debris has an opportunity to collect. It would likely require property owners to give up some land to the brook. The intent would be to facilitate permitting of wall repairs, incrementally progress toward a larger more flood resilient channel, and possibly (in the name of flood resiliency) qualify the work to public funding. The design would be developed in coordination with State and Federal regulators.
Repair failed channel walls throughout City using the Flood Resilient Design Standard. (see site 15 on Map 2)	Land and buildings adjacent to channel in Barre City	>10 local businesses and 40 employees; >30 multi-family dwellings	High	◐	●	●	Moderate	>\$200K	>5 years	This is implementation of the "Flood Resilient Design Standard" developed in the previous mitigation strategy.
Remove the now-closed Harrington Avenue Bridge (see site 14 on Map 2)	Town Road and adjacent buildings	>10 local businesses and 40 employees; >30 multi-family dwellings	High	●	●	●	Easy	\$50K-\$100K	1-2 years	Bridge damaged during May 2011 flood and has not been open to traffic since. Adjacent homeowner reports four out-of-bank flood events at the bridge since 1998, all involving debris. There are no utilities associated with the crossing. Initial public input suggests loss of pedestrian access is acceptable. Removing the bridge deck could help reduce the collection of debris, but additional work to remove the bridge abutments and restore nearby floodplain would do more to reduce the flood risk.
Develop and implement a Debris Management Plan (see site 8 on Map 2)	Buildings and roads in the Gunners Brook floodplain in Barre City	>10 local businesses and 40 employees; >30 multi-family dwellings	High	●	◐	●	Moderate	\$10K-\$50K	1-2 years	There is a risk of woody debris observed in this area moving downstream into developed area and snagging at undersized structures causing out-of-bank flooding. However, the woody material observed in this area is acting as a trap for more wood and for sediment. A strategy to identify and manage debris risk would serve the City well.
Preserve floodplain near the Barre City/Barre Town line (see site 9 on Map 2)	Buildings and roads in the Gunners Brook floodplain in Barre City	>10 local businesses and 40 employees; >30 multi-family dwellings	Medium	◐	◐	◐	Moderate	\$10K-\$50K	2-5 years	There is particularly good floodplain access in this area that reduces flood flows and promotes sediment and woody debris deposition (before they reach more developed locations). Mechanisms for preserving floodplain include easements, adoption of River Corridors, and zoning.
Remove debris adjacent to channel from former dump at Ricker Holdings, LLC (see site 7 on Map 1)	Buildings and roads in the Gunners Brook floodplain in Barre City	limited	Low	◐	◐	◐	Moderate	\$50K-\$100K	2-5 years	Debris blockage from trash and poor aesthetics (character). Possible contaminated soils and access to private property could complicate the project.
<b>Infrastructure Improvements</b>										
Replace undersized culvert on Plainfield Brook Road (see site 3 on Map 1)	Town Road	>10 local businesses and 40 employees	High	●	●	●	Moderate	\$100K-\$200K	2-5 years	Existing culvert is undersized (approximately 40% of channel width) and is prone to debris blockage that could cause road to overtop and fail. The road delivers vehicles to US Route 14, the main North-South link between Barre City and Barre Town.
Monitor stability of Plainfield Brook Road Embankment below Ketchum Brook Tributary and repair erosion (see site 5 on Map 1)	Town Road	>10 local businesses and 40 employees	High	○	●	●	Easy	<\$10K	1-2 years	Because the road parallels the stream for a significant distance, there is elevated risk of embankment erosion and road damage. The embankment should be monitored following significant storm events.
Replace undersized bridge on Upper Brook Street (see site 12 on Map 2)	City Streets and adjacent buildings	>10 local businesses and 40 employees; >30 multi-family dwellings	High	●	●	●	Difficult	>\$200K	2-5 years	Bridge was constructed in 1927. The opening is undersized and causes flooding during approximately the 10-year flow. The flooding impacts multiple single and multi-family structures and water flows down Farwell Street.

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

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

**Barre**

**Recommended Projects to Protect Businesses and Infrastructure from Flooding  
Vermont Economic Resiliency Initiative (VERI)  
March 31, 2015**



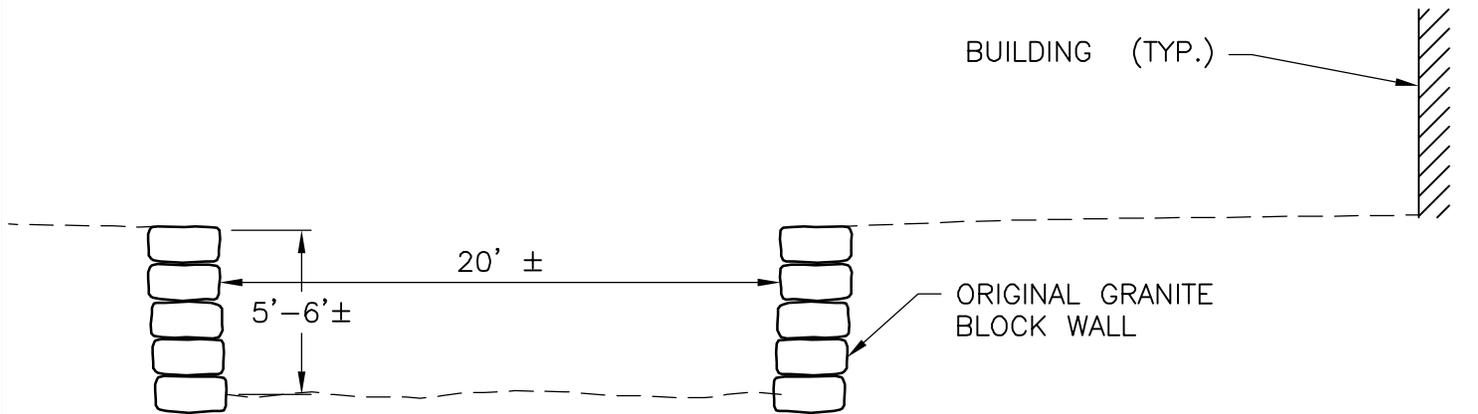
\* Priority rating based on objectives and potential business impact

