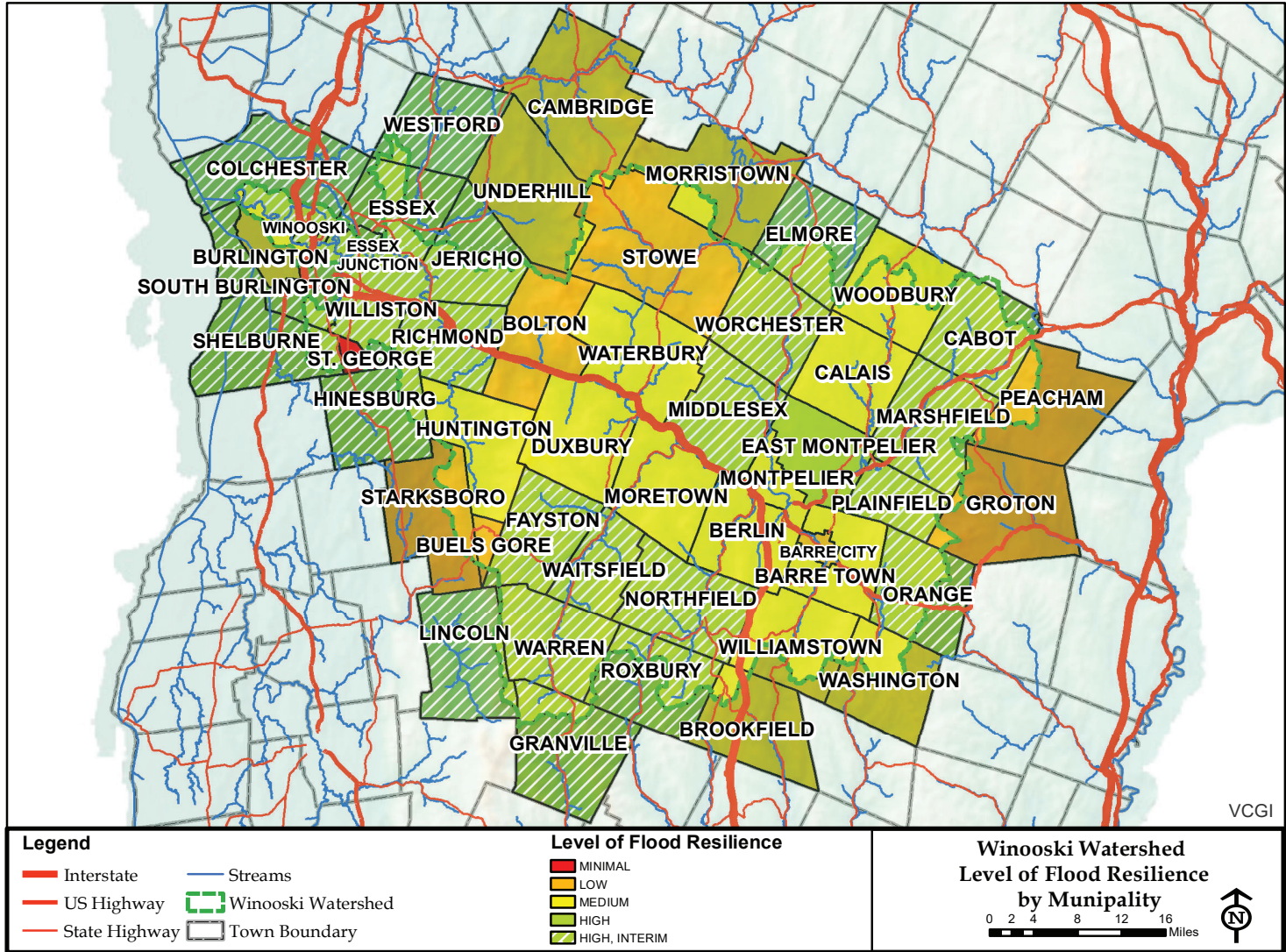


FIGURE 2. Winooski River Watershed municipalities and their flood resilience ratings from this scorecard.



