

# **Upper West Branch Little River Corridor Plan**

**Stowe, Vermont  
October 12, 2010**



Prepared by:  
Bear Creek Environmental, LLC  
297 East Bear Swamp Road  
Middlesex, Vermont 05602



Prepared for:  
The Lamoille County Planning Commission  
632 LaPorte Road  
Morrisville, VT 05661

# Upper West Branch Little River Corridor Plan Stowe, Vermont

## Table of Contents

<b>1.0 EXECUTIVE SUMMARY</b> .....	<b>1</b>
<b>2.0 LOCAL PLANNING PROGRAM OVERVIEW</b> .....	<b>2</b>
2.1 RIVER CORRIDOR PLANNING TEAM .....	2
2.2 GOALS AND OBJECTIVES OF THE PROJECT .....	2
<b>3.0 BACKGROUND WATERSHED INFORMATION</b> .....	<b>3</b>
3.1 GEOGRAPHIC SETTING .....	3
3.1.1 Watershed Description .....	3
3.1.2 Political Jurisdictions .....	3
3.1.3 Land Use .....	3
3.2 GEOLOGIC SETTING .....	7
3.3 GEOMORPHIC SETTING .....	10
3.4 HYDROLOGY .....	14
3.5 ECOLOGICAL SETTING .....	15
<b>4.0 METHODS</b> .....	<b>18</b>
4.1 PHASE 1 METHODOLOGY .....	18
4.2 PHASE 2 METHODOLOGY .....	18
4.3 BRIDGE AND CULVERT .....	18
4.4 RIVER CORRIDOR PLAN .....	19
4.5 QUALITY CONTROL/QUALITY ASSURANCE PROCEDURES .....	19
<b>5.0 RESULTS</b> .....	<b>19</b>
5.1 PHASE 2 RESULTS .....	19
5.2 BRIDGE AND CULVERT ASSESSMENT .....	29
<b>6.0 STRESSOR, DEPARTURE AND SENSITIVITY ANALYSIS</b> .....	<b>34</b>
6.1 STRESSOR IDENTIFICATION .....	34
6.1.1 Hydrologic Regime Stressors .....	34
6.1.2 Sediment Regime Stressors .....	34
6.1.3 Channel Modifiers .....	38
6.1.4 Boundary Conditions and Riparian Modifiers .....	38
6.2 DEPARTURE ANALYSIS .....	41
6.3 SENSITIVITY ANALYSIS .....	42
<b>7.0 PRELIMINARY PROJECT IDENTIFICATION AND PRIORITIZATION</b> .....	<b>47</b>
7.1 WATERSHED-LEVEL OPPORTUNITIES .....	48
7.2 REACH-LEVEL OPPORTUNITIES .....	49
7.3 SITE LEVEL OPPORTUNITIES .....	56
7.4 NEXT STEPS .....	80
<b>8.0 GLOSSARY OF TERMS</b> .....	<b>81</b>
<b>9.0 REFERENCES</b> .....	<b>84</b>



## Bear Creek **Environmental**

297 East Bear Swamp Road, Middlesex, Vermont 05602  
Phone: (802) 223-5140 / Fax: (802) 229-4410

# Upper West Branch Little River Corridor Plan Stowe, Vermont

## 1.0 EXECUTIVE SUMMARY

The River Corridor Planning effort is sponsored by the Lamoille County Planning Commission (LCPC) with funding provided through a grant from the Agency of Natural Resources Clean and Clear Program and the Federal Emergency Management Agency (FEMA). The Vermont Department of Environmental Conservation (DEC) River Management Program provided technical expertise and shared quality control/quality assurance responsibilities with Bear Creek Environmental, LLC (BCE). The River Corridor Plan (RCP) followed the Vermont Agency of Natural Resources River Corridor Planning Guide. Information for the RCP came from the DEC, the Vermont Center for Geographic Information (VCGI), and field data collected by BCE and LCPC.

The primary objective of the RCP is to use stream geomorphic assessment data to identify and prioritize river corridor protection and restoration projects within the West Branch of the Little River watershed, primarily in the Town of Stowe. A planning strategy based on fluvial geomorphic science (see glossary at end of report for associated definitions) was chosen because it provides a holistic, watershed-scale approach to identifying the stressors on river ecosystem health. The stream geomorphic assessment data can be used by resource managers, community watershed groups, municipalities and others to identify how changes to land use alter the physical processes and habitat of rivers. The Vermont Stream Geomorphic Assessment Protocol includes three phases:

1. Phase 1- Remote sensing and cursory field assessment;
2. Phase 2 – Rapid habitat and rapid geomorphic assessment to provide field data to characterize the current physical condition of a river; and
3. Phase 3 – Detailed survey information for designing “active” channel management projects.

A Phase 1 Stream Geomorphic Assessment following Agency of Natural Resources Protocols was completed for the West Branch Little River watershed by Lamoille County Planning Commission (LCPC) during summer 2005. During Phase 1, the West Branch watershed was divided into 72 reaches, encompassing roughly 47 miles of river channel.

In the fall of 2005, a Phase 2 Stream Geomorphic Assessment following Agency of Natural Resources Protocols was completed for the lower portion of the West Branch (downstream of the Ranch Brook confluence) by BCE. A corridor plan for the lower West Branch using the stream geomorphic assessment information was prepared in 2007 by LCPC (Lamoille County Planning Commission 2007). To expand the corridor planning to the rest of the West Branch watershed, a Phase 2 assessment on the West Branch main stem (upstream of Ranch Brook

confluence), Pinnacle Brook, Inn Brook, Big Spruce Brook, and Long Trail Tributary was conducted in 2008; approximately 7 miles of river were assessed. Bridge and culvert data collected by BCE during the Phase 2 assessment were used to identify structures that have the potential to fail because of channel adjustments, are having a geomorphic impact on the stream, or are impeding aquatic organism passage. Stream geomorphic and habitat data collected during 2008 were used to develop the corridor plan for the upper West Branch watershed.

The major problems in the upper West Branch watershed include channel straightening associated with the construction of roads and development. Alteration of stream channels has caused major to extreme channel degradation resulting in sediment build up, channel widening and planform adjustment. Many of the small streams, such as Inn Brook, have undersized stream crossing that are causing localized geomorphic instability and are impeding aquatic organism passage. High quality streamside buffers are lacking along Inn Brook and some areas of the West Branch and Big Spruce Brook. Generally the West Branch above the Ranch Brook confluence and Pinnacle Brook have high quality forested buffers that are worthy of conservation.

As the river works toward a more stable equilibrium, the community of Stowe has the opportunity to provide long-term protection to the river corridor and encourage the reestablishment of floodplain vegetation and healthy instream habitat. At the reach and site level, potential restoration and protection projects that would be compatible with geomorphic adjustments and managing the stream toward equilibrium conditions were identified. A list of 23 potential restoration and conservation projects was developed during project identification. Types of projects include: river corridor protection through corridor easements and conservation efforts, replacing undersized structures causing localized channel instability, improving riparian buffers, and arresting active channel incision.

## **2.0 LOCAL PLANNING PROGRAM OVERVIEW**

### **2.1 River Corridor Planning Team**

The river corridor planning team for the Upper West Branch Little River watershed is comprised of the Lamoille County Planning Commission, the Agency of Natural Resources, Bear Creek Environmental, LLC, local municipalities and landowners. This planning effort is sponsored by the Lamoille County Planning Commission. Funding for the project is provided through a grant from the Clean and Clear Program and FEMA. Gretchen Alexander from the Vermont River Management Section of the Vermont Agency of Natural Resources (VANR) provided technical guidance for this project.

### **2.2 Goals and Objectives of the Project**

The primary objective of the River Corridor Management Plan is to use the Phase I and 2 Stream Geomorphic Assessment data to identify and prioritize river corridor protection and restoration projects within the West Branch watershed. The State of Vermont's River Management Program has set out several goals and objectives that are supportive of the local initiative in the West Branch watershed. The state management goal is to, "manage toward, protect, and restore the fluvial geomorphic equilibrium condition of Vermont rivers by resolving conflicts between human investments and river dynamics in the most

economically and ecologically sustainable manner” (Vermont Agency of Natural Resources, 2007b). The objectives of the Program include fluvial erosion hazard mitigation and sediment and nutrient load reduction, as well as aquatic and riparian habitat protection and restoration. The Program seeks to conduct river corridor planning in an effort to remediate the geomorphic instability that is largely responsible for problems in a majority of Vermont’s rivers. Additionally, the Vermont River Management Program has set out to provide funding and technical assistance to facilitate an understanding of river instability and the establishment of well developed and appropriately scaled strategies to protect and restore river equilibrium.

## **3.0 BACKGROUND WATERSHED INFORMATION**

### **3.1 Geographic Setting**

#### **3.1.1 Watershed Description**

The West Branch has a watershed size of 27.7 square miles (Figure 3.1). The Phase 2 study focused on stream reaches on the main stem of the West Branch upstream of the Ranch Brook confluence, and the lowest stream reaches on Pinnacle Brook, Inn Brook, Big Spruce Brook, and Long Trail Tributary. The combined length of the stream reaches assessed is 6.7 miles. The West Branch begins on Mt Mansfield and flows southeast towards the Little River, which then enters the Winooski River at approximately 390 feet above sea level and drains westerly into Lake Champlain.

#### **3.1.2 Political Jurisdictions**

The West Branch watershed flows through three towns (Cambridge, Underhill, and Stowe). The West Branch watershed falls under the jurisdiction of the LCPC and the Chittenden County Regional Planning Commission. This project focused on only those reaches within Lamoille County (Figure 3.2).

The Mount Mansfield Natural Area and Mount Mansfield State Forest are public lands within the West Branch watershed. A description of each of these areas is included under Section 3.5 (Ecological Setting).

#### **3.1.3 Land Use**

Geographic Information System (GIS) data from 1992 was obtained from the Vermont Center for Geographic Information (VCGI) to analyze land use within the West Branch watershed. The majority of the West Branch is forested (Figure 3.3). The land use breakdown for the watershed is 77 percent forest, 12 percent agriculture, 5 percent developed and urban land, 5 percent water and 1 percent wetland. The most concentrated areas of development in the watershed are along the Mountain Road in Stowe. Agricultural lands are prevalent within the lower portion of the watershed including the West Branch corridor. Lands marked as agricultural lands in the upper part of the West Branch are actually ski trails and not agricultural land.

### West Branch Little River Watershed Project Location Map

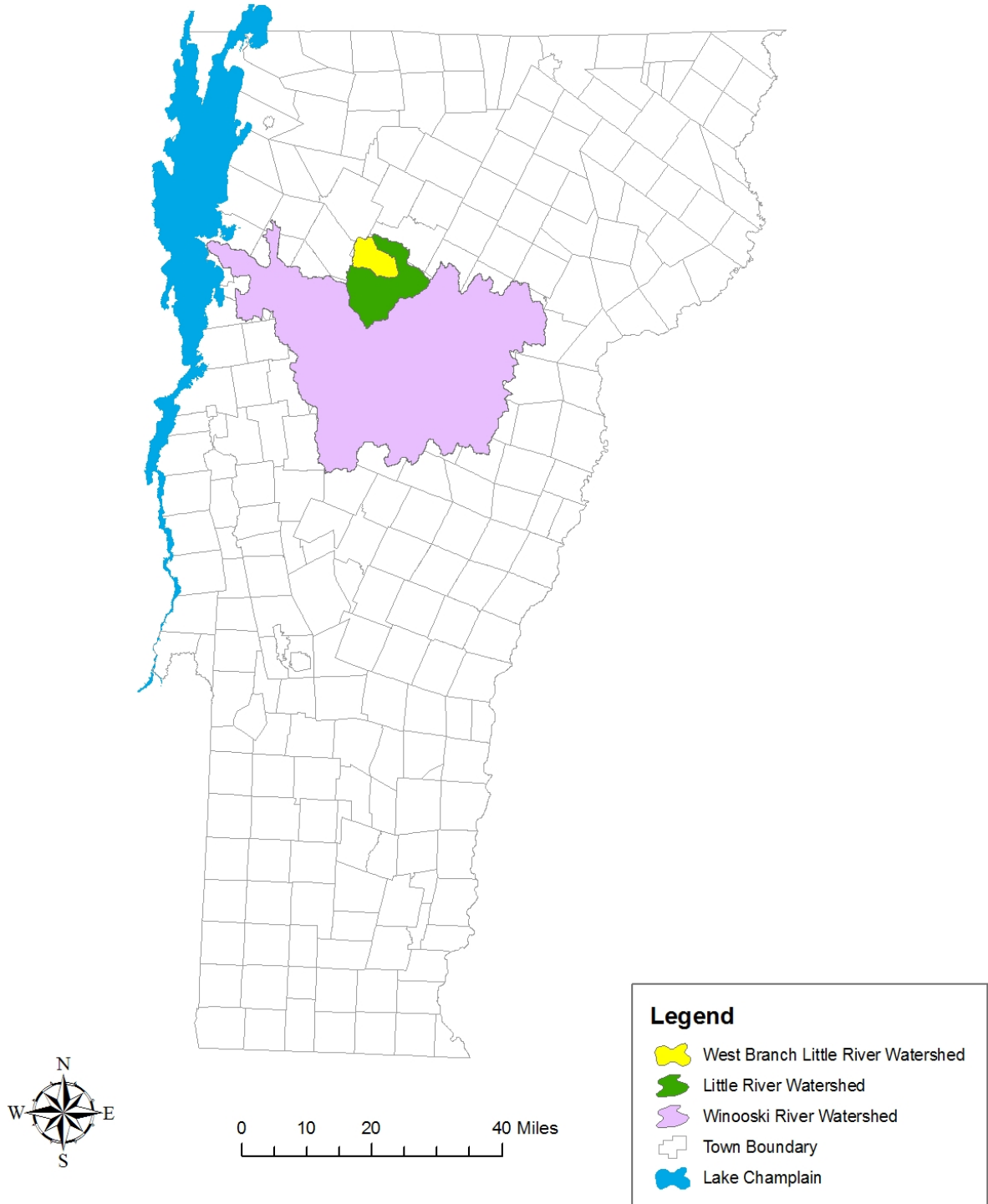


Figure 3.1. Project Location Map for the West Branch Little River Watershed

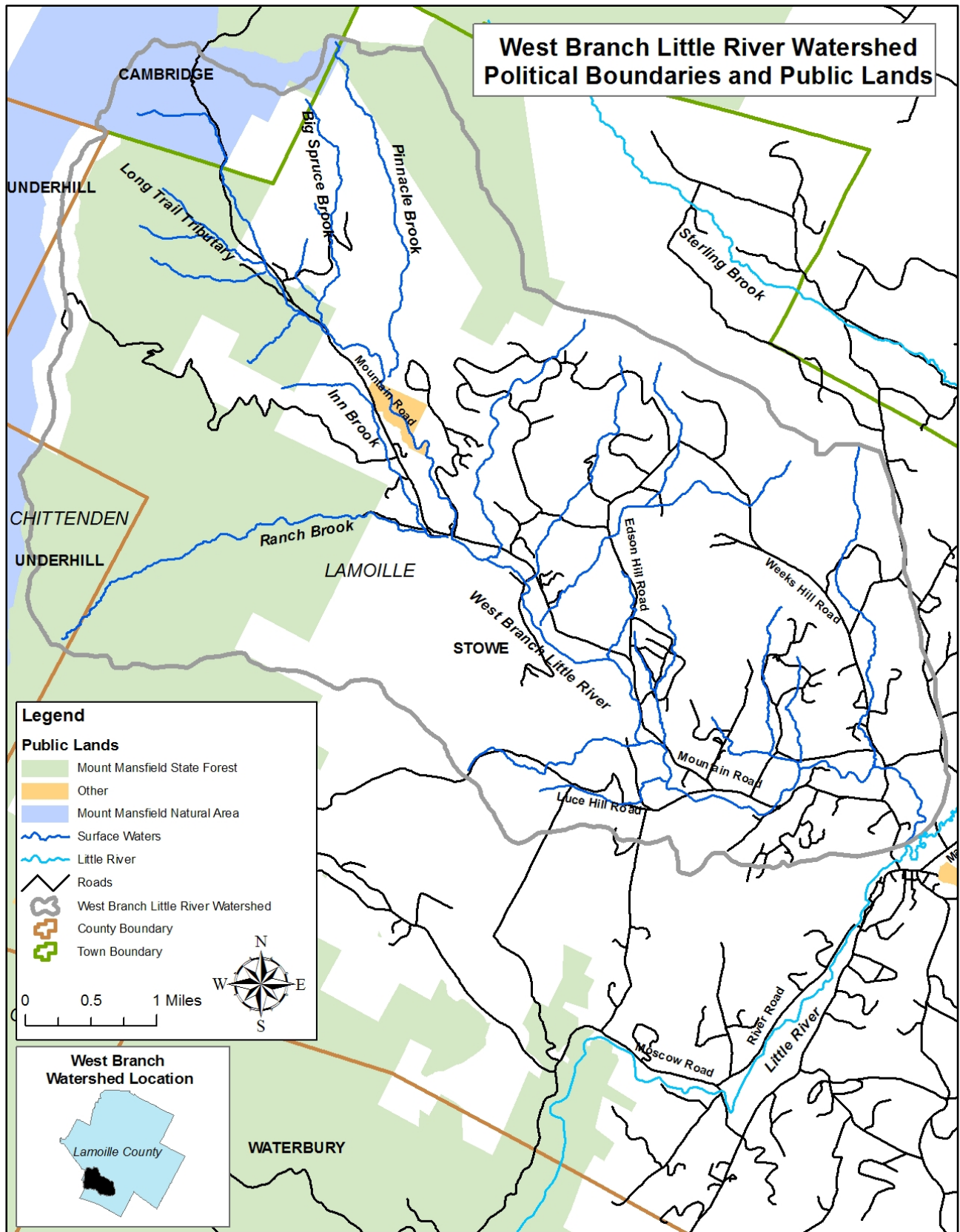


Figure 3.2. West Branch Little River Political Boundaries and Public Lands

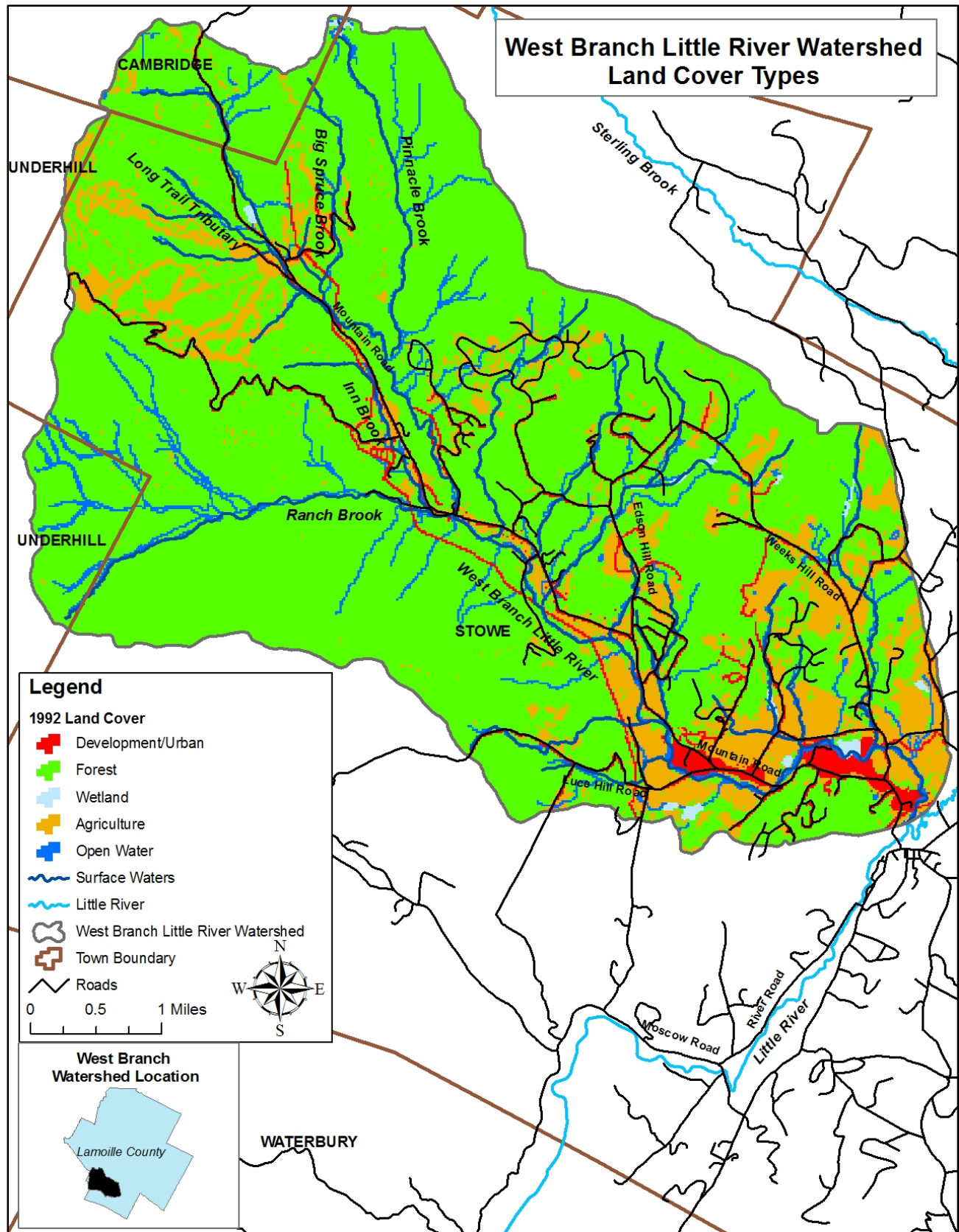


Figure 3.3. Land Cover and Land Use Map for the West Branch Little River Watershed

### **3.2 Geologic Setting**

The West Branch watershed is located within the Green Mountain Geo-physiographic Province. The Green Mountains were uplifted during the Taconic orogeny about 455 million years ago (Doolan, 1996). The bedrock of the West Branch watershed primarily consists of the Hazens Notch Formation. The Hazens Notch Formation is comprised of interbedded carbonaceous and noncarbonaceous schist (Doll, 1961). More detailed geologic mapping of the Mt. Mansfield area shows that generally between Bingham Falls and Ranch Brook the bedrock is dominated by the Fayston Formation. The Fayston Formation consists of aluminous phyllite and schist and chlorite-quartz-muscovite schist and gneiss (Thompson and Thompson, 2000).