Project	What is At Risk?	Potential Business Impacts	Priority*	OBJECTIVES			FEASIBILITY			Comments
				Reduces Flood Risk <sup>1</sup>	Reduces Erosion Risk <sup>2</sup>	Protects Businesses, Infrastructure, and Property	Ease of Implementation	Cost Range	Estimated Time for Implementation	
Replace undersized culvert on Mitchell Road (see site 1 on Map 1)	Town Road	limited	Medium	●	●	●	Moderate	\$100K-\$200K	2-5 years	Existing culvert is undersized (approximately 40% of channel width) and is prone to debris blockage that could cause road to overtop and fail. Road is unpaved and has relatively low traffic volume.
Improve river and road stability on Plainfield Brook Road (see site 2 on Map 1)	Town Road	>10 local businesses and 40 employees	Medium	○	●	●	Easy	\$10K-\$50K	1-2 years	The road embankment has been repaired (presumably following May 2011) but remains vulnerable to future erosion. Repairs should be done to current flood resilient standards that include larger rock than was used in previous repairs. The road delivers vehicles to US Route 14, the main North-South link between Barre City and Barre Town.
Replace undersized culvert on East Montpelier Road (US Route 14) (see site 6 on Map 1)	State Highway	>10 local businesses and 40 employees	Medium	◐	◐	◐	Difficult	>\$200K	>5 years	Existing culvert is undersized (approximately 55% of channel width), but it is in good condition. Though it is narrow, it is relatively tall and is reported to effectively pass debris during flood events.
Replace undersized bridge on Seminary Street (see site 17 on Map 2)	City Streets and adjacent buildings	>10 local businesses and 40 employees; >30 multi-family dwellings	Medium	◐	◐	◐	Difficult	>\$200K	>5 years	Bridge was constructed in 1972 and is located at approximately the upstream limit of the 100-year flood on the Stevens Branch. Adjacent buildings and other site constraints make installation of a taller or wider structure very difficult.
Replace undersized bridge on Lower Brook Street (see site 18 on Map 2)	City Streets and adjacent buildings	>10 local businesses and 40 employees; >30 multi-family dwellings	Medium	◐	◐	◐	Difficult	>\$200K	>5 years	Bridge appears to be 1930s construction. The surrounding channel walls are narrower than the bridge opening. The bridge would be fully submerged by the 100-year flood on the Stevens Branch.
Replace undersized bridge on N. Main Street (see site 20 on Map 2)	State Highway and adjacent buildings	>10 local businesses and 40 employees; >30 multi-family dwellings; regional impacts	Medium	◐	◐	◐	Difficult	>\$200K	>5 years	The bridge opening is 19' side by 6.4' high. The width matches surrounding channel walls. There is a sewer crossing inside the bridge on the stream bed. The bridge is fully submerged by the 100-year flood on the Stevens Branch.
Improve stormwater drainage on Farwell Street (see site 10 on Map 2)	City streets	limited	Low	○	●	◐	Moderate	\$50K-\$100K	2-5 years	There were washouts and areas of missing pavement on Farwell St following the May 2011 storm. Mitigation efforts should address locations of prior repeat damage.
<b>Public Safety Improvements</b>										
Consider buyouts for 3-4 at-risk buildings on right bank above upper Brook Street bridge (see site 11 on Map 2)	Single and multi-family homes	2 multi-family and 2 single family dwellings	High	●	●	●	Difficult	>\$200K	>5 years	This is a long-term strategy that would follow a feasibility study. Removing the buildings would prevent repeated damages and allow the floodplain to be restored to promote deposition of woody debris in the floodplain instead of at bridge openings. Some buildings are located in the newly-mapped FEMA floodway.
Consider buyouts for 6-9 of the most at-risk buildings between upper Brook Street bridge and Dix Place (see site 13 on Map 2)	Single and multi-family homes	>2 multi-family and >4 single family dwellings	High	●	●	●	Difficult	>\$200K	>5 years	This is a long-term strategy that would follow a feasibility study. The buildings on the right bank are generally subject to the greatest flood depths and velocities. Removing them would prevent repeated damages and allow the floodplain to be restored to promote deposition of woody debris in the floodplain instead of at bridge openings. Some buildings are located in the newly-mapped FEMA floodway.
Consider buyouts for 8 - 10 of the most at-risk buildings between Dix Place and Main Street (see site 16 on Map 2)	Single and multi-family homes	7 multi-family dwellings and 1 local business with 3 employees	High	●	●	●	Difficult	>\$200K	>5 years	This is a long-term strategy that would follow a feasibility study. Removing these buildings would prevent repeated damages and allow the floodplain to be restored. These properties are subject to flooding from both Gunners Brook and from Stevens Branch. In combination with additional buyouts upstream of Dix Place, this project would provide a largely unobstructed floodway throughout the City. Some buildings are located in the newly-mapped FEMA floodway.
Remove multiple unused outbuildings adjacent to channel from upper Brook Street bridge to Stevens Branch (see site 19 on Map 2)	Commercial Buildings, single and multi-family homes	>10 local businesses and 40 employees; >30 multi-family dwellings	Medium	◐	○	●	Moderate	\$10K-\$50K	1-2 years	There are a number of damaged and unused garages and sheds immediately adjacent to the channel. During flood events they elevate flood levels and may become sources of debris that worsens flooding downstream. Many of these are now (as of 2014) in the mapped FEMA floodway, which limits the ability to repair or replace them.