Map created by University of Vermont Spatial Analysis Lab

Erosional Flood Resilience Scorecard

for Communities of the Winooski Watershed of Vermont

Background

As a result of human alterations to rivers, many Vermont streams have lost their connection to their floodplains, putting local communities at greater risk of damage and economic loss due to erosion and flooding during high flow events (Kline 2016). Since European settlement, impacts have included increased sediment transport due to deforestation, channelization of streams for railroads, ditching of them for agriculture, and removal of gravel from them for road construction (Kline 2016). Increased impervious surfaces in urban and suburban areas influences the volume, duration and impact of stormwater during rain events (Kline 2016). Extreme events are predicted to occur more regularly as the climate warms (Melillo et al. 2014).

Tropical Storm Irene caused more than \$733 million in damage to 800 buildings and 500 miles of roads, including 300 bridges in Vermont on August 28, 2011 (Pierre-Lewis 2016). The storm brought between 5 and 11.2 inches of rain in a 24-hour period to the hardest hit communities within Vermont (Masters 2011). Between August and September 2011, some areas of Vermont received an average of 25 inches of rain, two-thirds the average annual rainfall (U.S. Climate Data 2017).

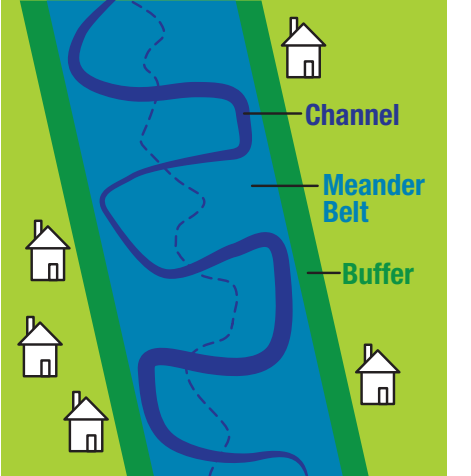
River Corridors and Financial Support in Times of Loss

In partnership with numerous collaborating organizations, the State has identified river corridors for streams and rivers in Vermont. River corridors include the area needed by the river to minimize erosion and ensure bank stability. This area includes the river channel, the area encompassed within the full width of the meander belt, and a buffer, as shown in Figure 1. If protected from development, river corridors allow rivers room to move over time. Protected river corridors can help minimize communities' economic losses due to damages caused by erosional flooding.

While the National Flood Insurance Program (NFIP) provides emergency relief funds to registered communities when damage to homes and businesses occurs due to inundation flooding, damage due to erosional flooding is not covered by that program. Federal funds may be available to cover 75% of damages from erosional flooding if a disaster is federally-declared. The State of Vermont will supplement those funds, contributing an additional 7.5% towards clean-up efforts.

Additionally, if communities take certain steps to project river corridors, the State offers increasing incentives (12.5% and 17.5% of costs) for erosional flood relief assistance through the Emergency Relief and Assistance Fund (ERAF).

FIGURE 1. River corridors include the channel and area encompassed within the full width of the meander belt.



Source: Vermont Rivers Program

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Photo Credit: Lars Gange & Mansfield Heliflight. <http://www.mansfieldheliflight.com/flood/index2.html>

Disclaimer: This scorecard is designed to provide a generalized view of community flood resilience based on policies in towns across the watershed. However, criteria used to develop this scorecard may have more or less significance in any given town, and resilience is dependent upon a wide variety of factors, some of which may not be reflected in this tool (e.g., the town's location in the watershed, geology, soils, slope, amount and location of development). Each town should work with the local Regional Planning Commission, Vermont Rivers Program, or other local technical assistance agency staff to generate a more complete assessment of their resilience to flood events.



Prevention Strategies Communities Can Adopt to Ensure a Strong Economic Outlook for Years to Come

Communities can take a number of steps to minimize economic losses in the event of flooding.

For ERAF 12.5% support, the Vermont Rivers Program indicates communities have “adopted four mitigation measures:

1. **National Flood Insurance Program** (participate or have applied)
2. **Town Road and Bridge Standards** (adopt standards that meet or exceed the 2013 template in the current VTrans Orange Book Handbook for Local Officials found at: <http://vtrans.vermont.gov/operations>)
3. **Local Emergency Operations Plan** (adopt annually after town meeting and before May 1)
4. **Local Hazard Mitigation Plan** - Adopt a Federal Emergency Management Agency (FEMA)- approved local plan (valid for five years). Or, a draft plan has been submitted to FEMA Region 1 for review.”