The Green Mountains and adjacent valleys have been covered with ice during historic glacial periods. The last large ice sheet, the Laurentide Ice Sheet, covered all of New England and advanced up over the Green Mountains. Glacial striations in the bedrock of the Green Mountains show that the glacier moved from northwest to southeast (Wright, 2003). As the climate warmed, the glacier slowly retreated. Following the retreat of the ice sheet, the Winooski River and its tributaries, including the Little River and the West Branch, began eroding the sediments left behind by the glacier (Wright, 2003).

Natural Resource Conservation Service (NRCS) soils information for the West Branch watershed was acquired from the Vermont Center for Geographic Information. The dominant surficial geology of the West Branch watershed consists of glacial till as shown in Figure 3.4. Outwash (ice-contact deposits), alluvial and lacustrine deposits are subdominant within the watershed. Alluvial deposits and lacustrine are the dominant soil parent materials within the lower West Branch corridor, while outwash is dominant within the upper West Branch corridor. The watershed is primarily comprised of highly erodible and potentially highly erodible soils (Figure 3.5). Where there are highly erodible soils there is a higher potential for sediment input to the stream channel. Within the West Branch corridor, there are concentrated areas of non-highly erodible soils within the West Branch corridor downstream of the Ranch Brook confluence.

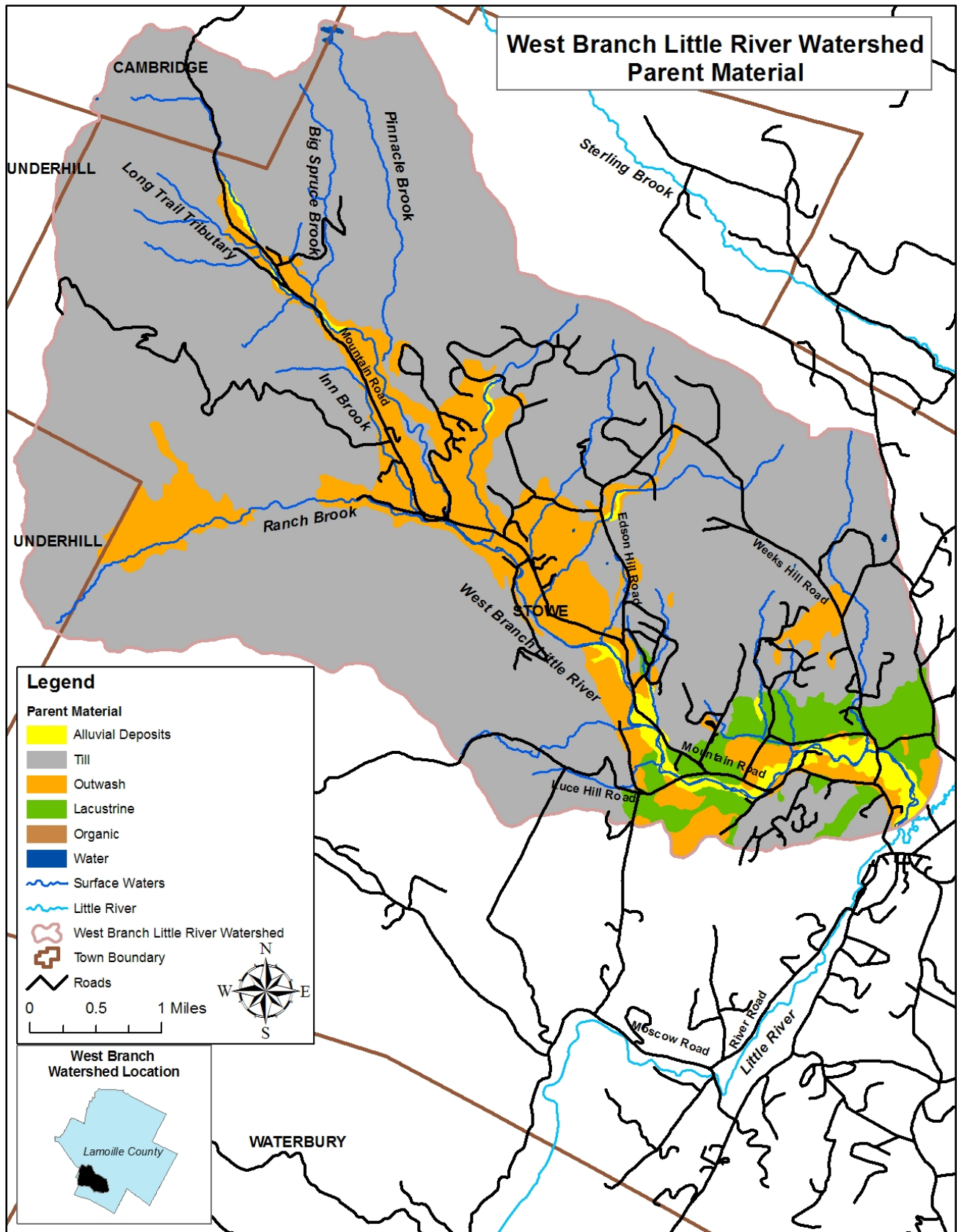


Figure 3.4 West Branch Little River Watershed Soil Parent Material

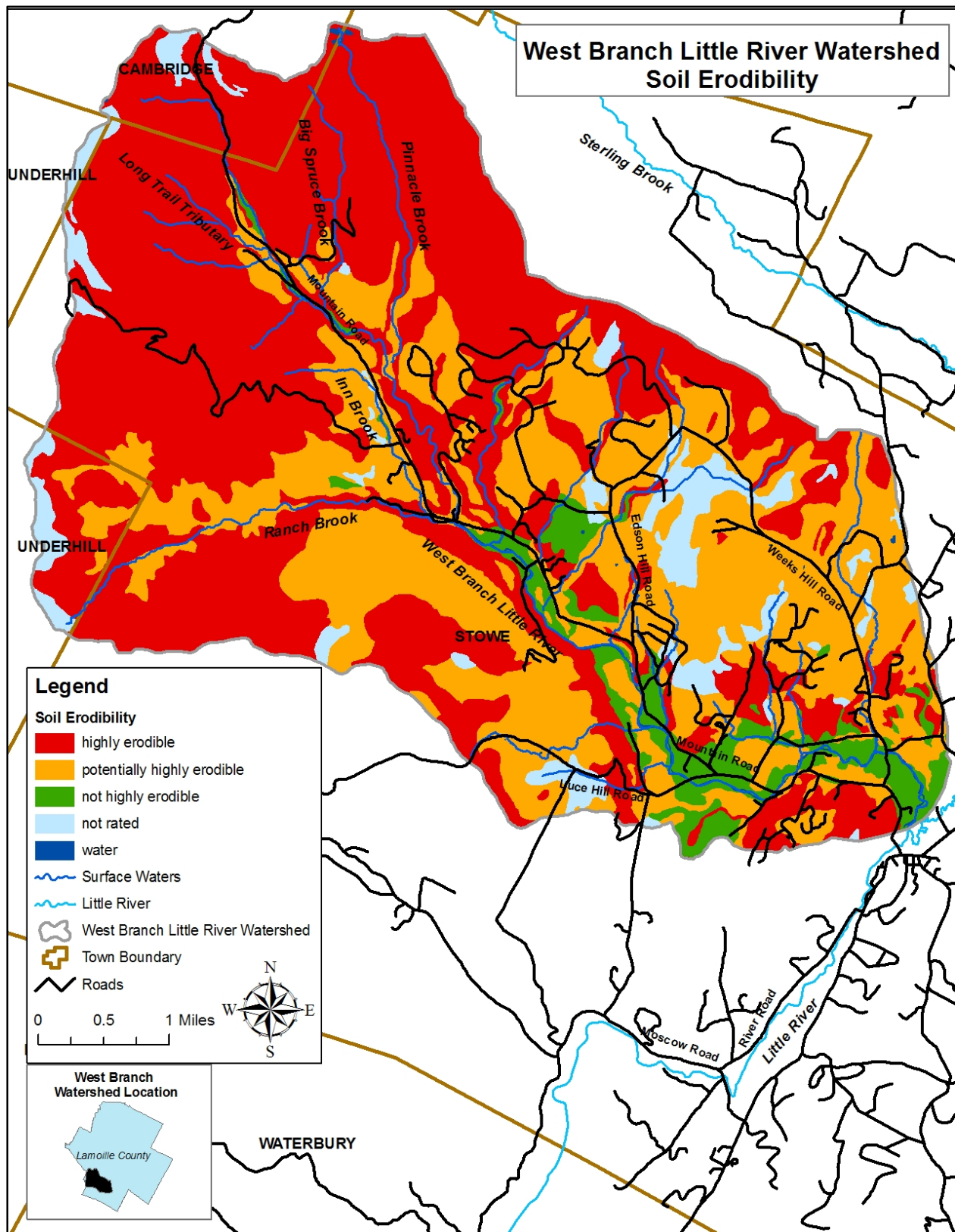


Figure 3.5 West Branch Little River Soil Erodibility

### 3.3 Geomorphic Setting

A Phase I Stream Geomorphic Assessment was conducted on 72 reaches of the main stem of the West Branch and its major tributaries (Peterson Brook, Ranch Brook, Pinnacle Brook, Big Spruce Brook, Little Spruce Brook, Inn Brook, Long Trail Tributary, and sixteen unnamed tributaries). The Phase 2 study of the upper West Branch watershed focused on three stream reaches on the main stem of the West Branch, one reach on Pinnacle Brook, three reaches on Big Spruce Brook, one reach on Inn Brook, and one reach on Long Trail Tributary. The combined length of the stream reaches assessed during the Phase 2 study is approximately 7 miles (Figure 3.6). Each reach represents a similar section of the stream based on physical attributes such as valley confinement, slope, sinuosity, bed material, dominant bedform, land use, and other hydrologic characteristics. Each point represents the downstream end of the reach.

Reference stream types are based on the valley type, geology and climate of a region and describe what the channel would look like in the absence of human-related changes to the channel, floodplain, and/or watershed. Stream and valley characteristics including valley confinement, and slope were determined from digital USGS topographic maps. The reference reach characteristics were refined during the windshield survey and Phase 2 Assessment. Reference reach typing was based on both the Rosgen (1996) and the Montgomery and Buffington (1997) classification systems. Table 1 shows the typical characteristics used to determine reference stream types (Vermont Agency of Natural Resources, 2007b).

Table 2 lists the reference stream types for assessed reaches in the upper West Branch watershed. Reaches assessed for Phase 2 on Inn Brook and Long Trail Tributary are “C” channels by reference (Figure 3.7). Reference “C” channels have unconfined valleys with moderate to gentle valley slopes and moderate to high width to depth ratios and sinuosity. The two most downstream reaches on Big Spruce Brook are “C” channels by reference and the most upstream reach assessed for Phase 2 is a “B” channel by reference. “B” channels have moderate to steep slopes and have narrower valleys than “C” channels. On the West Branch, the two most downstream reaches assessed for Phase 2 are “B” channels by reference and the most upstream assessed reach is a “C” channel. The reach assessed for Phase 2 on Pinnacle Brook is an “A” channel by reference. “A” channels have very steep slopes and are confined or narrowly confined.

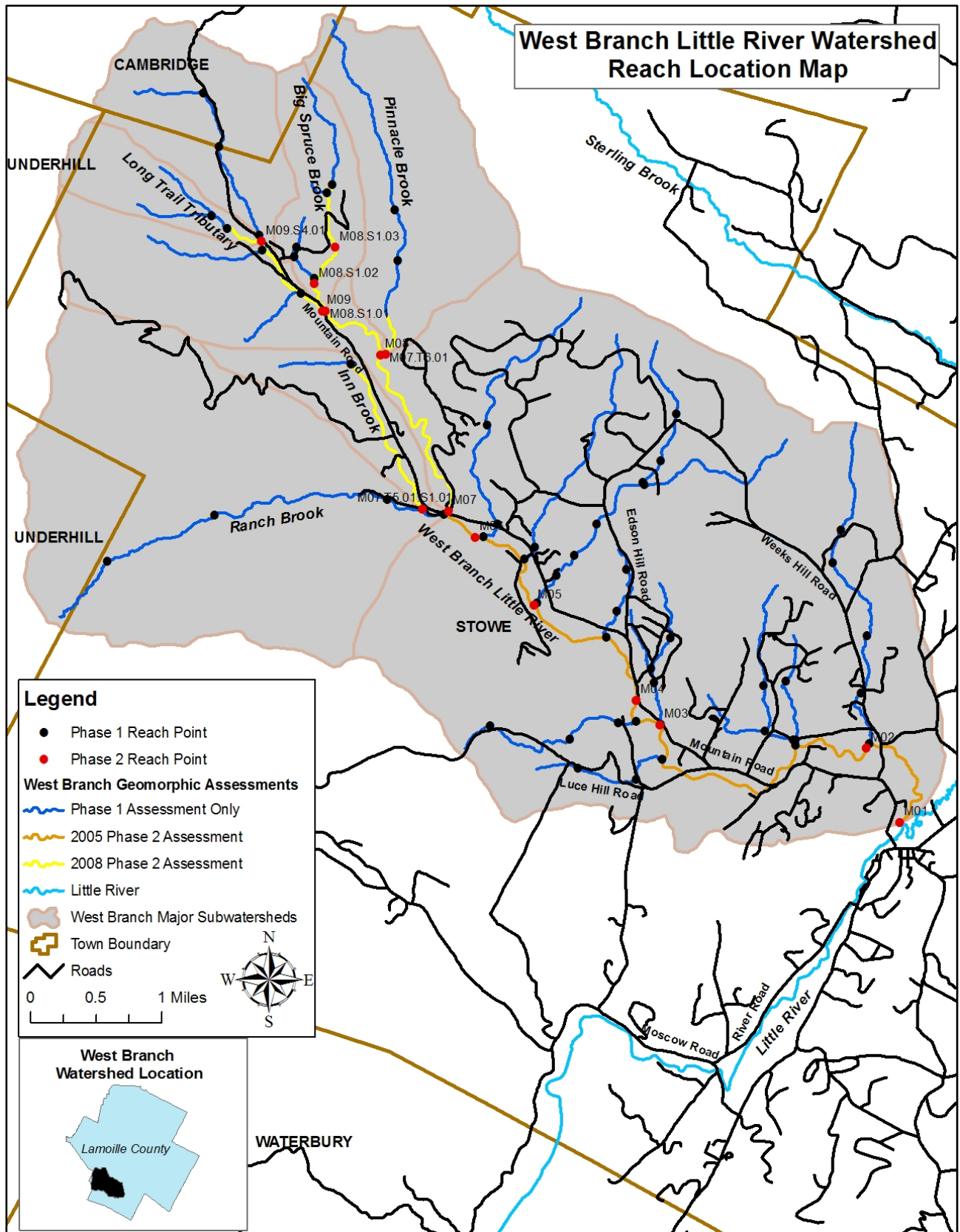


Figure 3.6 West Branch Little River Watershed Reach Location Map

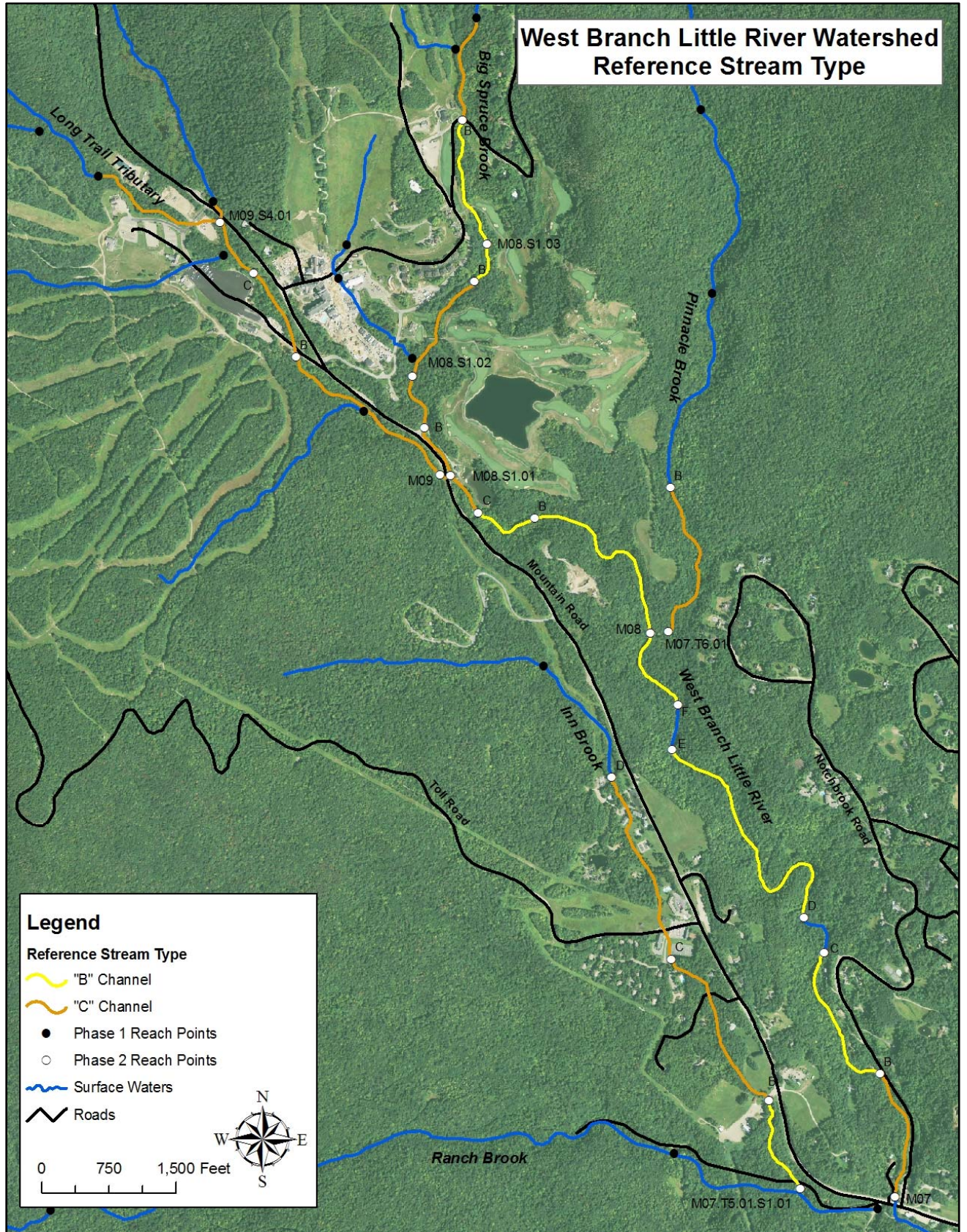


Figure 3.7 Reference Stream Type for Phase 2 Geomorphic Assessments

<b>Table 1: Reference Stream Type</b>			
<b>Stream Type</b>	<b>Confinement</b>	<b>Valley Slope</b>	<b>Bed Form</b>
A	Narrowly Confined	Very steep > 6.5 %	Cascade
A	Confined	Very steep 4.0 - 6.5 %	Step-Pool
B	Confined or Semi-confined	Steep 3.0 – 4.0 %	Step-Pool
B	Confined, Semi-confined or Narrow	Moderate to Steep 2.0 – 3.0 %	Plane Bed
C or E	Unconfined (Narrow, Broad or Very Broad)	Moderate to Gentle <2.0 %	Riffle-Pool or Dune-Ripple
D	Unconfined (Narrow, Broad or Very Broad)	Moderate to Gentle <4.0 %	Braided Channel

<b>Table 2: Geomorphic Setting of Assessed Reaches</b>					
<b>Stream</b>	<b>Reach ID</b>	<b>Reference Stream Type</b>	<b>Confinement<sup>1</sup></b>	<b>Valley Slope</b>	<b>Bedform</b>
West Branch Little River	M07	B	Broad	3.91	Step-Pool
	M08	B	Broad	4.09	Riffle-Pool
	M09	C	Broad	4.89	Riffle-Pool
Inn Brook	M07.T5.01S1.01	C	Very Broad	5.58	Riffle-Pool
Pinnacle Brook	M07.T6.01	A	Semi-confined	7.82	Cascade
Big Spruce Brook	M08.S1.01	C	Narrow	3.60	Step-Pool
	M08.S1.02	C	Very Broad	8.55	Step-Pool
	M08.S1.03	B	Very Broad	11.19	Step-Pool
Long Trail Tributary	M09.S4.01	C	Very Broad	4.33	Step-Pool

<sup>1</sup> Due to the uncertainty in the reference bankfull channel width, the valley confinement type may actually be narrower than indicated.