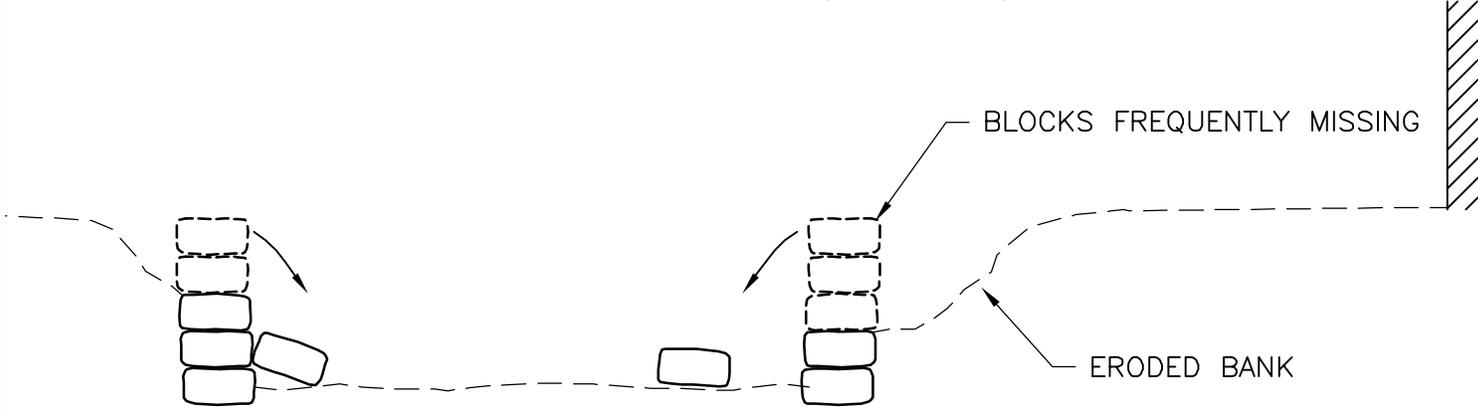
<sup>1</sup>Reduces Flood Risk - The proposed project/strategy lowers the flood level.

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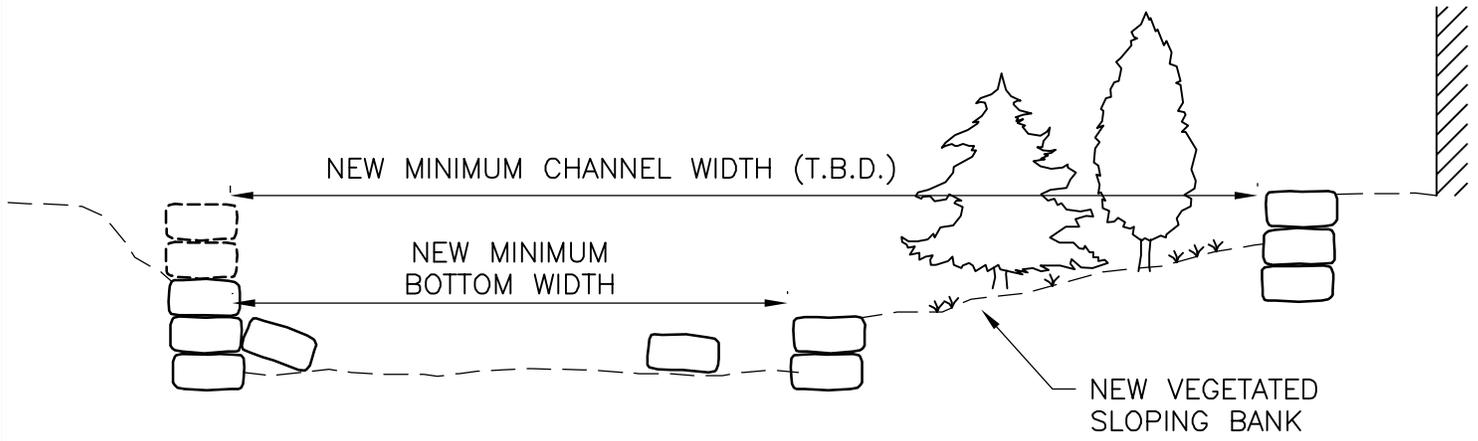
**Appendix J:**  
**Conceptual Design Drawing for Flood Resilient**  
**Channel Walls**



ORIGINAL WALL (TYPICAL)



CURRENT CONDITION (TYPICAL)



FLOOD RESILIENT DESIGN CONCEPT

**DuBois & King** INC.

ENGINEERING • PLANNING •  
MANAGEMENT • DEVELOPMENT

VERI-BARRE  
GUNNARS BROOK  
FLOOD RESILIENT  
CHANNEL WALL DETAILS

DRAWN BY ZDC	DATE FEB. 2015
CHECKED BY MTM	D&K PROJECT # 122618L
PROJ. ENG. MTM	SCALE N.T.S.