For the full 17.5% support available from ERAF, the Vermont Rivers Program indicates that communities must additionally “protect river corridors from new encroachment; or, protect their flood hazard areas from new encroachments and participate in the FEMA Community Rating System.”

Communities in Vermont have adopted more and more protections to build flood resiliency, but many communities still bear significant economic risks by lacking sufficient river corridor protections (Table 1). Adopting river corridor protections is a fairly new option that the Vermont Rivers Program, Regional Planning Commissions, and partner organizations are working diligently to assist communities in understanding, and to aid them in adopting.

TABLE 1. Flood resiliency practices adoption rates among Vermont communities over time.

ACTION	PERCENT OF VERMONT COMMUNITIES			
	JUNE 2014	JANUARY 2015	JULY 2016	JANUARY 2017
NFIP	87	89	89	89
2013 Road and Bridge Standards	70	80	91	93
Local Emergency Operations Plan	36	66	80	92
Local Hazard Mitigation Plan	35	44	64	69
River Corridor Protection	20	23	27	29

Source: Vermont Rivers Program

What Is Your Community’s Level of Flood Resilience?

This scorecard helps communities visualize the actions that other communities up and downstream of them have taken to minimize economic risks during a flood. Such actions can help – or lack of actions can harm – surrounding communities during a flood event. Scorecard users should recognize that the suite of policies towns have adopted must be both enforced and implemented holistically in a community (e.g., not removing a village from a fluvial erosion hazard area) to provide effective resilience during a flood. Additionally, there may be a variety of other actions that towns with high ratings in this scorecard can take to be most resilient in a flood.

Table 2 ranks Vermont communities in the Winooski River Basin based on actions they have taken related to the state guidelines. Those with minimal levels of flood resilience have no protections against economic impacts due to floods. Those with low levels of resilience at a minimum participate in the National Flood Insurance Program, and may have adopted one or two additional mitigation measures of the four listed above. Those with medium levels of resilience have adopted all four of the mitigation measures listed above, but have not fully protected river corridors from new encroachment. Finally, those with highest level of flood resilience have protected river corridors from new encroachments. Some towns with high resilience have passed only interim measures for some of the categories. These measures will cease to be recognized by the state two years after statewide river corridor maps are updated to include Vermont Rivers Program designated “Phase 2” field data. In the table, these towns are marked with diagonal shading. Visit: http://floodready.vermont.gov/assessment/community_reports to see the Vermont Rivers Program’s Community reports for more details.

Refer to the following table and map to see how your community rates.

TABLE 2. Winooski River Watershed flood resilience ratings by community

MUNICIPALITY	NFIP (year)	LEVEL OF FLOOD RESILIENCE BASED ON ADOPTED POLICIES			
		Minimal	Low	Medium	High
Barre City	1985		X		
Barre Town	1978			X	
Berlin	1984			X	
Bolton	1981		X		
Brookfield	2008			X	
Buels Gore			X*		
Burlington	1978			X	
Cabot	1985				X
Calais	1985			X	
Cambridge	1983			X	
Colchester	1982				X
Duxbury	1982			X	
East Montpelier	1983				X
Elmore	1989				X
Essex	1981				X
Essex Junction	2012				X
Fayston	1980				X
Granville	1991				X
Groton	1991		X		
Hinesburg	1985				X
Huntington	1978			X	
Jericho	1981				X
Lincoln	1986				X
Marshfield	1984				X
Middlesex	1982				X
Montpelier	1973			X	
Moretown	1978			X	
Morristown	1979			X	
Northfield	1978				X
Orange	1985				X
Peacham	2011		X		
Plainfield	1983				X
Richmond	1982				X
Roxbury	1986				X
Saint George		X			
Shelburne	1980				X
South Burlington	1981				X
Starksboro	1985		X		
Stowe	1980		X		
Underhill	1988			X	
Waitsfield	1978				X
Warren	1977				X
Washington	1998			X	
Waterbury	1982			X	
Westford	2010				X
Williamstown	1978			X	
Williston	1981				X
Winooski	1978				X
Woodbury	1985			X	
Worcester	1978				X

Sources: http://floodready.vermont.gov/assessment/community_reports#RCProtection and Chittenden County Regional Planning Commission
*Does not participate in NFIP as has no mapped floodplain.