### 3.4 Hydrology

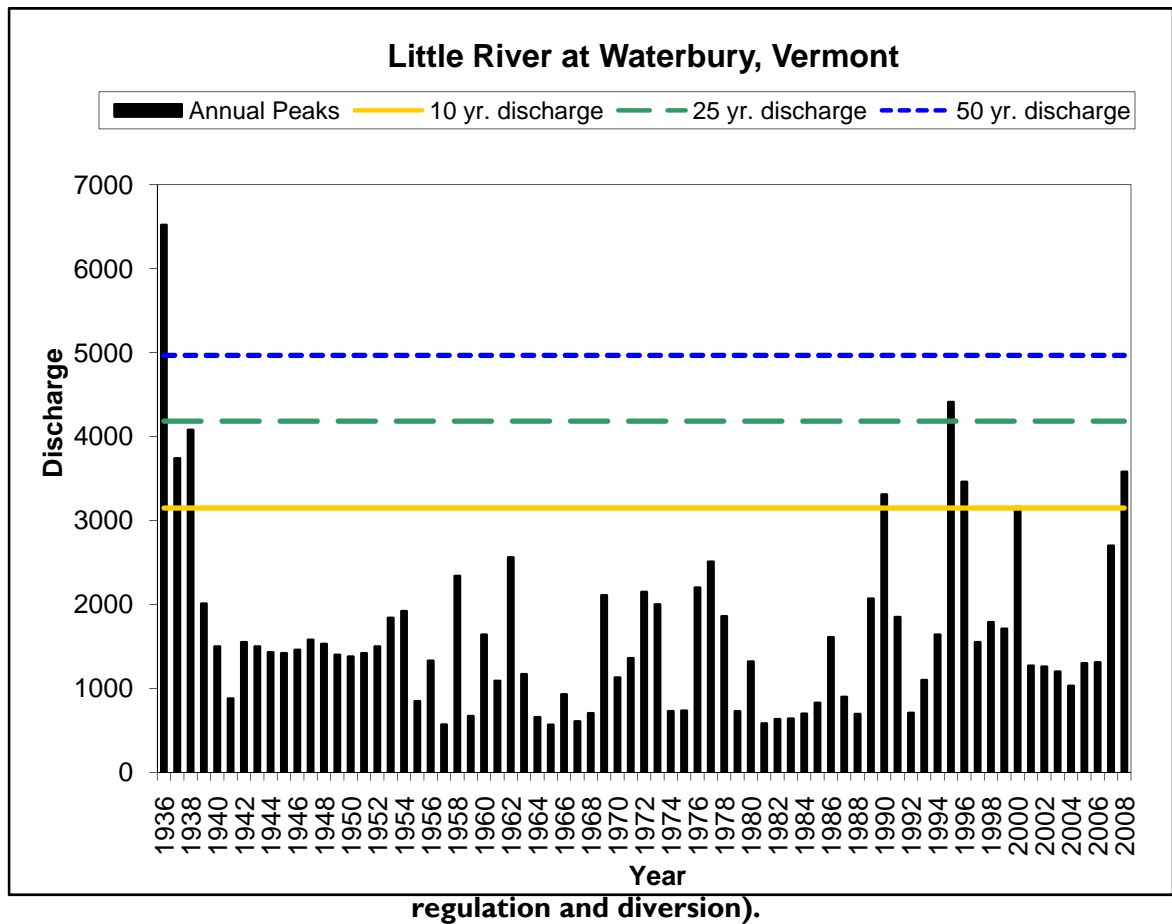
In order to better understand the flood history of the West Branch, long term data from the U.S. Department of the Interior, U.S. Geological Survey (USGS) gauge on the Little River in Waterbury, VT were obtained (USGS 2009). Seventy-three years of record (1936-2008) are available for the Little River gauge.

The long term record for the Little River shows that 1936 had the highest flow on record and exceeded the 50 year discharge. The 25 year discharge was exceeded in 1995. The long term record on the Little River gauge shows major flood events also occurred in the years 1937, 1938, 1990, 1996 and 2008. The graph below (Figure 3.8) provides a flood frequency analysis for the Little River gauge. The flow at this gauge is affected by regulation or diversion at the dam for Waterbury Reservoir.

Of all the natural hazards experienced in Vermont, flooding is the most frequent, damaging, and costly. Over the last 50 years, flood recovery has cost Vermonters an average of 14 Million dollars a year. During the period of 1995-1998 alone, flood losses in Vermont totaled nearly \$57 Million. While some flood losses are caused by inundation (i.e. waters rise, fill, and damage low-lying structures), most flood losses in Vermont are caused by “fluvial erosion”. Fluvial erosion is erosion caused by rivers and streams, and can range from gradual bank erosion to catastrophic changes in river channel location and dimension during flood events (Vermont Agency of Natural Resources 2006).

Closer study of our rivers and streams reveals that Vermont’s erosion hazard problems are largely due to pervasive, human-caused alteration during the past 150 to 200 years of our waterways and landscapes they drain. By end of the nineteenth century, forests had been cleared from many watersheds, resulting in major changes in watershed hydrology and sediment production. Towns and villages, the centers of commerce, grew on the banks of rivers. Benefits of power generation and transportation initially outweighed flood risks. In addition, many watersheds were changed by development, agriculture, log drives, roads and railways. This landscape manipulation has led to streams that are unstable and prone to fluvial erosion (Vermont Agency of Natural Resources 2006).

Flooding events are usually correlated with extreme weather patterns. The majority of the twentieth century’s largest floods have occurred during the summer months of June through August and are associated with intense cloudbursts, which stay in the mountains producing high rainfall amounts. The remainder are divided quite evenly between fall floods (September through November) which are often associated with hurricanes. Winter/spring floods (January through April) are associated with rain on snow events or snowmelt. Summer and fall floods are associated with greater flood damage than winter snowmelt floods. A flood in July 2004 in Stowe dropped as much as 4 inches of rain in one hour causing almost \$500,000 in flood damage according to the Federal Emergency Management Agency (Barg, 2004).



### 3.5 Ecological Setting

The West Branch watershed lies exclusively within the Northern Green Mountains biophysical region (Figure 3.9). This region is characterized by Thompson and Sorenson (2005) as having high elevations and cool summers. The Green Mountains have a strong influence on the weather resulting in an abundance of precipitation in the form of both rain and snow. Precipitation within the West Branch watershed averages 53 inches annually (USGS, Scott Olson, pers. comm., 2004). On the top of Mount Mansfield annual precipitation averages over 78 inches. Precipitation increases with elevation, at about an inch per 1000 feet of elevation (Wemple, 2002). Mount Mansfield receives more precipitation than most areas in the State. An orographic effect often occurs on Mount Mansfield where convection off of sunny slopes leads to thunderstorms. Since the prevailing winds off of the Green Mountains are from the west, air rising through convection is shifted downwind and therefore increases precipitation onto the opposite (east slope). The direction from which the air comes affects the outcomes of storms. Air which arrives from the south is usually moisture laden and causes extreme rainfall events, while storms that come from the north or northwest typically have dry air.

Northern hardwood forest is the dominant community in the Northern Green Mountains biophysical region. The Northern Green Mountains provide important habitat for both aquatic and terrestrial animals. According to Thompson and Sorenson (2005), the Green Mountains offer extensive habitat for black bear, white-tailed deer, bob cat, fisher, beaver and red squirrel. Birds such as blackpoll warblers, Swainson's thrush and the rare Bicknell's thrush nest in the high elevation forests.

The Vermont Significant Wetland Inventory GIS layer provides important information about the distribution of wetland habitat within the West Branch watershed. Small areas of wetland habitat are located in the southeast portion of the watershed. In the 2008 Phase 2 study area, wetland habitat is limited.

Deer wintering areas as identified by the Vermont Agency of Natural Resources are common within the southeastern portion of the watershed as shown in Figure 3.10. Rare, Threatened and Endangered Species & Significant Communities compiled by the Vermont Fish and Wildlife Department, Nongame and Natural Heritage Program (last updated in 2009) are mapped in Figure 3.9 to better understand the ecological setting of the West Branch watershed. The western portion of the West Branch watershed has been classified by the Nongame and Natural Heritage Program as a significant terrestrial community. Much of this area identified as significant terrestrial community is part of the Mount Mansfield State Forest (see Figure 3.2). Located along the western ridge of the West Branch watershed, this important natural area offers a subalpine spruce-fir forest.

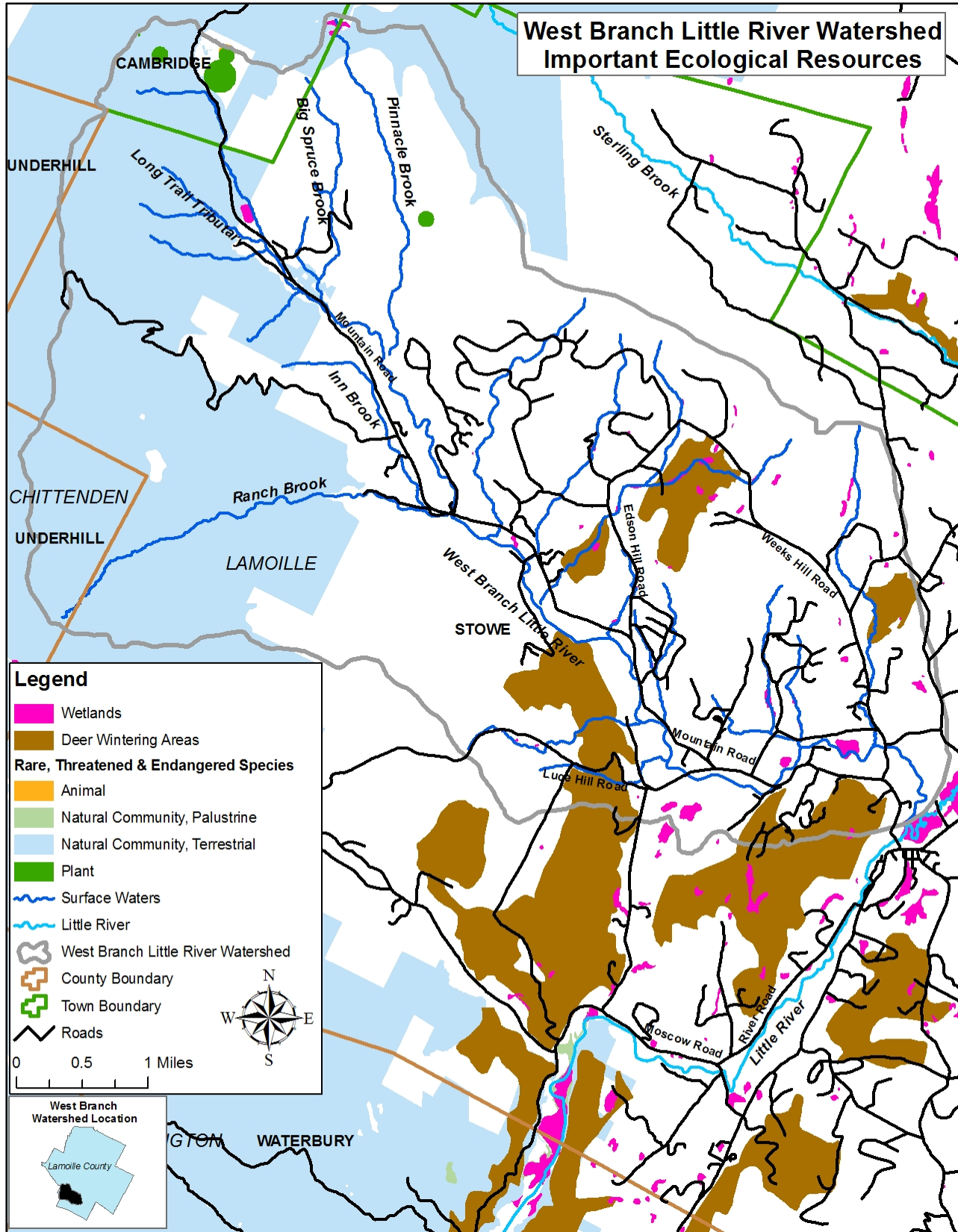


Figure 3.9. Important ecological resources within the West Branch Little River watershed

## **4.0 METHODS**

### **4.1 Phase 1 Methodology**

A Stream Geomorphic Assessment process is divided into three phases, based on VANR protocols. Phase I, the remote sensing phase, involves the collection of data from topographic maps and aerial photographs, from existing studies, and from very limited field studies called “windshield surveys” (Vermont Agency of Natural Resources, 2006). The Phase I assessment provides an overview of the general physical nature of the watershed. A Phase I Assessment of the West Branch watershed was completed by the Lamoille County Planning Commission in 2005.

### **4.2 Phase 2 Methodology**

The Phase 2 assessment of the West Branch watershed followed procedures specified in the Vermont Stream Geomorphic Assessment Handbook Phase 2 (Vermont Agency of Natural Resources, 2007b). All assessment data were recorded on the Agency of Natural Resources Phase 2 data sheets, and were entered in to the VANR Stream Geomorphic Assessment Data Management System (DMS). The Phase 1 database was updated using the field data from the Phase 2 assessment in 2008.

The parameters and protocols used for undertaking the Phase 2 assessment are outlined in the Phase 2 Handbook (Vermont Agency of Natural Resources, 2007b). The entire length of each Phase 2 reach was walked to determine segment breaks. Bank erosion, grade control structures, bank revetments, debris jams, depositional features, stormwater inputs, flood chutes, valley walls and other important features were mapped within all segments. BCE used the Stream Geomorphic Assessment Tool (SGAT) version 4.56 to index features that were mapped during the Phase 2 assessment. SGAT is an ArcView extension.

### **4.3 Bridge and Culvert**

Bridge and culvert inventory and assessments were conducted by BCE during the Phase 2 assessment to determine if stream crossings were contributing to localized streambank erosion, sedimentation, and reduced fish passage. Fourteen of these structures are located within the West Branch 2008 Phase 2 study area. The Agency of Natural Resources Bridge and Culvert protocols (Vermont Agency of Natural Resources, 2007b) were followed. The Vermont Culvert Geomorphic Screening Tool (Milone and MacBroom, Inc., 2008a) and the Vermont Culvert Aquatic Organism Passage Screening Tool (Milone and MacBroom, Inc., 2008b) were used to identify culverts within the Little River watershed that are highest priority for replacement/retrofit due to geomorphic incompatibility and/or for being potential barriers to movement and migration of aquatic organisms.

#### **4.4 River Corridor Plan**

The Vermont Agency of Natural Resources River Corridor Planning Guide (2007a) and Draft 9 of Chapter 5 of the plan dated October 2, 2007 were followed to generate a series of stressor maps, which are included in Section 6.0. The stressor maps were created using indexed data from the Phase 1 and Phase 2 Stream Geomorphic Assessments along with existing data available from VCGI, including roads, buildings and driveways. The stressor maps were then used to identify potential project locations that have few constraints to channel adjustment.

#### **4.5 Quality Control/Quality Assurance Procedures**

To assure a high level of confidence in the Phase 1 and 2 SGA data, strict quality assurance/quality control (QA/QC) procedures were followed by BCE. These procedures involved a thorough in-house review of all data as well as automated and manual QC checks with the DEC River Management Program.

In 2010, BCE completed its own in-house QA review after all the Phase 2 data were entered into the DMS and the Phase 1 data were updated. The Phase 1 DMS and ArcView shapefiles were updated by Pam DeAndrea and Mary Nealon based on the Phase 2 field assessment work during the Phase 2 QA/QC process. The DMS and the ArcView shapefiles for the West Branch Phase 2 study were submitted to Gretchen Alexander and Sacha Pealer of the VANR for a Quality Assurance review in spring 2010. The VANR QA review was completed in June 2010.

### **5.0 RESULTS**

#### **5.1 Phase 2 Results**

##### **Rapid Geomorphic Assessment**

During the Phase 2 assessment, nine reaches in the West Branch watershed were broken into 25 segments based on detailed field observations. The reference and existing stream type for each assessed reach/segment is included in Figure 3.7 and Figure 5.1, respectively. Detailed segment summary data are provided in Appendix A.