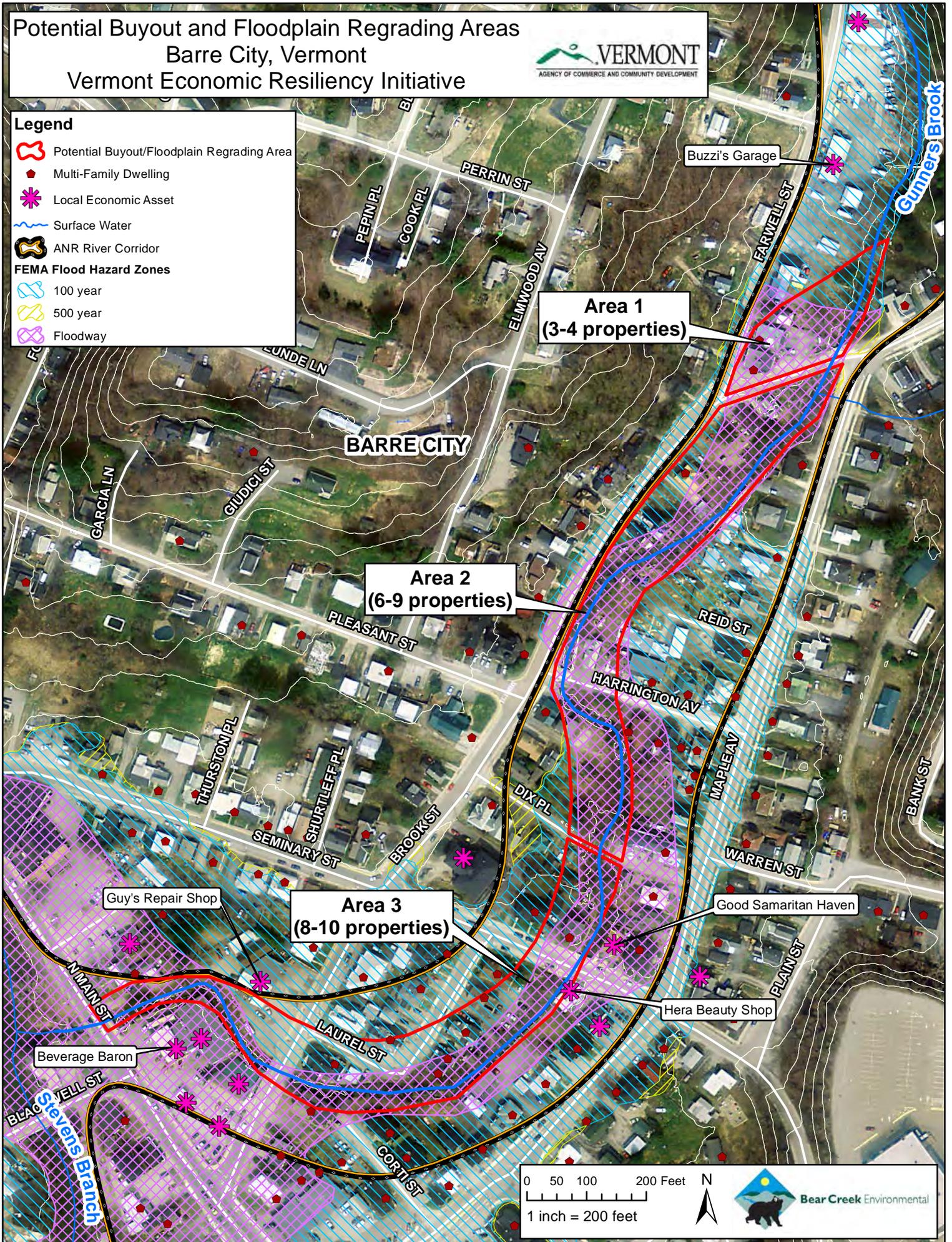
FIGURE

**Appendix K:  
Conceptual Design Site Plan for Relocation of Most At-  
Risk Buildings**

# Potential Buyout and Floodplain Regrading Areas Barre City, Vermont Vermont Economic Resiliency Initiative



- Legend**
- Potential Buyout/Floodplain Regrading Area
  - Multi-Family Dwelling
  - Local Economic Asset
  - Surface Water
  - ANR River Corridor
  - FEMA Flood Hazard Zones**
  - 100 year
  - 500 year
  - Floodway



**Appendix L:**  
**Community Forum Meeting Notes**

# Vermont Economic Resiliency Initiative (VERI)

## Community Forum – Barre City and Barre Town

### MEETING NOTES

October 27, 2014 – 6:00 – 8:00 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](http://accd.vermont.gov/strong_communities/opportunities/planning/resiliency/VERI)

#### Summary

25 community members, business owners, and homeowners from the Gunners Brook watershed Barre City and Barre Town attended the Vermont Economic Resiliency Community Forum. The community identified numerous river and flooding problems along the Gunners Brook. They include Harrington Ave Bridge which traps large debris forcing flood waters out of the river channel and onto the streets. And collapsed and failing retaining walls that line Gunners brook and narrow the river channel width. Further analysis and technical assistance needs of the community emphasized the need to trap and store debris upstream of Barre City so that it does not become lodged under the bridges. Repair or removal of the retaining walls so that the channel can have more access to flood plain. Also education on river dynamics and being good stewards of them is an important step.

#### Present

- Residents and Business Owners: Samantha Davisthock, Lucille Dente (Dente's Market), Patrick Gilbert, Scott Bascom, Al Flory (Northfield Savings Bank), Casey and Bob Harrington (Beverage Baron), Ken Alger, Wendy Alger, Connie Godin
- Barre City: Steven E. Mackenzie, Thom Lauzon, Jackie Calden, Michael Smith

- Barre Town: Andrew Dorsett, Jack Mitchell, Tom White
- Technical Assistance: Mary Nealon (Bear Creek Environmental) and Matt Murawski (DuBois and King)
- Regional Planning Commission: Susan Sinclair, Dan Currier, Emily Nosse-Leirer
- State of Vermont: Noelle MacKay and Wendy Rice (DHCD), Sasha Pealer (VT ANR DER River Program)

## **Introduction**

Steven MacKenzie (Barre City Manager) welcomed everyone and gave a brief statement as to why Barre City is participating in the Vermont Economic Resiliency Initiative (VERI) project. Namely that the VERI project study would help provide the research and strategies needed to deal with the flooding that occurs along Gunners Brook. He next introduced Commissioner Mackay from the Vermont Department of Housing and Community Development. Commissioner MacKay welcomed everyone and thanked people for participating in a first round of community forums presently being held in five Vermont communities state-wide. She next introduced the VERI project team including staff from the Central VT Regional Planning Commission, the Consultant team, and staff from VT ANR River Program. 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 ensure businesses rebound quickly. 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 State has contracted with a team of river scientist and engineers to review the geomorphology (defined as the study of landforms interacting with flowing water), 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 an overview of their work and initial observations in the river corridors at each of the community forums and provided technical assistance to the respective community throughout the meeting.

## Notes

- Matt Murawski of DuBois and King talked about the data gathered along Gunners Brook which includes: stream crossing, hydrology, river channel widths, exposed bedrock, bank erosion, landslides, and encroachments from development, floodplain areas, and bridge crossings. Additionally the river engineers are also modeling the flood levels along Gunners Brook and Stevens Branch to determine how they affect each other.
- Some of the observations so far include: the stream varies greatly from top to bottom with a more natural channel up stream and a more managed channel downstream. There are many landslides which are providing large amounts of sediment and debris into Gunners Brook. Matt also noted that the first bridge crossing in Barre City measures only 29 feet and that the bridge crossings become narrower as one moves down stream to the junction with the Stevens Branch. In past flooding events, the geomorphology of Gunner's Brook caused the water to rise relatively slowly over time, instead of being a rushing current. The consultant team will be look at all of these factors and more when they develop their strategies and recommendation for Gunners Brook.
- The draft of the study report will be ready by January 2015 with the project end date sometime in June 2015? The study and report will focus only on the Gunners Brook in Barre Town and Barre City and it will not analyze the headwaters in Plainfield.