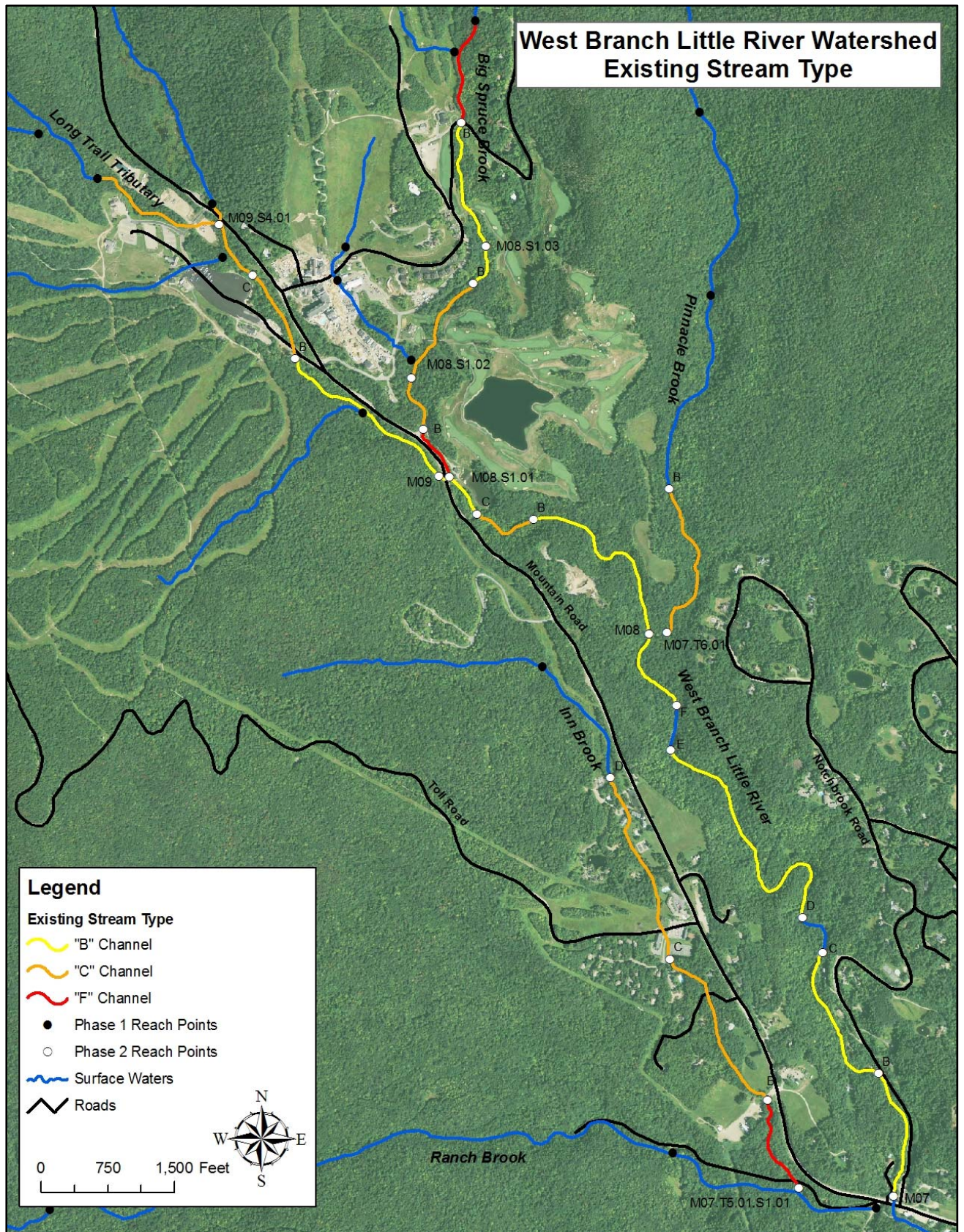


Figure 5.1 Existing stream types of the West Branch Watershed

There are a few segments where the existing stream type differs from the reference stream type or a stream type departure has taken place. A stream type departure occurs when the channel dimensions deviate so far from the reference condition that the existing stream type is no longer the reference stream type. In reach M09-A, a stream type departure from a reference “Cb” channel with slight entrenchment to a “B” channel with moderate entrenchment has occurred due to the placement of the Mountain Road. A stream type departure occurred in the most downstream segment of Inn Brook (M07.T5.01.SI.01-A) where a moderately entrenched “B” channel has become a very entrenched “F” channel. A more extreme stream type departure from a reference “Cb” channel with slight entrenchment to an entrenched “F” channel has occurred on Big Spruce Brook in segments M08.SI.01-A and M08.SI.03-B. In segment M08.SI.01-A, the departure is due to historic rerouting and channelization of the stream so that it would not cross the Mountain Road. The incision that has occurred in segment M08.SI.03-B has resulted in a stream type departure from a “Cb” to an “F” channel. A localized stream type departure from a “Cb” to “B” has taken place in segment M08-C on the West Branch adjacent to the snowmaking pond. However, the overall segment is best classified as “Cb”.

These stream type departures represent a significant change in floodplain access and stability. Watersheds which have lost attenuation or sediment storage areas due to human related constraints are generally more sensitive to erosion hazards, transport greater quantities of sediment and nutrients to receiving waters, and lack the sediment storage and distribution processes that create and maintain habitat (Vermont Agency of Natural Resources, 2007a).

Functioning floodplains play a crucial role in providing long term stability to a river system. Natural and anthropogenic impacts may alter the equilibrium of sediment and discharge in natural stream systems and set in motion a series of morphological responses (aggradation, degradation, and widening and/or planform adjustment) as the channel tries to reestablish a dynamic equilibrium. Small to moderate changes in slope, discharge, and/or sediment supply can alter the size of transported sediment as well as the geometry of the channel; while large changes can transform reach level channel types (Ryan 2001). Human-induced practices that have contributed to stream instability within the West Branch watershed include:

- Forest clearing
- Channelization and bank armoring
- Removal of woody riparian vegetation
- Floodplain encroachments
- Poor road maintenance and installation of infrastructure
- Loss of wetlands

These anthropogenic practices have altered the balance between water and sediment discharges within the West Branch watershed. Channel morphologic responses to these practices contribute to channel adjustment that may further create unstable channels. All three adjustment processes, aggradation, widening and planform migration as a result of historic degradation within the channel are common in the West Branch watershed.

Degradation is the term used to describe the process whereby the stream bed lowers in elevation through erosion, or scour, of bed material. Aggradation is a term used to describe the raising of the bed elevation through an accumulation of sediment. The planform of a channel is its shape as seen from the air. Planform change can be the result of a straightened course imposed on the river through different channel management activities, or a channel response to other adjustment processes such as aggradation and widening. Channel widening occurs when stream flows are contained in a channel as a result of degradation or floodplain encroachment or when sediments overwhelm the stream channel and the erosive energy is concentrated into both banks.

The existing geomorphic condition is depicted in Figure 5.2. Geomorphic condition is determined based on the degree (if any) of channel degradation, aggradation, widening and planform adjustment. Except for seven reaches/segments, the assessed segments and reaches in the upper West Branch watershed were found to be in “fair” geomorphic condition. The other five assessed reaches were in “good” geomorphic condition. Four segments did not receive a full Phase 2 assessment. Segment M07.T5.01.S1.01-D is a wetland and was not assessed. Segments M07-C and M07-E on the West Branch and M07.T6.01-B on Pinnacle Brook were not assessed because they are located in bedrock gorges.

The reach condition ratings of the West Branch indicate that most of the reaches/segments are actively or have historically, undergone a process of minor or major geomorphic adjustment. Many of the reaches studied in the West Branch watershed are undergoing a channel evolution process in response to large scale changes in its sediment, slope, and/or discharge associated with the human influences on the watershed. Table 3 below summarizes the channel evolution of each study reach and the primary adjustment processes that are occurring.

Both the “D” stage and “F” stage channel evolution model (Vermont Agency of Natural Resources, 2007b) are helpful for explaining the channel adjustment processes underway in the Little River watershed. The “F” stage channel evolution model is used to understand the process that occurs when a stream degrades (incises). The common stages of the “F” channel evolution stage, as depicted in Figure 5.3 include:

- A pre-disturbance period
- Incision – channel degradation
- Aggradation and channel widening
- The gradual formation of a stable channel with access to its floodplain at a lower elevation

The “D-stage” channel evolution model applies to reaches where there may have been some minor historic incision; however, the more dominant active adjustment process is aggradation, which in turn leads to channel widening and planform adjustment. The D-stage adjustment process typically occurs in unconfined, low to moderate gradient valleys where the stream is not entrenched and has access to its floodplain or flood prone area at the 1-2 year flood stage.

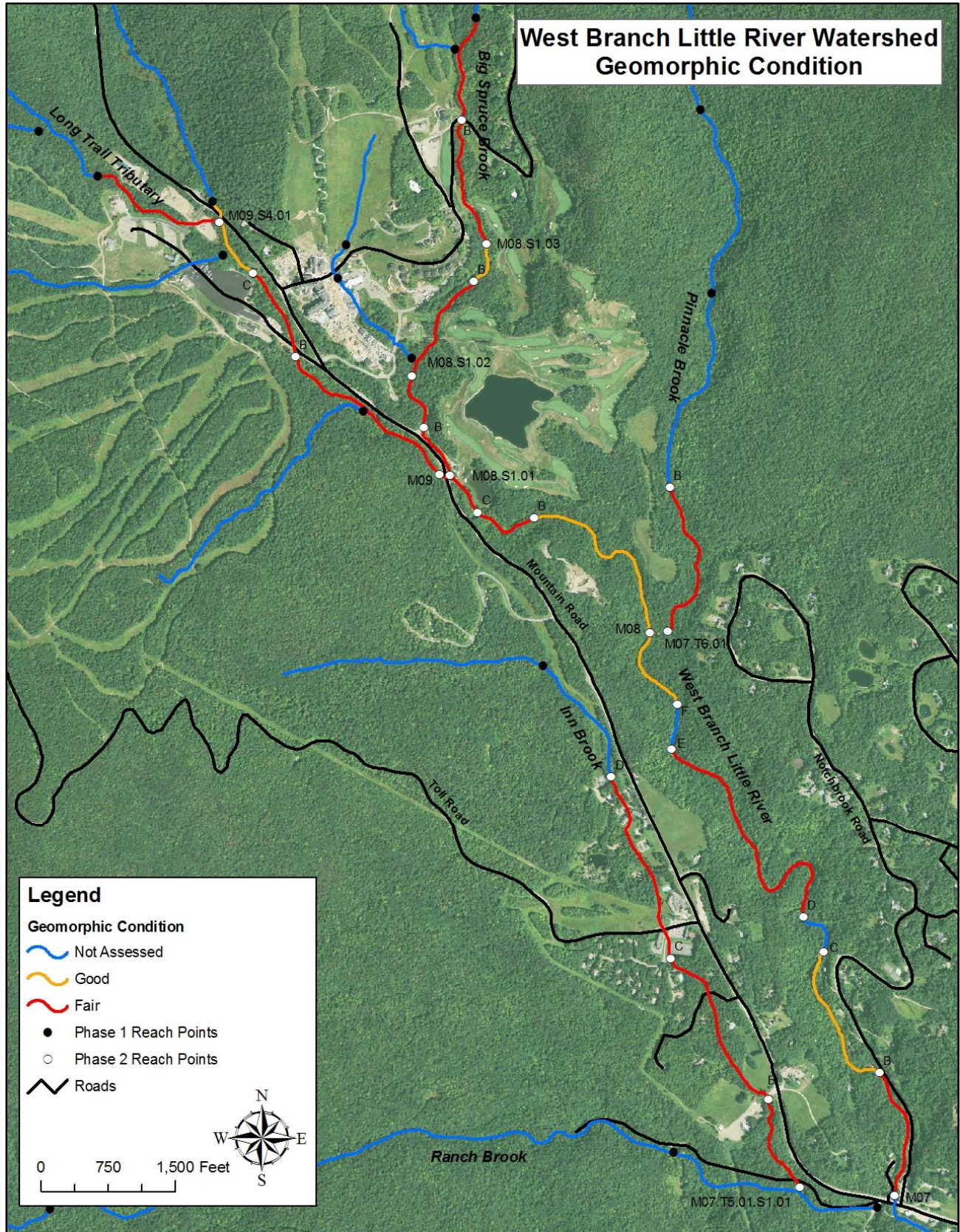
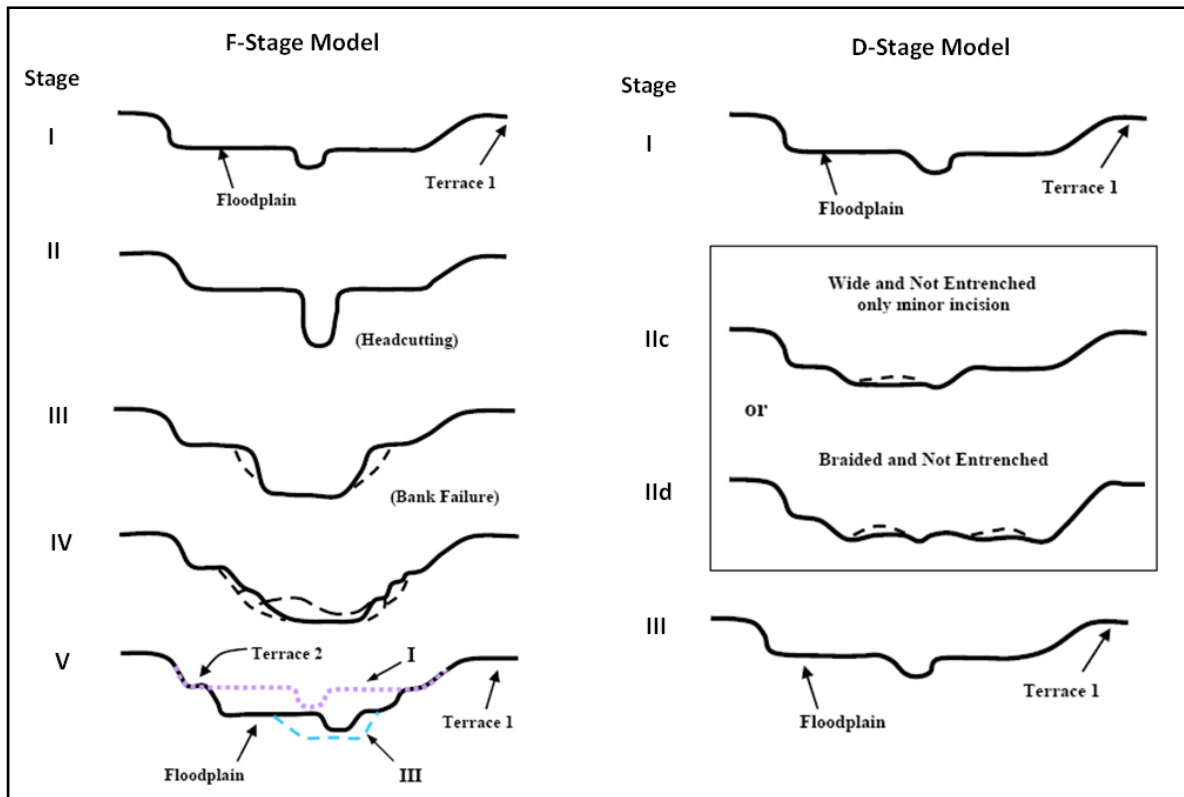


Figure 5.2. Phase 2 Geomorphic Condition of the West Branch Watershed

Table 3. Stream Type and Channel Evolution Stage							
Segment Number	Entr. Ratio	Width to Depth Ratio	Reference Stream Type	Incision Ratio	Existing Stream Type	Channel Evolution Stage	Active Adjustment Process
<b>West Branch Little River</b>							
M07-A	1.68	30.1	B3	2.19	B3	F-III	Aggradation Widening Planform
M07-B	1.42	14.3	B3	1.00	B3	F-I	Aggradation Widening
M07-C	Bedrock Gorge – Not Assessed						
M07-D	1.43	14.9	B3	1.52	B3	F-III	Aggradation Widening
M07-E	Bedrock Gorge – Not Assessed						
M07-F	1.44	24.7	B3	1.46	B3	F-III	Aggradation Widening
M08-A	1.20	19.1	B3	1.07	B3	D-IIc	<b>Aggradation</b> Widening Planform
M08-B	5.54	15.2	C4b	1.74	C4b	F-III	<b>Aggradation</b> Widening Planform
M08-C	1.95	16.9	C4b	1.24	B4	F-III	Aggradation Widening Planform
M09-A	1.47	12.8	C3b	2.05	B3	F-III	Aggradation Widening Planform
M09-B	3.26	17.1	C4b	1.81	C4b	F-IV	Aggradation Widening Planform
M09-C	2.53	13.7	C3b	1.00	C3b	D-IIc	Aggradation Widening Planform
<b>Inn Brook</b>							
M07.T5.01.SI.01-A	1.30	22.7	B3a	1.44	F3a	F-III	Aggradation <b>Widening</b> Planform
M07.T5.01.SI.01-B	34.1	12.8	C4b	1.61	C4b	F-III	Aggradation Widening Planform
M07.T5.01.SI.01-C	5.34	16.9	C4b	1.65	C4b	F-III	Aggradation Widening Planform
M07.T5.01.SI.01-D	Wetland – Not Assessed						

Table 3. Stream Type and Channel Evolution Stage							
Segment Number	Entr. Ratio	Width to Depth Ratio	Reference Stream Type	Incision Ratio	Existing Stream Type	Channel Evolution Stage	Active Adjustment Process
<b>Pinnacle Brook</b>							
M07.T6.01-A	2.59	25.5	C3b	1.00	C3b	D-IIc	<b>Aggradation Widening Planform</b>
M07.T6.01-B	Bedrock Gorge – Not Assessed						
<b>Big Spruce Brook</b>							
M08.SI.01-A	1.34	21.6	C4b	<b>3.39</b>	<b>F4b</b>	F-III	<b>Aggradation Widening Planform</b>
M08.SI.01-B	4.77	13.5	C4b	1.68	C4b	F-III	Aggradation Widening Planform
M08.SI.02-A	4.42	18.7	C4b	1.68	C4b	F-III	Aggradation Widening Planform
M08.SI.02-B	1.54	12.9	B3a	1.37	B3a	F-IV	Aggradation Widening Planform
M08.SI.03-A	1.65	11.1	B3a	1.58	B3a	F-III	<b>Aggradation Planform</b>
M08.SI.03-B	1.29	16.7	C4b	4.48	<b>F4a</b>	F-III	<b>Aggradation Widening Planform</b>
<b>Long Trail Tributary</b>							
M09.S4.01	4.82	12.4	C3b	1.36	C3b	F-IV	Aggradation Widening Planform
	<p><b>Bold Black lettering</b> – denotes major adjustment process                      Black lettering (no bold) – denotes minor adjustment process                      Red denotes severe incision ratio                      Blue denotes moderate incision ratio                      Green denotes a stream type departure</p>						



**Figure 5.3 Typical channel evolution model for F-Stage and D-Stage (Vermont Agency of Natural Resources, 2007b)**

When stream channels are altered through straightening, it can set this evolution process into motion and cause adjustment processes to occur. The bed erosion that occurs when a meandering river is straightened in its valley is a problem that translates to other sections of the stream. Localized incision will travel upstream and into tributaries, thereby eroding sediments from otherwise stable streambeds. These bed sediments will move into and clog reaches downstream, leading to lateral scour and erosion of the streambanks. Channel evolution processes may take decades to play out. Even landowners that have maintained wooded areas along their stream and riverbanks may have experienced eroding banks as stream channel slopes adjust to match the valley slopes. It is difficult for streams to attain a new equilibrium where the placement of roads and other infrastructure has resulted in little or no valley space for the stream to access or to create a floodplain.

Channel equilibrium can be assessed by looking at the regimes of sediment transport within the watershed. The analysis of sediment regimes at the watershed scale is useful for summarizing the stressors affecting the equilibrium condition of river channels. Sediment regime mapping provides a context for understanding the sediment transport and channel evolution processes which govern changes in geometry and planform for river channels in a state of disequilibrium.

In terms of the VANR channel evolution model, the upper West Branch of the Little River is predominately at stage III of the “F-stage” channel evolution model. In many reaches the channel has undergone historic degradation. Many of the cross sections on 2008 study

reaches were found to be incised, with two segments on the West Branch main stem and two segments on Big Spruce Brook having severe incision ratios. Along many of the segments, the system is actively adjusting to this lower bed elevation by moving laterally and widening in order to create a new floodplain at a lower elevation. This widening and planform adjustment is leading to another adjustment process, aggradation. Both aggradation and widening are minor in most segments. Aggradation in the upper West Branch study area seems to be a combination of endogenous sediment that is created as the stream widens and erodes its banks to reestablish a new floodplain as well as from exogenous sources such as gravel roads and land clearing. Unvegetated mid-channel bars, point bars, side bars, and flood chutes confirm the West Branch is undergoing extensive lateral migration. One segment on the West Branch mainstem (M07-B), located downstream of a bedrock gorge) was found to be in stage I of the “F-stage” channel evolution model, wherein a no major adjustment processes were noted. Either this segment has not incised historically due to the natural grade controls or a recently abandoned floodplain could not be readily identified.

Three segments within the West Branch study area (M08-A, M09-C, and M07.T6.01-A) fall into the “D-stage” evolution model, where the more dominant active adjustment process is aggradation. This build up of sediment leads to channel widening and planform adjustment. All of these segments have not undergone historic incision and fall into the D-IIc stage. In the D-IIc stage, a steeper gradient may have been imposed through activities such as channelization, but due to the resistance of the bed material, the stream has not incised or lost access to its floodplain (remaining a “C” Stream Type). There is some minor widening and planform adjustment as the channel migrates laterally through bank erosion caused by the increased stream power. The balance between stream power and boundary materials is re-established when the slope flattens after a process of channel lengthening and increased sinuosity. The stream bed in these channels may be a combination of poorly defined riffle-pool features and plane bed features.

Segment M07.T6.01-A on Pinnacle Brook (D-IIc stage) is undergoing major aggradation, which has led to major planform adjustment. The resistance of the bed material and upstream bedrock gorge has prevented incision in Segment M07.T6.01-A. There is a drop in valley slope and increase in valley width resulting in the sediment load exceeding the transport capacity thereby causing large depositional features and subsequent flood chutes.

Four segments have experienced stream type departures. On Big Spruce Brook, two segments with “C” reference stream types (M08.SI.01-A and M08.SI.03-B) have become “F” channels. Segment M08.SI.03-B is actively incising as shown by two head cuts. One segment on the main stem of the West Branch (M09-A) has evolved from “C” channel to a “B” channel. The most downstream segment on Inn Brook (M07.T5.01.SI.01-A) was once a “B” channel, but is now an “F” channel. The extensive channel alteration and development upstream along Inn Brook has most likely caused the incision and subsequent widening in segment M07.T5.01.SI.01-A. The stream type departures in M09-A and M08.SI.01-A are likely due to channel alteration and/or encroachment within the river corridor thereby resulting in incision.