### **For more information on past river studies**

This area has had a river study completed in the past and the consultants are incorporating this past work in to the VERI project. That study can be found here:

<http://map1.msc.fema.gov/data/50/S/PDF/50023CV001A.pdf>.

### **Public Input**

The DHCD Commissioner solicited input from forum participants with regard to flood risk and mitigation opportunities in Barre City and Town. 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: Responses from the Public

1. Harrington Avenue Bridge
  - It's narrow, low, and fills up with flood-causing debris during storms
  - Residents want the debris to be removed from that area, either through removing the bridge or replacing it with a better structure
  - It made Maple Avenue impassible during the May 2011 flooding
2. The North Main Street Bridge also clogs during flooding
3. The infill near Hope Cemetery is a problem area
4. Retaining walls throughout Barre City are falling into the brook
  - They are hard to repair because no one knows who owns them, who is responsible for maintaining them, and what the prevailing regulations governing work in the waterway are
5. Berlin Street near the lumberyard serves as a choke point as well
6. Community members rake leaves into the street which flow into the stormwater system, clogging it and leading to overflow
7. Buzzi's has a huge deposition area where water just flows over a dirt road
8. Sterling Hill Brook (South Barre) has been in-filled and critical fish habitat loss has been lost
9. Rural roads (Class 3 roads) carry extra sediment into the rivers

## 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: Responses from the Public

1. There is better prevention before and during flooding, such as staging bulldozers in problem spots to make sure they don't clog
2. The city has better models and more awareness about the possible extent of flooding and damage
3. The city is implementing planning and zoning that takes flood risk into account

4. Emergency Preparation Plan – public works crews check catch basins, choke points, culverts etc. to decrease flood potential before big storms; Stage backhoes at the 5 bridges in anticipation of major storms.
5. Businesses and property owners are more prepared (for example, not storing inventory or furnaces in basement)
6. City has installed a stormwater catchment area at 62 and North Main Street
7. All of downtown repaved, businesses recovering
8. Stormwater system has more capacity than it did, but this capacity could still get exceeded
9. Planning office requires a permit if you are going to change the grade of your property at all
10. City has a better warning system alerting people to clean culverts etc. when storms are imminent

### **Resiliency and Sustainability Planning**

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

#### Notes: Responses from the Public

1. Trash racks upstream to capture debris before it get to Barre City bridges
2. A grant or loan program for repairing the retaining walls
3. The granite excavators have filled the river with grout and this probably needs to be dredged. Need to be able to accept more floodwater in the future.
4. Cooperation with upstream neighbors like Plainfield and Williamstown
5. Biannual river inspections with regulatory partners
6. Uphill storm water storage
7. Are there areas in the city that can act as catchment and retention areas
8. A plan for handling the salt/snow/sand mixture on the roads in the winter (sometime these debris are pushed into the river)
9. Channel widening
10. Individual landowner education (how to create water sinks on private property, the risks of putting woody debris or vegetation in the waterway, impacts of snow pack being pushed into the river etc.)
11. Immediate financial aid for businesses after storm events (revolving loan funds?)
12. Regulatory and financial cooperation between the State and municipalities
13. Creation of a regional stormwater management district, mirroring perhaps the structure of the solid waste district approach

14. Try to find a way to related storm water management to Lake Champlain cleanup projects
15. Strategic plan to acquire properties along Gunner's Brook- probably 30-40 places that could be candidates for acquisition

### **Information Sharing and Dissemination**

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

#### Notes: Responses from the Public

1. Clarification of who owns and is responsible for the waterway and structures within the waterway such as retaining wall
2. Analysis of the historic flood plain
3. Talk about dredging and its benefits and drawbacks
4. Keep educating business owners on flood resilience
5. Contact information for the appropriate people to get in touch with regarding river and brook issues
6. A timeline of projects to help plan budgeting
7. Prioritization of projects and details about those projects
8. Identification of small but impactful projects

# Vermont Economic Resiliency Initiative (VERI)

## Community Forum – Barre City & Barre Town

### MEETING NOTES

April 16, 2015 – 6:00 – 8:00 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/Barre](http://accd.vermont.gov/strong_communities/opportunities/planning/resiliency/VERI/Barre)

#### Summary

32 community members, business owners, and town officials from the Gunner's Brook watershed attended the third VERI community forum in Barre City. The forum showcased eight high priority projects which could significantly decrease flood risk for Barre Town and Barre City, if implemented. Community members were given the opportunity to ask questions, provide input, and rank the proposed projects. The projects which the community most supported included: replacing the undersized bridge on Upper Brook Street, considering voluntary buy-outs for the most at-risk buildings between Upper Brook Street and Dix Place, and removing the Harrington Avenue Bridge. Integrating these projects into the municipal bylaws, policies, and plans will help Barre City and Barre Town to be safer and more resilient to future floods.

#### Welcome and Overview

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

Noelle MacKay provided background information on the VERI project and talked about a successful project in [Bennington](#) that led to this project. She also explained the process for selecting the five towns included in VERI– each town demonstrated an intersection between flood risk, economic activity and at-risk infrastructure. Barre Town and Barre City were selected as a VERI pilot community

because they ranked high in the state-wide assessment of economic activity and associated infrastructure that is at risk of flooding. Barre City also participated in the Leahy Center Environmental Summit where they talked about the projects and strategies coming out of this study. Commissioner MacKay went over the agenda for the evening and emphasized the importance of community input on the proposed flood reduction projects. The Agency of Commerce and Community Development will work with partners to help identify funding sources once priority projects are chosen.

## **Overview of Municipal Policies and Programs to Reduce Future Floods**

[Dan Currier, GIS Manager, Central Vermont Regional Planning Commission]

Dan Currier gave a presentation on the accomplishments that Barre City and Barre Town have made toward improving flood resilience, and recommendations from the VERI team for further improvement. Both municipalities have made accomplishments in their community planning programs, and collaboration between the two communities in the future is a key way to reduce flood risk. Land use regulations that meet the National Flood Insurance Program's minimum requirements, like raising buildings one foot above base flood elevation are used in both municipalities. Each also has a Local Hazard Mitigation Plan which recognizes that upgrading bridges and culverts will reduce damage from heavy rainfall and flooding. In Barre City, recommendations from the Vermont Downtown Action Team have been implemented including applying consistent marketing across the city and making improvements to Enterprise Alley.

Dan reviewed the Emergency Relief Assistance Fund (ERAF) chart which summarizes steps each municipality has taken to qualify for State reimbursement for a federally declared disaster. Barre Town currently qualifies for 12.5% State reimbursement and Barre City currently qualifies for 7.5% State reimbursement. These community profiles can be viewed at [floodready.vt.gov](http://floodready.vt.gov).

When presenting recommendations, Dan described how activities throughout the Gunners Brook Watershed, in both Barre Town and Barre City, have an impact on flood severity. An example of this is that debris pushed into the river upstream can wash downstream during high water, clogging culverts and making flooding worse. Developing dialogue and collaboration about land use and stormwater management is a low to no cost strategy to minimize damage. Other recommendations are to elevate buildings and basement utilities two to three feet above the baseline flood height, and not to allow fill in flood hazard areas. Filling to elevate buildings pushes water to nearby properties and reduces the land's ability to store the extra floodwater.

## Overview of Project Recommendations

[Matt Murawski, Engineer at Dubois & King, Inc.]

A team of river scientists and engineers conducted field surveys along Gunners Brook, and with community input, developed 22 recommended projects that will protect businesses and infrastructure. Matt Murawski, an engineer with the firm Dubois & King, Inc., presented the top eight recommended projects as follows:

1. Floodproof Buildings from Upper Brook Street to Stevens Branch: Modifications to a building itself such as elevating it, raising basement utilities, sealing the building, filling the basement or using water resistant building materials reduces the costs of damage when the building is flooded. It has been calculated that there is as many as 115 structures at risk in the flood plain along Gunners Brook.
2. Develop a Flood Resilient Design Standard for Channel Walls throughout the City: Downstream of upper Brook Street Bridge, nearly the entire channel is walled. Replacing deteriorating, vertical retaining walls, with more sloped walls, would give more room for the Brook to spread out, and provide a place for debris to settle. This would require landowners to lose some of their level land, but improves the possibility of accessing federal funding to make repairs, which would otherwise have to be paid for by the landowner.

Notes and Responses from the Public: There was concern that the change along the streambank from a sloped bank to a vertical bank could cause churning of the water at that transition. The solution to this is making the transition gradual rather than a sharp angled change to a vertical wall.

Participants also wanted to know how much property would need to be consumed to slope back the channel walls. This will vary depending on the width and other characteristics of the stream channel at each property, but a typical distance would be 12-15 feet in from the existing top of the bank.

3. Develop and Implement a Debris Management Plan: Woody debris from upstream clogs undersized bridges and culverts causing out-of-bank flooding. Barre Town and Barre City

could work with the Agency of Natural Resources to develop a plan for preventing and/or removing some woody debris that has fallen in the channel.

Notes and Responses from the Public: A participant noted that debris also catches on the railroad trestle across the Stevens Branch. It is possible a debris management plan would help to protect this structure as well.

4. Remove the Closed Harrington Avenue Bridge: This bridge was closed after flood damage in May 2011 and has experienced at least 4 debris clogs since 1998. Initial public input suggests losing the pedestrian crossing would be acceptable.

Notes and Responses from the Public: If the Harrington Ave. Bridge is removed, the problem could just move downstream to the Seminary St. Bridge. Regrading on the left side of the former bridge location could give debris a place to catch and prevent damage downstream.

Conversation continued about the East Barre Dam, and whether or not putting flood gates on it could reduce flooding downstream. The dam, however, has been designed to retain the maximum flood waters already though. It is unlikely there are modifications that would detain a significant amount of additional floodwater.

Dredging is a technique that is often thought to reduce flood problems by making the channel deeper to hold more water. However, dredged channels typically fill in again within a few years. Dredging also scours the bottom of the river, and where it starts to eat away at the toes of the river walls or banks, they risk collapsing or eroding further.

5. Replace Undersized Culvert on Plainfield Brook Road: This road provides important access to Route 14 and the culvert is prone to debris blockage. Subsequent flooding could overtop and wash out the road.
6. Monitor Stability of Plainfield Brook Road Embankment: The road parallels the brook, elevating risk of erosion to the bank and damage to the road. The embankment should be checked after significant storm events.

Notes and Responses from the Public: A participant was interested to know if there was potential for flood water storage in retention ponds along Gunners Brook. This is sometimes possible, but a great deal of space has to be set aside to make a difference in flood levels. The city owned ball field could conceivably be designed to store floodwater. The corner of

Route 62 stormwater project, e.g. the “big dig” will retain stormwater coming off of Main Street.

7. Replace Undersized Bridge on Upper Brook Street: Built in 1927, the undersized opening causes flooding during 10-year storm events. Flooding impacts single & multi-family structures and flows down Farwell Street.

Notes and Responses from the Public: There is a property where Brook Street meets Maple, and the house is 30 feet from the brook. Sloping the bank back here would reduce the property owner’s land. Mr. Murawski explained that engineers take many constraints into consideration when making recommendations and that ultimately communities are often faced with tough decisions when planning for the future.

High water from the Steven’s Branch will back up into Gunners Brook regardless of debris build up on steel beams or other structures on the Stevens Branch. This issue warrants further investigation to better understand the impacts of the Steven’s Branch on flooding in Gunners Brook.

8. Consider Voluntary Buy-outs of the Most At-Risk Buildings: This is recommended for the following reaches, and is a long-term strategy that would follow a feasibility study:
  - a. Right bank above upper Brook St. Bridge (3-4 structures)
  - b. Upper Brook Street Bridge to Dix Place (6-9 structures)
  - c. Dix Place to Main Street (8-10 structures)

Removing these buildings would end repeated damages and restore space for the river to use the floodplain. It would also allow woody debris to be deposited there in the floodplain instead of hanging up at bridges.

Notes and Responses from the Public: Buy-outs are conducted by evaluating the fair market value of the structure *before* the damage occurred. The FEMA Hazard Mitigation Grant program makes funding available for buy-outs, but there is also a 25% local match that would have to be provided by the municipality. Other communities have used Housing Conservation Board, and the Federal Housing & Urban Development Community Development Block Grants to meet this local contribution. Property owners must also demonstrate repeated occurrences of damage to access FEMA funding for buy-outs.