**HABITAT EVALUATION**

Table 4 below shows a comparison of the habitat condition based on the Rapid Habitat Assessment (RHA) and the geomorphic condition based on the Rapid Geomorphic Assessment (RGA). The stream condition is determined using the scores on the RGA and RHA field forms, and is defined in terms of departure from the reference condition. There are four categories to describe the condition (reference, good, fair and poor). These ratings are defined below.

- Reference – no departure
- Good – minor departure
- Fair – major departure
- Poor – severe departure

For eleven of the 21 assessed segments, both the RHA and the RGA resulted in a “fair” rating. Four segments (M07-F, M08-A, M09-C and M08.S1.02-B) had a rating of “good” for both the RHA and the RGA. Two segments (M07-B, M09-B and M09-S4.01) had a rating of “fair” for habitat but “good” for geomorphic condition, and four segments (M07-D, M08-B, M09-A and M07.T6.01-A) had a rating of “good” for habitat but “fair” for geomorphic condition. Many of the segments that had been straightened or had floodplain alterations lacked a strong riffle-pool bedform and the diversity of habitat features that this brings. Numerous segments had major intrusion into their river corridor from roads, and many segments had inadequate riparian buffers due to historic and /or recent land clearing. Overall, the RHA score was similar to the RGA score, implying that the ecological health of the West Branch is closely related to the geomorphic condition of the stream.

<b>Table 4. Comparison of RHA and RGA for Phase 2 Reaches</b>				
<b>Segment Number</b>	<b>Score RHA</b>	<b>Score RGA</b>	<b>Rating RHA</b>	<b>Rating RGA</b>
M07-A	0.58	0.56	Fair	Fair
M07-B	0.64	0.74	Fair	Good
M07-C	Bedrock Gorge – Not Assessed			
M07-D	0.71	0.64	Good	Fair
M07-E	Bedrock Gorge – Not Assessed			
M07-F	0.76	0.71	Good	Good
M08-A	0.72	0.65	Good	Good
M08-B	0.68	0.58	Good	Fair
M08-C	0.46	0.64	Fair	Fair
M09-A	0.64	0.56	Fair	Fair
M09-B	0.60	0.55	Fair	Good
M09-C	0.65	0.68	Good	Good
M07.T5.01.S1.01-A	0.55	0.51	Fair	Fair
M07.T5.01.S1.01-B	0.58	0.60	Fair	Fair

<b>Table 4. Comparison of RHA and RGA for Phase 2 Reaches</b>				
<b>Segment Number</b>	<b>Score RHA</b>	<b>Score RGA</b>	<b>Rating RHA</b>	<b>Rating RGA</b>
M07.T5.01.SI.01-C	0.41	0.54	Fair	Fair
M07.T5.01.SI.01-D	Wetland – Not Assessed			
M07.T6.01-A	0.70	0.60	Good	Fair
M07.T6.01-B	Bedrock Gorge – Not Assessed			
M08.SI.01-A	0.37	0.35	Fair	Fair
M08.SI.01-B	0.59	0.55	Fair	Fair
M08.SI.02-A	0.61	0.61	Fair	Fair
M08.SI.02-B	0.69	0.66	Good	Good
M08.SI.03-A	0.60	0.59	Fair	Fair
M08.SI.03-B	0.54	0.35	Fair	Fair
M09.S4.01	0.58	0.55	Fair	Fair

## 5.2 Bridge and Culvert Assessment

A total of 22 stream crossings (13 bridges and 9 culverts) are located within the Phase 2 West Branch study area (Figure 5.4). Eight bridges are not a floodprone constriction, and were not assessed. A bridge and culvert assessment using the VANR protocol was conducted on the remaining 14 structures by Bear Creek Environmental, LLC during the Phase 2 assessment. Seven of these stream crossings are on public roads. The geomorphic compatibility and AOP screening tools, photographs and Phase 2 constriction notes were used to prioritize structures for replacement/retrofit. A list of resources for towns regarding funding, planning and design for replacement and retrofit of stream crossings is available on the Vermont River Management and the Vermont Department of Fish and Wildlife’s web sites: [http://www.vtwaterquality.org/rivers/htm/rv\\_EducationalResources.htm](http://www.vtwaterquality.org/rivers/htm/rv_EducationalResources.htm) <http://www.vtfishandwildlife.com/library.cfm?libbase =Reports and Documents>).

Table 5 summarizes the data collected for the assessed structures within the Phase 2 study reach. The final column of Table 5 includes a prioritization of structures for replacement or retrofit based on three criteria: structure width in relation to bankfull channel width, aquatic organism passage (AOP) and geomorphic compatibility, and notes from the Phase 2 study.

One of three priorities for replacement was assigned (low, moderate or high). The following criteria explain the priority level assigned to each structure:

High Priority: Structures with spans of approximately 50 percent of the bankfull width or less, which are significantly impeding natural sediment transport. Culverts that are impeding the passage of aquatic organisms are automatically placed in the high priority category (e.g. free fall outlet).

**Moderate Priority:** Structures with spans less than 50 percent that are not causing significant geomorphic instability and structures with spans greater than 50 percent that are causing instability. Culverts that are resulting in reduced aquatic organism passage (e.g. do not have material throughout the structure or have a cascade outfall) result in at least moderate priority.

**Low Priority:** Stream crossing structures that are not included in either of the two categories above.

A bridge on Long Trail tributary (M09.S4.01) has a structure span of 104 percent of the bankfull channel width and is, therefore, not recommended for replacement. Deposition below was the only sediment transport issue noted at this bridge. Three bridges with a span of greater than 50 percent of the bankfull channel and causing geomorphic instability were identified as moderate priority for replacement/retrofit. One of these bridges is located on the main stem of the West Branch (M09-B), one crosses Inn Brook (M07.T5.01.S1.01-C), and one is located on Big Spruce Brook (M08.S1.01-A). The remaining 10 stream crossings were assigned a high priority for replacement due to a span of less than 50 percent and/or aquatic organism passage issues. The geomorphic compatibility rating based on the geomorphic screening tool was also factored into the assignment of high priority; structures found to be partially, mostly or fully incompatible were given a high priority for replacement/retrofit. A summary of the assessed structures along with photographs of the inlets and outlets is provided in Appendix B.

**Table 5**  
**West Branch Little River Watershed**  
**Evaluation using VANR Geomorphic Compatibility and AOP Screening Tools**

Stream Name	Reach/ Segment Number	Road Name	Structure Type	Percent Bankfull Channel Width <sup>1</sup>	Aquatic Organism Passage (AOP)	Geomorphic Compatibility	Phase 2 Constriction Notes	Priority for Replacement or Retrofit
West Branch Little River	M08-C	Mountain Road	Arch	36 <sup>2</sup>	NA	NA	Deposition and scour above and below	High
	M09-B	Mansfield Parking Area	Bridge	50 <sup>2</sup>	NA	NA	Deposition above, alignment	Moderate
	M09-C	Mountain Road	Bridge	38 <sup>2</sup>	NA	NA	Scour below, alignment	High
Inn Brook	M07T5.01SI.01-A	Ranch Brook Road	Culvert	46 <sup>3</sup>	Reduced AOP	Partially Compatible	Deposition above and below, scour below	High
	M07T5.01SI.01-B	Access Road to Cross Country Ski Center	Culvert	30 <sup>3</sup>	Reduced AOP	Mostly Incompatible	Deposition below, scour above	High
	M07T5.01SI.01-B	Lintilhac Drive	Culvert	26 <sup>3</sup>	No AOP Including Adult Salmonids	Mostly Compatible	Deposition above and below, scour below	High
	M07T5.01SI.01-C	Underground Culvert at Toll Road	Culvert	26 <sup>3</sup>	No AOP Including Adult Salmonids	Mostly Incompatible	Scour below, alignment	High
	M07T5.01SI.01-C	Private Driveway	Bridge	68 <sup>3</sup>	NA	NA	Deposition below, scour below, alignment	Moderate
	M07T5.01SI.01-C	Underground Culvert at The Lodge Parking Lot	Culvert	17 <sup>3</sup>	No AOP Including Adult Salmonids	Partially Compatible	Scour below, alignment	High
	M07T5.01SI.01-C	The Lodge Driveway	Culvert	30 <sup>3</sup>	Reduced AOP	Partially Compatible	Deposition above, scour below, alignment	High
Long Trail Tributary	M09S4.01	Mansfield Parking Lot	Culvert	50 <sup>2</sup>	Reduced AOP	Mostly Compatible	Deposition above	High

**Table 5**  
**West Branch Little River Watershed**  
**Evaluation using VANR Geomorphic Compatibility and AOP Screening Tools**

Stream Name	Reach/ Segment Number	Road Name	Structure Type	Percent Bankfull Channel Width <sup>1</sup>	Aquatic Organism Passage (AOP)	Geomorphic Compatibility	Phase 2 Constriction Notes	Priority for Replacement or Retrofit
	M09S4.01	Vehicle access near snowmaking building	Bridge	104 <sup>2</sup>	NA	NA	Deposition below	NR <sup>5</sup>
Big Spruce Brook	M08S1.01-A	Ski Hostel Driveway	Bridge	53 <sup>2</sup>	NA	NA	Deposition above and below, scour below	Moderate
	M08S1.03-B	Spruce Peak Road	Culvert	29 <sup>2</sup>	No AOP Including Adult Salmonids	Partially Compatible	Deposition above and below, scour below	High

<sup>1</sup>Shaded for bankfull width percentage less than 50%, <sup>2</sup>Percent bankfull width measured in the field during Phase 2 Assessment, <sup>3</sup>Percent bankfull width based on Vermont Hydraulic Geometry Curves, <sup>4</sup>Percent bankfull width measured during Bridge and Culvert Assessment in 2007; <sup>5</sup> NR = Not recommended for replacement

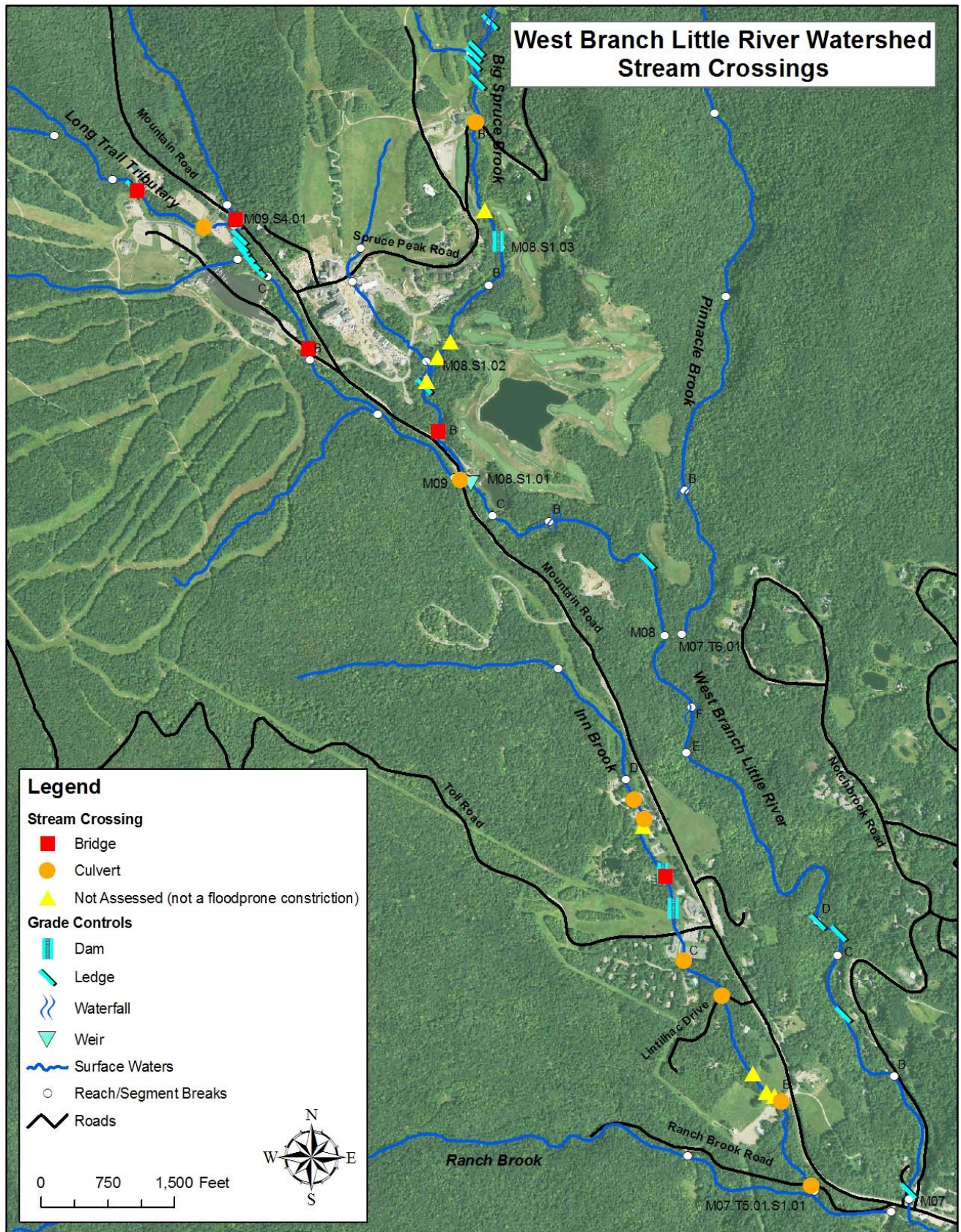


Figure 5.4. Stream Crossings within the West Branch Watershed

## **6.0 Stressor, Departure and Sensitivity Analysis**

Stressor, departure and sensitivity maps are presented here as a means of displaying the effects of all significant physical processes occurring within the West Branch of the Little River watershed that were observed during the Phase 1 and Phase 2 Stream Geomorphic Assessments. These maps also provide an indication of the degree to which the channel adjustment processes within the watershed have been altered at both the watershed scale and the reach scale. The analysis of existing and historic departures from equilibrium conditions along a stream network allows for the prediction of future alterations within the watershed. This is helpful in developing and prioritizing potential protection and restoration projects.

### **6.1 Stressor Identification**

#### **6.1.1 Hydrologic Regime Stressors**

The hydrologic regime is the timing, volume, and duration of flow events throughout the year and over time and is characterized by the input and manipulation of water at the watershed scale. When the hydrologic regime has been significantly changed, stream channels will respond by undergoing a series of channel adjustments. The land use within the watershed plays a role in the hydrology of the receiving waters. The percentage of urban and cropland development within the watershed are factors which change a watershed's response to precipitation. The most common effects of urban and cropland development is increasing peak discharges and runoff by reducing infiltration and travel time (United States Department of Agriculture 1986).

The dominant watershed land cover/land use within the West Branch watershed is forest. The most downstream reach on Inn Brook was the only Phase 2 reach which resulted in a watershed land cover/land use impact rating of high (10% or more is crop and/or urban). Analysis of hydric soils located where current land uses are agricultural or urban indicates some loss of wetland attenuation (Figure 6.1). Historical deforestation in the Little River watershed may also have contributed to wetland loss.

The West Branch watershed has a moderate network of roads as shown in Figure 6.1. Extensive road networks can contribute significantly to increased flows within a river resulting both from increased runoff and stormwater ditching. According to Foreman and Alexander (1998), increased peak flows in streams may be evident at road densities of 3.2 miles/ square mile. Subwatersheds with road densities of greater than 3.2 miles/ square mile account for about 26 percent of the West Branch watershed. The highest road densities within the watershed are along the tributaries to the West Branch in lower portion of the watershed and along Long Trail Tributary.

#### **6.1.2 Sediment Regime Stressors**

The sediment regime is the quantity, size, transport, sorting and distribution of sediments. The sediment regime may be influenced by the proximity of sediment

sources, the hydrologic regime, and the specific morphology of the valley, floodplain, and stream. The Sediment Load Indicators Map (Figure 6.2) shows the distribution of sediment load indicators in the study area. Figure 6.2 also shows the cumulative percentage of agricultural land (based on the percentage of cropland) for each subwatershed. As discussed in Section 3.1.3. Land Use, the West Branch watershed is 77 percent forest, 12 percent agriculture, 5 percent developed and urban land, 5 percent water and 1 percent wetland.

Bank erosion and mass failures contribute significant sediment inputs within the West Branch watershed. Bank erosion is defined as “an area of raw and barren soils where the vegetation does not have the ability to hold the soil and/or the soil has slumped or fallen into the channel”. Mass failures can occur when “a perennial stream erodes into or undercuts a high erodible landform, such as glacial lacustrine terrace” (Vermont Agency of Natural Resources, 2007b). Bank erosion mapped during the Phase 2 study totals approximately 17 percent on both the east and west banks of the 9 reaches assessed. Seven mass wasting sites were mapped during the Phase 2 assessment. The total length of mass failures on the upper West Branch Phase 2 reaches is about 335 feet. Mass failures were observed on all assessed streams except for Long trail Tributary.

Depositional features per mile are mapped to show areas of deposition and planform adjustment. Steep riffles, mid-channel bars, delta bars, flood chutes, avulsions and braiding are parameters included in the depositional features’ map layer. This layer does not necessarily explain the sources of sediment, but these depositional and channel bifurcation features are common in areas where the sediment transport capacity of the channel has been exceeded (VANR, 2007a). Channel migration features (avulsions and flood chutes) are included on the map to show areas of significant planform adjustment. Over 80 percent of the Phase 2 segments assessed have a high number (greater than 5) of depositional features per mile. Two segments on the main stem of the West Branch assessed for Phase 2 (M07-A and M09-B) are the only segments with a moderate (between 2 and 5) number of depositional features per mile. Segment M09-A on the main stem of the West Branch was the only segment with a low (less than 2) number of depositional features per mile.

The bank erosion and the prevalence of mass failures illustrate the West Branch and its tributaries are providing a source of sediment input. This is resulting in the channel being overwhelmed by sediment and exceeding the sediment transport capability as observed by the numerous depositional features per mile.

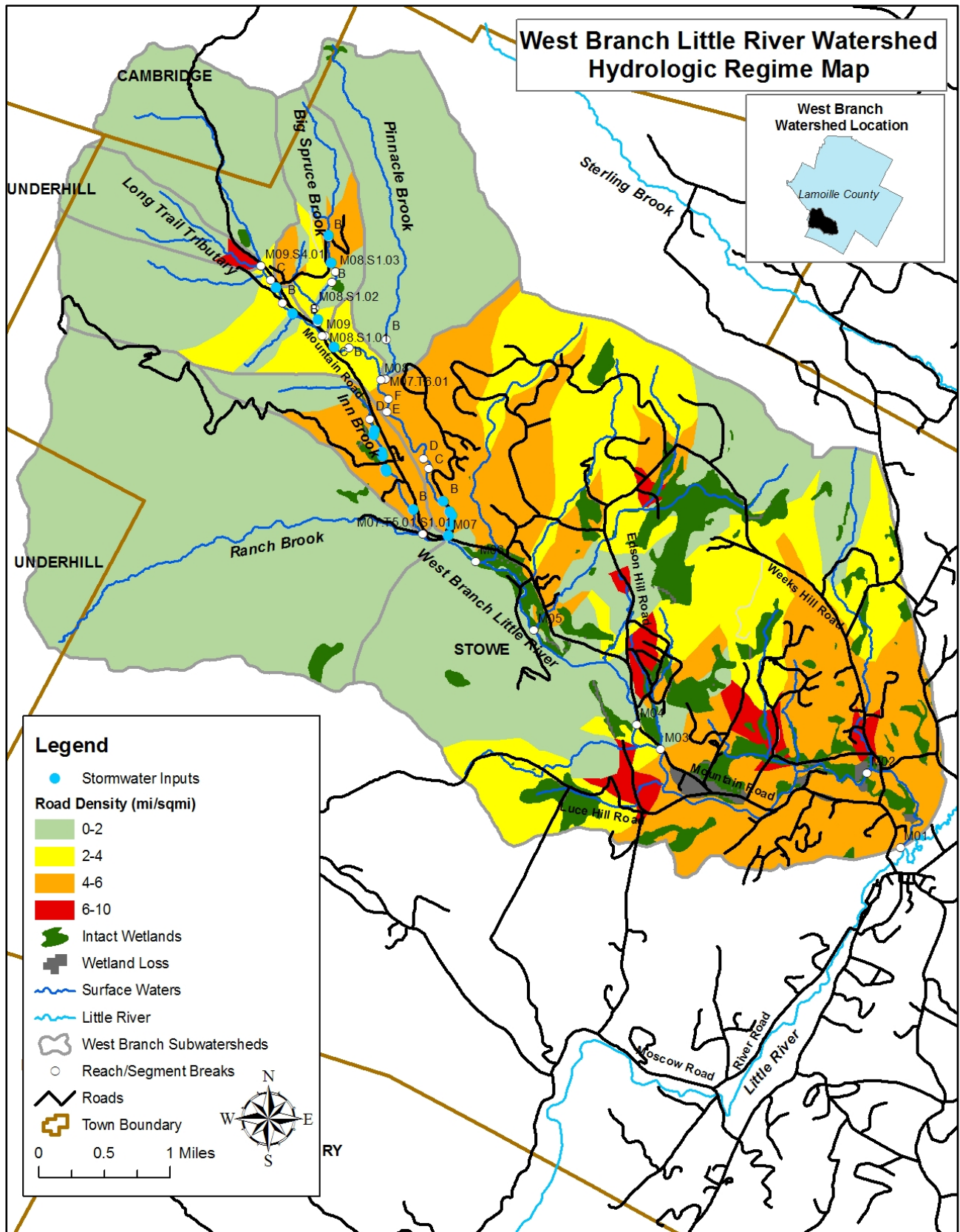


Figure 6.1 Hydrologic Regime Stressors in the West Branch Little River watershed

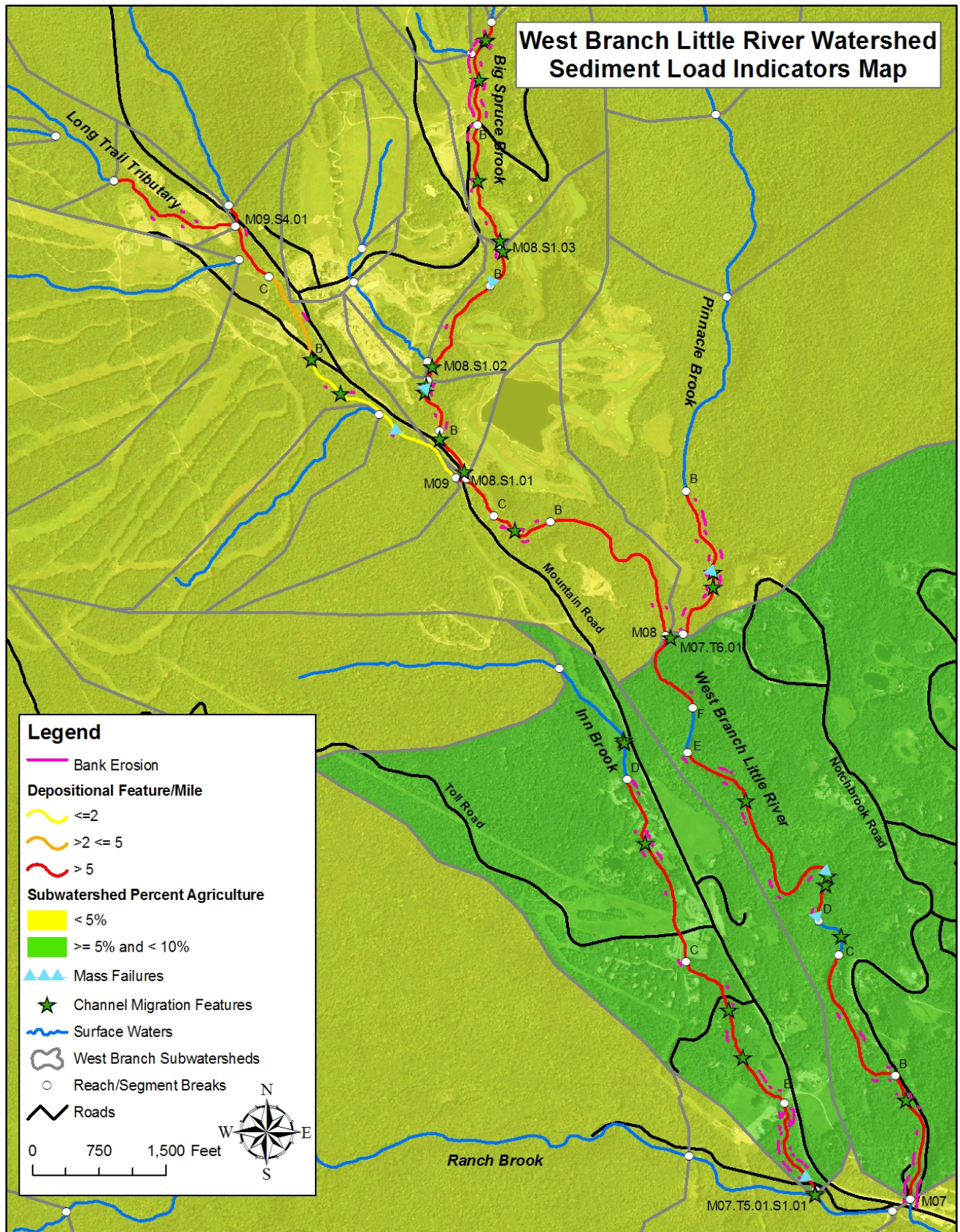


Figure 6.2. Sediment load indicators map for the West Branch

### **6.1.3 Channel Modifiers**

Channel straightening, floodplain encroachment, and berms and roads can increase the slope of a channel resulting in increased stream power. Increases in stream power (shown in red or orange in Figure 6.3) can initiate streambed erosion resulting in incision. The most extensive areas of channel straightening and floodplain encroachment (both development and adjacent berms and roads) are along central Inn Brook, the lower section of Big Spruce Brook, and the West Branch both in the most downstream segment (M07-A) and above the confluence of Big Spruce Brook (Figure 6.3). The streams within these segments run predominantly along the Mountain Road and Notchbrook Road and through the properties of The Inn at the Mountain and The Lodge. The majority of the channel straightening within the West Branch watershed is associated with roads that run parallel to the stream. Along Inn Brook, the channel straightening is related to channel rerouting through underground culverts. Another cause for slope increase is head cuts. There were two head cuts observed on Big Spruce Brook. The extensive areas with increases in stream power explain the channel adjustment that is occurring within the watershed.

Grade controls (waterfalls and ledge) and natural and manmade dams and constrictions (such bridges and culverts) constrict flows or raise the bed elevation. Backwater conditions and sediment deposition typically reduce channel slope and stream power (Vermont Agency of Natural Resources, 2007a). Localized areas where slope decreases are expected in the West Branch watershed are shown in blue and green in Figure 6.3.

### **6.1.4 Boundary Conditions and Riparian Modifiers**

The resistance of the channel boundary materials is important for understanding the sensitivity of a channel and for predicting when a channel will undergo adjustment from stressors in the watershed. There are a number of factors that can result in decreased boundary condition. One of the most important factors is the quality of the riparian buffer. Riparian buffers provide many benefits. Some of these benefits are protecting and enhancing water quality, providing fish and wildlife habitat, providing streamside shading, and providing root structure to prevent bank erosion. Woody vegetation is essential for holding the bank soils to provide resistance to streambank erosion. There are many locations along the lower West Branch and within the vicinity of the confluence of Big Spruce Brook and Inn Brook where there is little or no buffer as defined by buffers less than 25 feet in width (Figure 6.4). Many of these areas are in close proximity to roads, parking lots, or developed area and are not suitable for buffer plantings. These stream reaches which lack a high quality riparian buffer are at a significantly higher risk of experiencing high rates of lateral erosion.

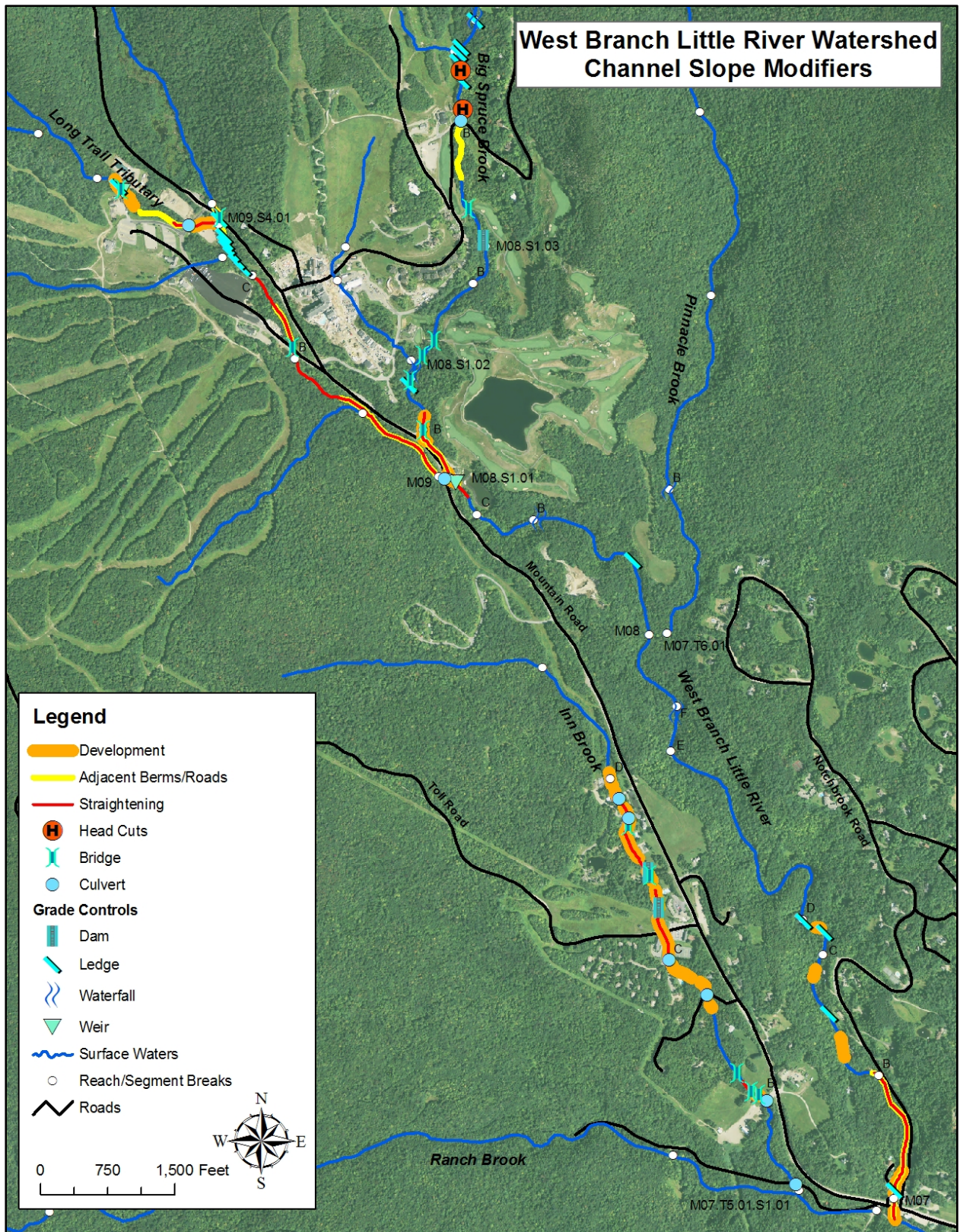
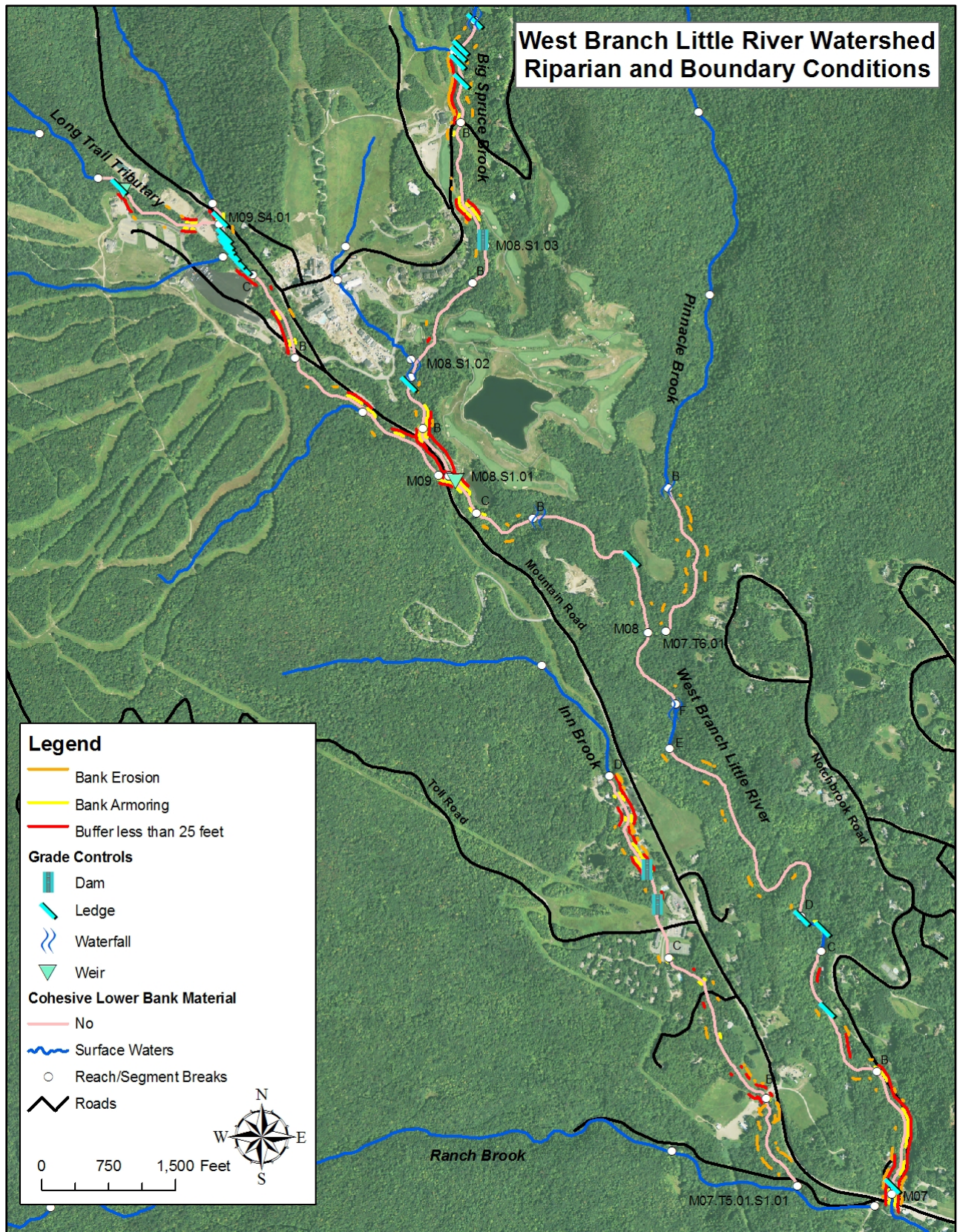


Figure 6.3. Channel slope modifiers map for the West Branch showing parameters contributing to increases (red and orange) or decreases (blue and green) in slope.



Parameters which are indicative of a decrease in boundary condition are shown in red and orange in Figure 6.4. While bank armoring may temporarily increase the boundary condition, it is indicative of where the stream power has resulted in bank erosion or widening of the channel. Extensive bank armoring may increase the stream power, resulting in downstream bank erosion. Areas where woody debris, bed substrate and plant material were removed from the channel also result in decreased boundary condition.

Important factors that result in an increase in boundary condition are included in Figure 6.4 with aqua colored symbols. Natural and man-made grade controls increase the resistance of the bed to erosion. There were several locations where man-made and natural grade controls (ledge) were mapped based on the Phase 2 fieldwork including Inn Brook, mainstem of the West Brook, Big Spruce Brook and Long Trail Tributary. The cohesiveness of the lower bank materials is another factor that was considered in evaluating boundary resistance. Cohesive bank material can increase the boundary condition. There were no reaches with cohesive lower banks.

## 6.2 Departure Analysis

Successful river corridor restoration and protection projects depend on a thorough understanding of the sources, volumes, and attenuation of flood flows and sediment loads within the stream network. If increased loads are transported through the network to a sensitive reach, where conflicts with human investments are creating a management expectation, little success can be expected unless the restoration design accommodates the increased load or finds a way to attenuate the loads upstream (Vermont Agency of Natural Resources, 2007a).

Within a reach, the principles of stream equilibrium dictate that stream power and sediment will tend to distribute evenly over time (Leopold, 1994). Changes or modifications to watershed inputs and hydraulic geometry create disequilibrium and lead to an uneven distribution of power and sediment. Large channel adjustments observed as dramatic erosional and depositional features may be the result of this uneven distribution of power and sediment, and these adjustments may continue until a state of equilibrium is reached.

The analysis of sediment regimes at the watershed scale is useful for summarizing the stressors affecting the equilibrium condition of river channels. Sediment regime mapping provides a context for understanding the sediment transport and channel evolution processes which govern changes in geometry and planform for river channels in a state of disequilibrium. Sediment Regime Maps have been prepared to show departure from reference conditions due to human alterations.

The reference sediment regime map (Figure 6.5) shows the Phase I reference stream sediment conditions for each reach within the stream network. In the reference condition, streams use available floodplain access as a means to store sediment within the watershed. All segments of the Phase 2 study area have a reference sediment regime of Coarse Equilibrium & Fine Deposition (*Equilibrium*), *Confined Source and Transport*, or *Transport*. The majority of the stream network has a reference sediment regime of *Equilibrium*. *Equilibrium* channels are unconfined on at least one side, and they transport and deposit sediment in equilibrium, wherein the stream power is balanced by

the sediment load, sediment size, and channel boundary resistance. *Transport* channels, on the other hand, are steep, dominated by bedrock and boulder/cobble substrates, and are typically in confined valleys. Transport channels do not supply appreciable quantities of sediments to downstream reaches (Vermont Agency of Natural Resources, 2007a). Three segments within the study area (M07-B, M08-A, and M07.T5.01.SI.01-A) are *Transport* channels by reference. Five segments (M07-D, M07-F, M08-B, M08SI.02-B, and M08.SI.03-A) have a reference regime of *Confined Source and Transport*. These channels have confining valleys walls with limited sediment storage capacity due to both channel slope and entrenchment (Vermont Agency of Natural Resources, 2007a).

Changes in hydrology (such as development and agriculture within the riparian corridor) and sediment storage within the watershed have altered the reference sediment regime types for some reach segments. All departures were derived from the DMS according to the sediment regime criteria established by the Vermont Agency of Natural Resources (2007a). Existing sediment regimes have not been established for reaches that were not assessed during the phase 2 stream geomorphic assessment. Many segments that were *Coarse Equilibrium (in=out) & Fine Deposition* or *Confined Source and Transport* type segments by reference have been converted to *Fine Source and Transport & Coarse Deposition* sediment regimes based on the Phase 2 Stream Geomorphic Assessment data (Figure 6.6). This means that most fine sediment entering the stream is transported through without being deposited as a result of channel incision and reduced floodplain access. Additionally, coarse sediment storage is increased due to increased load along with lower transport capacity.

The existing sediment regime for the West Branch watershed includes reduced floodplain access, increased stream power, reduced boundary resistance, and lateral constraints, such as roads, at various locations throughout the stream network. Watersheds which have lost attenuation or sediment storage areas, due to human related constraints, are generally more sensitive to erosion hazards, transport greater quantities of sediment and nutrients to receiving waters, and lack the sediment storage and distribution processes that create and maintain habitat (Vermont Agency of Natural Resources, 2007a).

### **6.3 Sensitivity Analysis**

Stream sensitivity refers to the likelihood that a stream will respond to a watershed or local disturbance or stressor, such as: floodplain encroachment, channel straightening or armoring, changes in sediment or flow inputs, and/or disturbance of riparian vegetation (Vermont Agency of Natural Resources, 2007b).