Other concerns regarding buy-outs were that the properties would no longer generate revenue for the Town/City grand list, and that a significant amount of housing capacity would be lost. Many of the properties recommended for buy-out are multi-family. The feasibility study investigating this recommendation further could look into alternatives for replacement housing capacity.

There was a discussion of whether or not the buy-outs would still produce the desired effect if only a portion of structure owners agreed to the buy-out. As this is a long-term strategy, not all of the buy-outs would need to happen all at once to gain long-term benefit. The first few structures removed would contribute to restoring the floodplain, and the community could continue planning for future buy-outs to improve the situation over time.

## **General Discussion**

After learning about projects and strategies that are recommended by the VERI Team, the audience continued general discussion about reducing flood risk in Barre Town and Barre City. The following points were made:

- Buying and converting a vacant building in the floodplain into a parking lot for a business would help to restore flood storage space. Without well designed stormwater management, the lot would contribute to stormwater run-off volumes because pavement does not allow rainwater to filter into the ground. This would not make a big difference during the largest flooding events, but would contribute to cumulative stormwater impacts.
- One resident has been flooded four times at his house and always responded to the damage using his own resources rather than relying on the City.
- Flooding in Barre Town and Barre City has been increasing for the last 15 years and this trend is also occurring throughout the state.

## **Project Prioritization**

Sticky dots were handed out for people to place on the charts to prioritize project recommendations in Barre City and Barre Town. The community's ranking of the high priority projects can act as a road map for the community to follow moving ahead. The results of the project prioritization are below, in order of popularity - with number of sticky dots received in parenthesis.

1. Replace undersized bridge on Upper Brook Street (23)
2. Consider buyouts for 6-9 of the most at-risk buildings between upper Brook Street Bridge and Dix Place (14)
3. Remove the now closed Harrington Avenue Bridge (12)
4. Replace undersized bridge on North Main Street (8)
5. Consider buyouts for 3-4 at-risk buildings on right bank above upper Brook Street Bridge (7)
6. Consider buyouts for 8-10 of the most at-risk buildings between Dix Place and Main Street (6)
7. Develop and implement a Debris Management Plan (4)
8. Repair failed channel walls throughout City using the Flood Resilient Design Standard (3)
9. Update policies allowing fill in flood hazard areas (2)
10. Emphasize watershed-wide stormwater planning to reduce flooding impacts (2)
11. Replace undersized culvert on Mitchell Road (2)
12. Develop a Flood Resilient Design Standard for channel walls throughout the City (2)
13. Preserve floodplain near the Barre City/Barre Town line (2)
14. Educate business owners, landlords and contractors about flood resilience (1)
15. Educate people about the causes, risks and warning signs of floods (1)
16. Require repaired and rebuilt structures to be built higher (1)
17. Document damages from flood events (1)
18. Document road, sewer, and water infrastructure vulnerabilities in municipal and capital plans (1)
19. Floodproof multiple buildings in floodplain from upper Brook Street Bridge down to the Stevens Branch (1)
20. Remove multiple unused outbuildings adjacent to channel from upper Brook Street bridge to Stevens Branch (1)

## **Next Steps and Where to Get Help**

Barre City and Barre Town have already taken steps to make the town safer, and continuing with this effort is in everyone's best interest. The Barre community can become more flood resilient by understanding the risks and developing bylaws, policies, plans, and projects which address those risks. Community members can help the municipalities to:

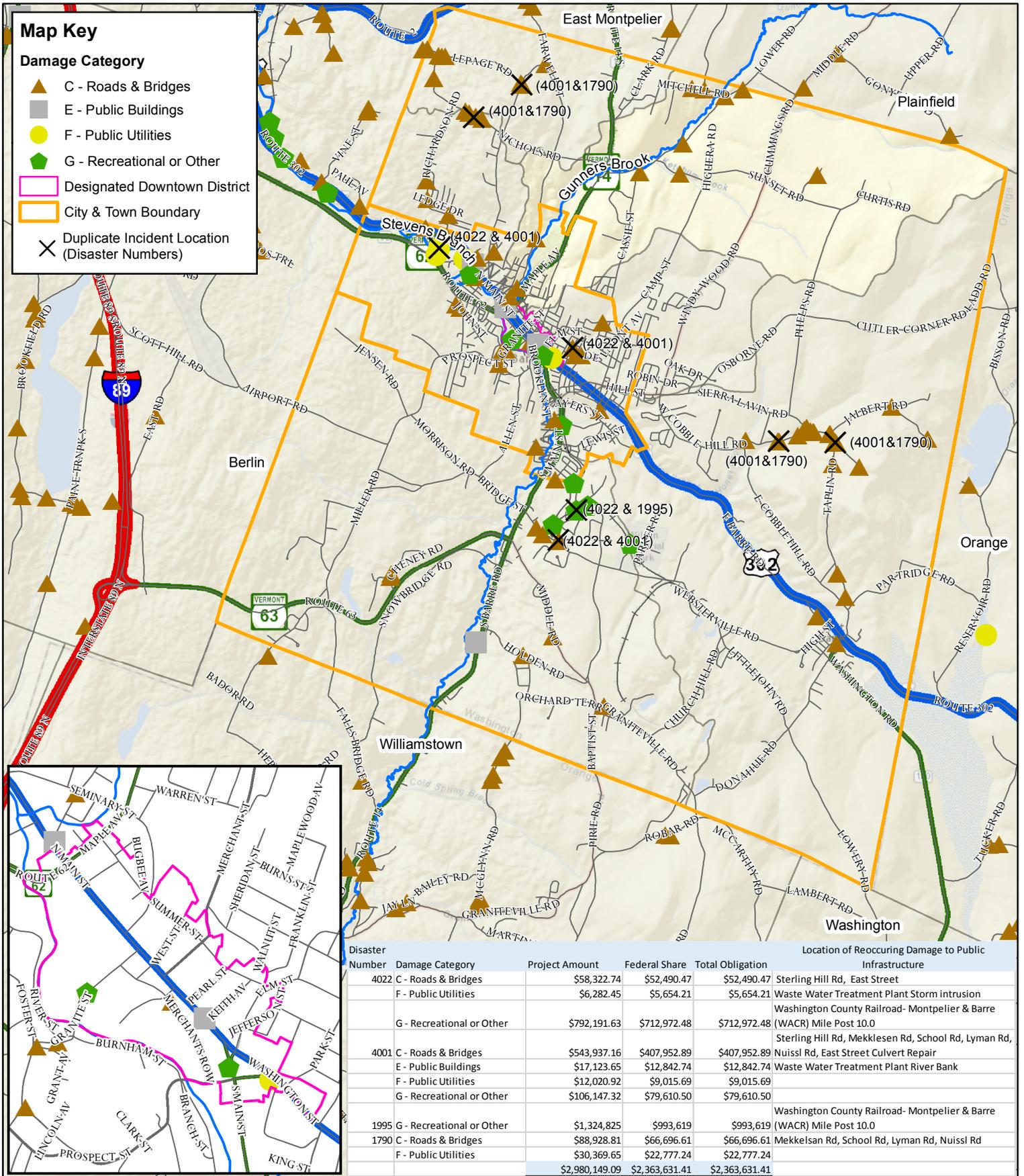
- Prioritize projects to better secure funding.
- Prioritize projects that have support across multiple sectors, municipal government, business, real estate & banking, service and non-profit organizations.

- Try to do a couple of projects per year, not all at once, to better identify resources and to build momentum.
- Know who owns your town's work plan- City Council, Planning Commission, Fire Department or others.

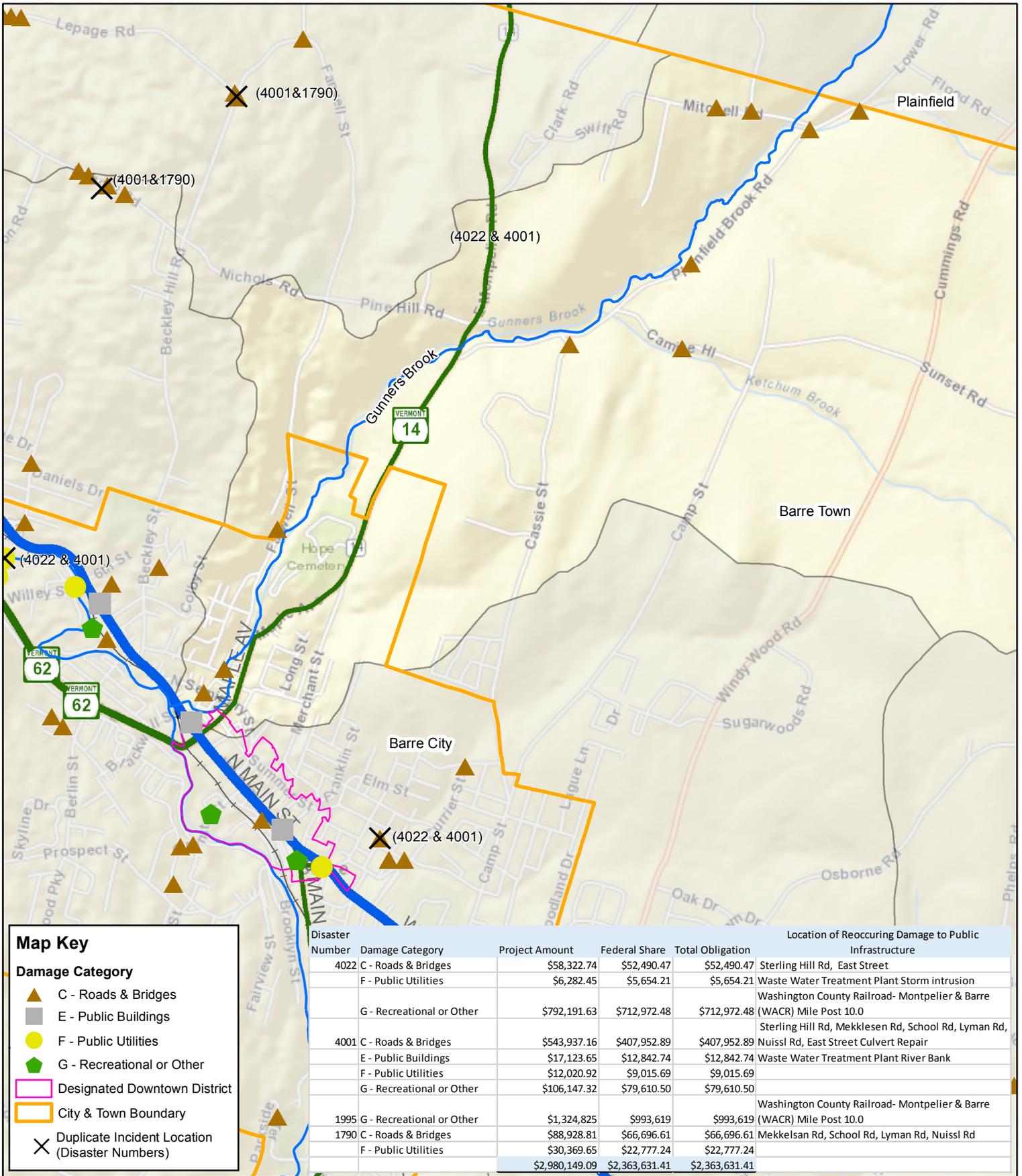
Any comments or suggestions on the draft report can still be sent to Wendy Rice via the VERI website. The final report will be ready for distribution in late May.

**Appendix M:**  
**Maps of Repetitive Damage for Barre City and Town**

# Gunners Brook and Stevens Branch, Barre City & Barre Town, VT



# Gunners Brook, Barre City & Barre Town, VT



# Vermont Economic Resiliency Initiative [VERI]

## Consultant Team



**Fitzgerald Environmental Associates, LLC.**

Applied Watershed Science & Ecology



**MILONE & MACBROOM**

*Engineering, Planning,  
Landscape Architecture  
and Environmental Science*



**VERMONT**

**AGENCY OF COMMERCE & COMMUNITY DEVELOPMENT  
DEPARTMENT OF HOUSING & COMMUNITY DEVELOPMENT**