Assigning a sensitivity rating to a stream is done with the assumption that some streams, due to their setting and location within the watershed, are more likely to be in an episodic, rapid, and/or measurable state of change or adjustment. A stream's inherent sensitivity may be heightened when human activities alter the characteristics that influence a stream's natural adjustment rate including: boundary conditions; sediment and flow regimes; and the degree of confinement within the valley. Streams that are currently in adjustment, especially those undergoing degradation or aggradation, may become acutely sensitive (Vermont Agency of Natural Resources, 2007b). Stream sensitivity is assigned based on the existing stream type and condition. For a particular stream type, a segment in "reference" or "good" condition has a lower sensitivity than a reach in "fair" condition. The highest sensitivity is assigned for segments in "poor" condition and reaches which have undergone a stream type departure. There are many variables that are contributing to the sensitivity of the reaches in the West Branch watershed. Many segments contain numerous bedrock grade controls, which decreases the stream's sensitivity to vertical adjustments. In some reaches, the lack of bedrock and cohesive lower banks decrease the resistance to lateral and vertical adjustments; thereby, making the channel more sensitive. Additionally, bank vegetation and roots which hold the soil are lacking especially along the West Branch at the lower end of the study area and within the vicinity of the confluence of Big Spruce Brook, and Inn Brook where there is little or no buffer. Reaches that are lacking high quality riparian vegetation are more sensitive to channel adjustment.

The location and slope of a stream also affects its morphology and sensitivity. Streams that are transporting sediment through the channel are less sensitive than streams that are storing and responding to sediment. Flow regime and floodplain constrictions may be affecting the sensitivity of the West Branch watershed. Changes in land use and land cover that increase impervious cover, peak discharges, and/or the frequency of high flows will heighten a stream's sensitivity to change and adjustment. Confinement becomes a significant sensitivity concern when structures such as roads, railroads, and berms significantly change the confinement ratio, reduce or restrict a stream's access to floodplain, and result in higher stream power during flood stage.

Figure 6.7 is a map presenting the stream sensitivity, generalized according to stream type and condition as per the VANR protocol, and current adjustments for each reach segment in the West Branch watershed. Sensitivity ratings have not been assigned for bedrock dominated segments and wetland segments that were not assessed. On Big Spruce Brook, segments M08.SI.01-A and M08.SI.03-B are gravel dominated segments that have undergone a stream type departure from a reference "C" channel to an "F" channel. This has resulted in a change in sensitivity from high to extreme (Figure 6.7). The channel sensitivity on segment M07.T5.01.SI.01-A on Inn Brook has gone from moderate to extreme due to a stream type departure from a "B" channel to an "F" channel. These stream type departures are attributed to historic incision. Major aggradation adjustment processes are displayed on the corridor where they were found to be actively occurring and not evaluated as historic. Aggradation is a current major active process for just four segments: M07.T6.01-A on Pinnacle Brook, M08-A and M08-B on the West Branch, M08SI.03-A on Big Spruce Brook, and M09.SI.04 on Long Trail Tributary. Degradation was found to be an active process in segment M08SI.03-B due to the presence of two headcuts.

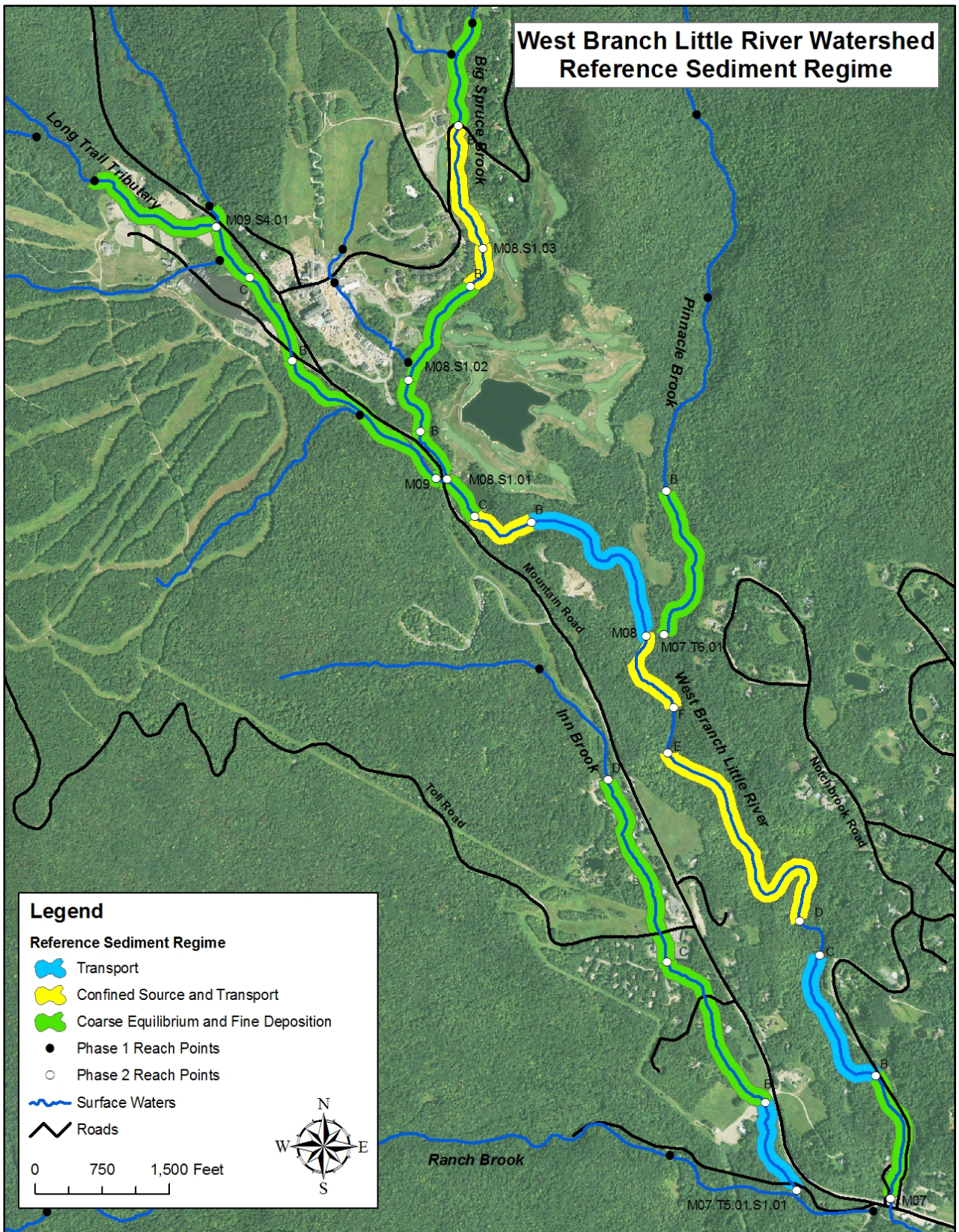
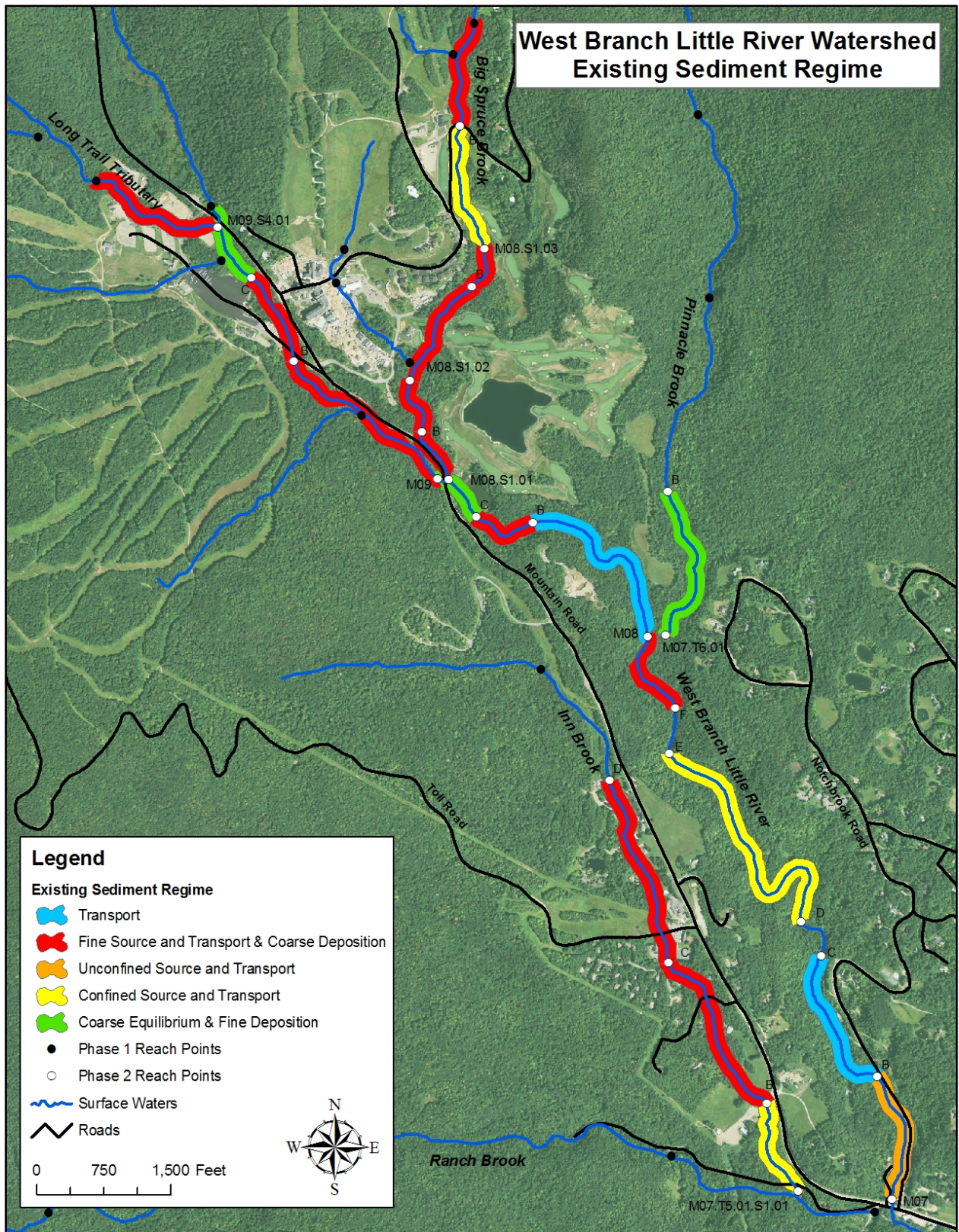


Figure 6.5. Reference Sediment Regime Departure Map showing areas of coarse equilibrium and fine deposition, confined source and transport, and transport reaches.



**Figure 6.6. Existing Sediment Regime Departure Map showing predominantly areas of fine source and transport and coarse deposition, coarse equilibrium and fine deposition, confined source and transport, unconfined source and transport, and transport reaches**

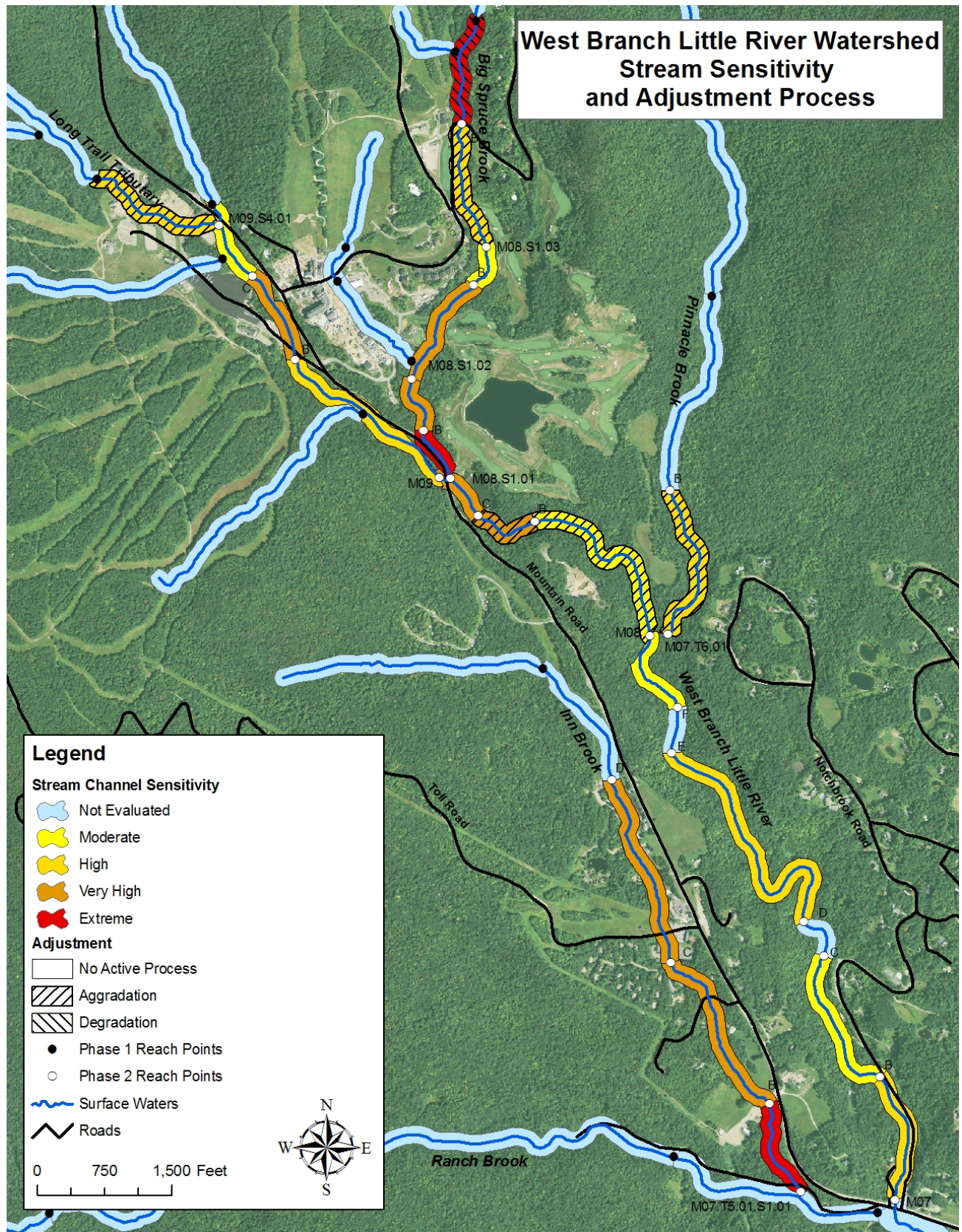


Figure 6.7. Stream sensitivity and current adjustment of the West Branch

## 7.0 PRELIMINARY PROJECT IDENTIFICATION AND PRIORITIZATION

The departure and sensitivity analyses presented in Section 6.0 of this report provide beneficial background for selecting potential projects that will effectively help the channel return to equilibrium conditions by assessing limiting factors and by identifying underlying causes of channel instability. The stream reaches evaluated in this study present a variety of planning and management strategies which can be classified under one of the following categories: Active Geomorphic Restoration, Passive Geomorphic Restoration, and Conservation.

Active Geomorphic Restoration implies the management of rivers to a state of geomorphic equilibrium through active, physical alteration of the channel and/or floodplain. Often this approach involves the removal or reduction of human constructed constraints or the construction of meanders, floodplains or stable banks. Active riparian buffer revegetation and long-term protection of a river corridor is essential to this alternative.

Passive Geomorphic Restoration allows rivers to return to a state of geomorphic equilibrium by removing factors adversely impacting the river and subsequently using the river's own energy and watershed inputs to re-establish its meanders, floodplains and equilibrium conditions. In many cases, passive restoration projects may require varying degrees of active measures to achieve the ideal results. Active riparian buffer revegetation and long-term protection of a river corridor is also essential to this alternative.

Conservation is an option to consider when stream conditions are generally good and nearing a state of dynamic equilibrium. Typically, conservation is applied to minimally disturbed stream reaches where river structure and function and vegetation associations are relatively intact.

There are a number of voluntary programs available for river protection. One of the primary programs is the River Corridor Easement (RCE). The River Corridor Easement is designed to promote the long term physical stability of the river by allowing the river to achieve a state of equilibrium (where sediment and water loads are in balance). River corridor easements are vital for a passive geomorphic restoration approach and can also be used for conserving rivers that are in good condition (equilibrium). Rivers that are in equilibrium have access to their floodplains and therefore experience less erosion and negative impacts from flooding events. A description of this program is provided below.

### **River Corridor Easement (RCE)**

- Easements are in perpetuity, meaning the agreement stays with the land forever.
- A onetime payment is received by the landowner for transferal of channel management rights to a second party (a land trust).
- Transferal of channel management rights means that the landowner would no longer be able to rock line river banks or remove gravel for personal use.
- A RCE requires a minimum 50 foot buffer that floats with the river. No active land use is allowed within the buffer. The buffer can be actively planted or allowed to revegetate passively.

- The easement does not take away the agricultural land use rights, so the landowner could continue to crop or pasture the farm land mapped outside of the buffer, yet within the corridor, for as long as the river allows.

## **7.1 Watershed-Level Opportunities**

### **Fluvial Erosion Hazard Zones**

Of all types of natural hazards experienced in Vermont, flash flooding represents the most frequent disaster mode and has resulted in by far the greatest magnitude of damage suffered by private property and public infrastructure. While inundation-related flood loss is a significant component of flood disasters, the predominant mode of damage is associated with the dynamic, and oftentimes catastrophic, physical adjustment of stream channel dimensions and location during storm events due to bed and bank erosion, debris and ice jams, structural failures, flow diversion, or flow modification by man-made structures. These channel adjustments and their devastating consequences have frequently been documented wherein such adjustments are related to historic channel management activities, floodplain encroachments, adjacent land use practices and/or changes to watershed hydrology associated with land use and drainage.

The purpose of defining Fluvial Erosion Hazard Zones is to prevent increases in fluvial erosion resulting from uncontrolled development in identified fluvial erosion hazard areas; minimize property loss and damage due to fluvial erosion; prohibit land uses and development in fluvial erosion hazard areas that pose a danger to health and safety; and discourage the acquisition of property that is unsuited for the intended purposes due to fluvial erosion hazards. The basis of a Fluvial Erosion Hazard Zone is a defined river corridor which includes the course of a river and its adjacent lands. The width of the corridor is defined by the lateral extent of the river meanders, called the meander belt width, which is governed by valley landforms, surficial geology, and the length and slope requirements of the river channel. The width of the corridor is also governed by the stream type and sensitivity of the stream. River corridors, as defined by the Vermont Agency of Natural Resources (2008), are intended to provide landowners, land use planners, and river managers with a meander belt width which would accommodate the meanders and slope of a balanced or equilibrium channel, which when achieved, would serve to maximize channel stability and minimize fluvial erosion hazards. Information collected during the Phase 2 Assessment including reach sensitivity, reach condition, and stream type is used to develop these zones. Towns have the opportunity to work with the Vermont River Management Program to develop fluvial erosion hazard zones to reduce conflicts within the river corridor. The Town of Stowe has already adopted FEH zone for the lower section of the West Branch of the Little River.

### **STORMWATER**

Stormwater runoff rates are of particular concern in urbanized and agricultural watersheds because stormwater runs off from impervious surfaces rather than naturally infiltrating the soil. The cumulative effect of the increased frequency, volume, and rate of stormwater

runoff results in increases in wash-off pollutant loading to streams and destabilization of stream channels. All potential restoration projects within the West Branch watershed should be evaluated in terms of their effects on stormwater.

## **7.2 Reach-Level Opportunities**

A description of each reach/segment is provided in this section along with general recommendations for restoration and protection strategies. The reaches are listed from downstream to upstream. Further details about project types for each reach will be discussed in Section 7.3. The reaches are broken into sections based on the stream they are located in: West Branch, Inn Brook, Big Spruce Brook, and Long Trail Tributary.

### **West Branch**

The West Branch of the Little River reaches (M07 through M09) arrange from incised channels in stage F-III to areas with good floodplain access that were associated with bedrock grade controls. The sediment regime is variable and the stream type is generally either “B” or “Cb” by reference. In two of the West Branch segments (M08-A and M09-C), the channel is not incised. Segment M09-C is located in a *Coarse Equilibrium and Fine Deposition* regime, while M08-A is located in the *Transport* regime. The segments are in stage IIc of the D channel evolution model.

Channel widths measured in cross sections in the West Branch watershed were in most cases much greater than those widths calculated from the hydraulic geometry curve. However, the width to depth ratios remained low to moderate indicating that the segments/reaches in this watershed have not been over widened from reference conditions. The low to depth ratios could possibly be attributed to the field measured bankfull elevation being too high. As previously discussed, the bankfull elevation was difficult to determine on many of the cross sections. The wider channel widths as compared to the hydraulic geometry curve widths can be explained by the West Branch watershed being located in a mountainous region that receives more precipitation than other locations in Vermont. An orographic effect often occurs on Mount Mansfield where thunderstorms are common as a result of convection off of sunny slopes. Prevailing western winds off of the Green Mountains causes air to rise and shifted downwind thereby increasing precipitation onto the eastern slope.

#### **Reach M07**

##### **Abutment Removal Conservation**

Reach M07 was divided into five segments due to differing buffer conditions and the presence of bedrock gorges. The most downstream assessed segment on the West Branch, M07-A, is 1,775 feet in length and begins just upstream of the Ranch Brook confluence. Notchbrook Road encroaches on the eastern side of the river corridor for the entire segment and has caused a human caused change in valley width. Channel straightening has occurred on most of the segment length, which has resulted in channel incision. An old

abutment is causing a channel and floodprone constriction resulting in deposition upstream and scour downstream (Figure 7.1). This structure could be removed to improve geomorphic stability. Rip-rap armoring is common along the eastern bank where Notchbrook Road is close to the channel. The majority of the eastern side of the corridor has a buffer less than 25 feet with residential its dominant land use due to development on Notchbrook Road (Figure 7.2). Due to the close proximity of the road, a planting project is not recommended for this reach. The western corridor is well forested with a wide riparian buffer.



**Figure 7.1. Straightened channel and old abutment in Segment M07-A**



**Figure 7.2. Development and armoring along Segment M07-A**

Segment M07-A is a “B” cobble dominated segment. The rapid geomorphic assessment (RGA) scored in the “fair” category due to the major historic degradation and minor widening, aggradation, and planform adjustment. The rapid habitat assessment (RHA) rated in the “fair” category mostly due to the lack of large woody debris, large pools, and undercut banks. The channel straightening and poor condition of the eastern bank and riparian corridor also contributed to the “fair” rating.

At the downstream end of segment M07-B the channel migrates away from Notchbrook Road and continues for 1,750 feet. Forest is the dominant land use within both corridors and the buffer is predominantly greater than 100 feet on both sides (Figure 7.3). On the eastern side, the subdominant buffer width is 26-50 feet due to development. No incision has occurred in segment M07-B. Therefore, the segment is in stage F-I of the channel evolution model. The presence of mid-channel bars, side bars and a delta bar indicate that M07-B is somewhat depositional. There are more large pools in segment M07-B than downstream in M07-A (Figure 7.4), but large woody debris is still limited.



**Figure 7.3. Typical channel of M07-B in well forested corridor**



**Figure 7.4. Large pool and bedrock constriction in M07-B**

The channel in M07-B is a cobble dominated “B” stream that has not incised. The RGA rated in the “good” category due to its well forested and wide buffers with stable stream banks. Although the segment rated “good” for RGA, the RHA score was “fair”. The lack of large woody debris, limited undercuts, and some development within the eastern riparian corridor contributed to the “fair” habitat condition.

The next segment, M07-C, was not assessed since it is a 700 foot long bedrock gorge (Figure 7.5). It is located just downstream of the Bingham Falls parcel conserved by the Stowe Land Trust and owned by the State of Vermont (Stowe Land Trust, 2010a). To continue conservation efforts along the West Branch and to preserve the existing condition, segments M07-C and M07-B are being recommended for conservation.



**Figure 7.5. Bedrock grade control segment M07-C**

Upstream of the bedrock gorge, the corridor continues to be well forested. The channel in segment M07-D becomes a cobble dominated “B” type channel that has moderately incised and is now in stage F-III. There are two mass failures within segment M07-D totaling approximately 100 feet in length (Figure 7.6). Suspended sediment can be seen in the channel downstream of the mass failures (Figure 7.7).



**Figure 7.6. Mass failure in segment M07-D**

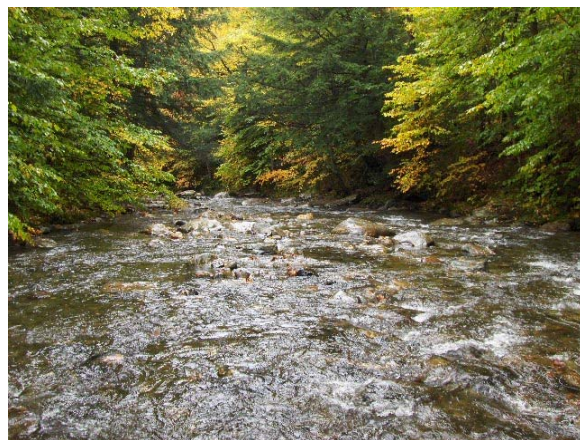


**Figure 7.7. Turbid water downstream of mass failures in M07-D**

The RGA rated in the “fair” category due to major historic incision and minor widening. There are depositional features, but aggradation is minor. The major historic incision in this segment is uncertain. The recently abandoned floodplain (RAF) was difficult to discern in the field and upstream and downstream bedrock grade controls could have prevented M07-D from incising. The RHA scored in the “good” category due to the presence of large woody debris, low embeddedness, abundant pools, and well forested riparian buffers. The western corridor and about half of the eastern corridor in M07-D was conserved in 2001 within the Bingham Falls parcel by the Stowe Land Trust (Stowe Land Trust, 2010a). This 72 acre parcel is used for non-motorized recreation activities such as swimming, hiking, and hunting.



**Figure 7.8. Bedrock gorge of Bingham Falls in M07-E**



**Figure 7.9. Typical channel in M07-F**

Another segment, M07-E, was created due to a second bedrock gorge, which is the location of Bingham Falls (Figure 7.8). The 520 foot long segment M07-E was therefore not assessed (Figure 7.5). The Bingham Falls parcel conserved by the Stowe Land Trust contains segment M07-E (Stowe Land Trust, 2010a).

Upstream of the bedrock gorge is M07-F, a cobble dominated “B” channel (Figure 7.9) that continues for 1,130 feet until the confluence with Pinnacle Brook. The stream remains in a well forested corridor with a wide buffer on both sides. Moderate incision has occurred in segment M07-F placing it in stage F-III of channel evolution. Similar to M07-D, the RAF in M07-F was difficult to determine. Since both upstream and downstream segments contain bedrock grade controls, it is possible that M07-F actually has not incised and the channel does not have a recently abandoned floodplain.

The riparian corridor remains well forested in segment M07-F and the dominant buffer width is greater than 100 feet. Both the RGA and the RHA scored “good” in M07-F. Although historic incision was potentially major, widening and aggradation are minor resulting in the “good” RGA score. Abundant large woody debris, low embeddedness, and high quality corridors and buffers contributed to the “good” habitat score. The upstream extent of the Bingham Falls property conserved by the Stowe Land Trust includes about 60 percent of segment M07-F (Stowe Land Trust, 2010a). The remaining 300 feet is being recommended for conservation to continue with the Bingham Falls property.

### **Reach M08**

#### **Conservation**

#### **Culvert Replacement**

Reach M08 was divided into three segments based on grade controls and differences in stream type and buffer conditions. The most downstream segment, M08-A, starts at the confluence of Pinnacle Brook and continues for 2,237 feet until the channel becomes less entrenched. The stream type is a cobble dominated “B” channel. There are two grade controls (one bedrock and one waterfall) within M08-A. The upstream end of the segment where the waterfall is located is in a bedrock gorge. Because the gorge was so short, it was lumped into segment M08-A. The rest of segment M08-A is dominated by riffle-pool features with step-pool features subdominant. Depositional features, such as mid-channel bars, were observed indicating that the segment is somewhat depositional.

Both the RGA and the RHA were rated “good”. The riparian corridor is well forested and buffers on both sides are wide, which has contributed to the high quality geomorphic and habitat conditions. The channel has not incised and aggradation, widening and planform adjustment are minor. Since there was no incision, M08-A is in stage F-I of the channel evolution model. To preserve the high quality conditions along the West Branch and to continue conservation efforts from the downstream Bingham Falls property, segment M08-A has been recommended for conservation.

Segment M08-B begins where the valley width opens up and the channel is therefore less entrenched and continues until the confluence of Big Spruce Brook. The stream type is a gravel dominated “B” channel that has predominantly riffle-pool features with step-pool features subdominant. The segment is 720 feet long and continues until bank and buffer conditions change where the former snowmaking pond encroaches upon the eastern corridor. Both corridors within segment M08-B are well forested and the dominant buffer width is greater than 100 feet (Figure 7.10). There is a stormwater input from the

snowmaking pond within segment M08-B at the upstream end (Figure 7.11). There is also a weir in the upstream segment that diverts water from the West Branch into the new snowmaking pond during the winter.



**Figure 7.10. Well forested corridor and buffer in M08-B**



**Figure 7.11. Stormwater outlet from former snowmaking pond in M08-B**

Historic incision and aggradation are major within segment M08-B and widening and planform adjustment are minor. The RGA scored as “fair” in M08-B mostly due to the historic incision and depositional features including steep riffles. The RHA scored “good” in segment M08-B as a result of abundant large woody debris, good quality pools, stable banks and a well forested quality riparian area. Segment M08-B has been recommended for river corridor protection through the adoption of corridor easements.

Segment M08-C begins where bank and buffer conditions change from forested to a buffer of less than 25 feet on the eastern side and predominantly 51 to 100 feet on the western side. Route 108 (Mountain Road) encroaches upon 14 percent of the western side of the corridor in segment M08-C causing a human caused change in valley width and a narrow buffer. Rip-rap armoring lines over half of the western bank and one-third of the eastern bank. More than half of the segment has also been straightened.

There is a weir grade control in segment M08-C where flow is diverted into a snowmaking pond during the winter. The weir is causing a channel constriction that is resulting in sediment deposition above and below the structure (Figure 7.12). There is a 2.2 foot drop on the downstream end of the weir, which may be impeding the passage of fish (Figure 7.13). A significantly undersized arch at Mountain Road is causing deposition and scour above and below the structure. There is sediment throughout the structure, and fish passage does not appear to be an issue. This structure has been given a high priority for replacement given the sediment transport issues.



**Figure 7.12. Upstream view of weir and sediment deposition in M08-C**



**Figure 7.13. Downstream view of weir in M08-C**

Segment M08-C is a gravel dominated channel that is moderately incised and in stage F-III of the channel evolution model. There is a stream type departure at the cross section location that is related to the former snowmaking pond; however, the overall segment is best classified as “Cb”. Both the RGA and the RHA were scored as “fair”. Channel alteration has led to minor historic incision, aggradation, widening and planform change. Unstable and armored banks, lack of large woody debris and undercut banks, the presence of a fish passage obstruction, and poor riparian areas have contributed to the “fair” habitat condition.

### **Reach M09**

#### **Bridge replacement**

#### **Improve stability of mass failure**

Due to variable channel dimensions and grade controls near the upstream end, reach M09 was divided into three segments. Segment M09-A is located within the Mount Mansfield State Forest. It begins at the confluence of Big Spruce Brook and continues for about one-half mile along Route 108 until just downstream of the entrance to the Mansfield Parking area. Route 108 (Mountain Road) encroaches along the eastern corridor for half of the segment length and has caused a change in valley width and confinement, resulting in a stream type departure from a “Cb” to a “B” stream.

There is a 240 foot long berm on the downstream end of the segment in between the stream and Route 108. The berm was most likely placed there to protect Route 108 from flooding. Since there is still floodplain access on the western side, BCE has not recommended that this berm be removed. The entire length of the channel has been straightened, which has contributed to the stream type departure and historic incision. Rip-rap armoring has occurred along approximately 20 percent of the eastern bank (Figure 7.14). Due to the presence of Route 108, the dominant buffer along the eastern side is 51-100 and the subdominant is less than 25 feet. Floodplain access within M09-A is short and not continuous. A mass failure is located within segment M09-A is providing a significant sediment source to the stream (Figure 7.15). Based on field observations in fall 2010, this

mass failure has become more active. A project to redirect the streamflow away from this bank and improve stability of the mass failure is recommended.



**Figure 7.14. Straightening and armoring of M09-A along Route 108 causing lack of riparian buffer and decreased floodplain access**



**Figure 7.15. Mass failure 25 feet wide by 65 feet high along M09-A**

The RGA resulted in a “fair” score due to the extreme historic incision. The incision has led to a series of events including minor aggradation, widening and planform adjustment. Despite the geomorphic instability, the RHA for segment M09-A was scored in the low “good” range. Woody debris was abundant with a debris jam present. Abundant undercut banks, pools and refuge areas also contributed to the “good” score. Poor quality banks and riparian areas on the eastern side prevented the segment from scoring higher in the “good” range.

Three-quarters of segment M09-B is located within the Mount Mansfield State Forest. Segment M09-B begins just downstream of the entrance to the Mansfield Parking area and continues for one-quarter mile until the confluence with an unnamed tributary. The stream type is a gravel dominated “Cb” riffle-pool channel. The valley is more open in this segment than downstream and upstream segments. However, the valley width and type has changed due to the placement of the Mansfield Parking area on the western side and Route 108 on the eastern side. The majority of the segment has been straightened for Route 108 and the parking lot (Figure 7.16).



**Figure 7.16. Straightening along segment M09-B**



**Figure 7.17. Bedrock grade control in M09-C**

The eastern side of M09-B has a dominant buffer of 51 to 100 feet and a subdominant buffer of 26 to 50 feet. Over half of the western side has a buffer less than 25 feet and the subdominant buffer width is 51 to 100 feet. Land use within the eastern river corridor is predominantly residential due to Route 108 and the western corridor is mostly commercial land use.

Historic incision likely occurred in M09-B, and a juvenile floodplain appears to be developing at a lower elevation than the historic floodplain. Segment M09-B appears to be in Stage IV of the F channel evolution model. The RGA resulted in a “fair” score due major historic incision, and minor aggradation, widening and planform adjustment. The RHA scored “fair” due to channel alteration and the reduced width of riparian areas.

Segment M09-C begins at the confluence of an unnamed tributary and continues for 800 feet. The cobble dominated “Cb” channel has mostly step-pool features with numerous bedrock grade controls (Figure 7.17). The placement of Route 108 and the Mansfield Parking area has resulted in a human caused change in valley width, but not a change in valley type. Almost half the segment has been straightened, but the channel has not incised due to the abundant grade controls. A bridge that crosses the Mountain Road is significantly undersized and has been recommended for replacement. The scour associated with this undersized bridge is causing undermining of the wing walls at both the upstream and downstream ends of the structure.

The buffer width on the eastern side is predominantly greater than 100 feet and 26 to 50 feet subdominant. The western side has a dominant buffer of 51 to 100 feet with a width of less than 25 feet subdominant. Land use is mostly forest in the east corridor, but commercial within the west corridor.

Both the RGA and the RHA resulted in a “good” condition. The lack of incision and minor aggradation, widening, and planform adjustment contributed to the “good” geomorphic condition. Abundant large woody debris, high quality pools and stable banks were responsible for the “good” habitat condition.

## **Inn Brook**

### **Reach M07.T5.01.S1.01**

**Garbage clean-up**

**River Corridor Easement**

**Culvert Replacement**

**Streamside Planting**

**Stormwater Improvements**

**Buffer Improvements**

Reach M07.T5.01.S1.01 was divided into four segments based on channel dimensions, valley widths, and the presence of wetlands. The assessed portion of Inn Brook is a moderately incised channel (1.44 to 1.65 incision ration) in stage F-III. The sediment regime is *Coarse Source and Transport* on the downstream end with a stream type of “B” by reference. The most upstream section is wetland and the center is characterized by a *Fine Source and Transport & Coarse Deposition* regime with a “C” stream type by reference.

The most downstream segment, M07.T5.01.S1.01-A, begins at the confluence with Ranch Brook and continues until the access road to the cross country ski center. The slope is very steep in most of segment M07.T5.01.S1.01-A and the entrenchment is much greater than upstream (ratio of 1.3). Extreme historic incision has resulted in a stream type departure from a cobble dominated “Ba” channel to an “Fa” channel. Incision is most likely due to the widespread channel alteration within upstream segments and has led to a chain of events including major widening as shown by erosion along approximately 30 percent of each bank. The downstream end of the segment becomes depositional where the slope decreases.

There is a significant amount of trash (e.g. glass, plastic bottles, and scrap metal) in segment M07.T5.01.S1.01-A. Therefore, a clean-up project would help to improve the aesthetics and possibly the habitat conditions. There is a mass failure 65 feet long and 40 feet high on the western bank (Figure 7.18). The mass failure and erosion of the banks has led to abundant debris in the channel causing four debris jams (Figure 7.19).



**Figure 7.18. Mass failure in segment M07.T5.01.S1.01-A**



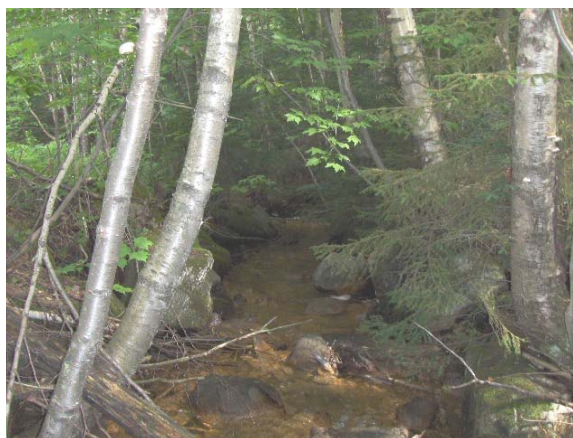
**Figure 7.19. Abundant debris in channel of segment M07.T5.01.S1.01-A**

As a result of the extreme historic incision, subsequent stream type departure and major current widening, the RGA was scored as “fair”. Aggradation and planform adjustment are minor geomorphic processes in segment M07.T5.01.S1.01-A. The RHA also score “fair”. The unstable stream banks, abundant exposed substrate, lack of pools, undercut banks, and refuge areas, and the presence of invasive plants in the eastern riparian corridor (Japanese knotweed) all contributed to the “fair” habitat condition. To prevent further impact to the geomorphic and habitat conditions, it is recommended that a river corridor easement be implemented for M07.T5.01.S1.01-A.

The slope decreases and the valley width increases where the road to the cross country ski center crosses Inn Brook. This is where segment M07.T5.01.S1.01-B begins and continues for 2,000 feet until the stream disappears into an underground culvert at the Inn at the Mountain. The entrenchment was variable within the segment, but the dominant stream type is a riffle-pool and gravel dominated “Cb” with some step-pool features. Buffers are wide and well forested predominantly, but there is some residential development in both sides of the corridor. The subdominant buffer width is 26 to 50 feet, especially at the downstream end within the cross-country ski center. Banks are well vegetated, which provides a good canopy for both sides (Figure 7.20).



**Figure 7.20. Well vegetated banks providing good canopy for segment M07.T5.01.S1.01-B**



**Figure 7.21. Iron staining covering substrate in M07.T5.01.S1.01-B**

Widespread channel alteration within this segment has resulted in major historic incision. Segment M07.T5.01.S1.01-B has incised and is in stage F-III. Current processes include minor widening, aggradation, and planform adjustment. Similar to M07.T5.01.S1.01-A, both the RGA and the RHA were scored as “fair”. The “fair” score is due to the major historic incision and minor widening, aggradation, and planform adjustment. The limited large woody debris, pools, undercuts banks, and refuge areas all contributed to the “fair” habitat condition. Additionally, iron seepage from the underground culvert in M07.T5.01.S1.01-C covered much of the substrate in the upstream end of segment M07.T5.01.S1.01-B (Figure 7.21). Iron precipitate often occurs in areas where soil has been disturbed. This can result in a decrease in available food and habitat for macroinvertebrates.

Segment M07.T5.01.S1.01-C begins where an underground culvert reroutes the stream for 600 feet at the Inn at the Mountain (Figure 7.22). The segment continues upstream of the culvert for another 1,500 feet until a wetland at the upstream end of the reach. The channel has been radically altered from extensive channel straightening (Figure 7.23), two dam grade controls (Figure 7.24), and the rerouting into two underground culverts. Buffer widths are predominantly less than 25 feet on both sides and due to the hotels (Figure 7.25), the dominant land use within the corridor is commercial on both sides.



**Figure 7.22. Location of underground culvert in M07.T5.01.S1.01-C**



**Figure 7.23. Channel straightening and armoring in M07.T5.01.S1.01-C**



**Figure 7.24. Dam grade control creating small pond in M07.T5.01.S1.01-C**



**Figure 7.25. Lack of buffer at The Lodge in M07.T5.01.S1.01-C**

At the upper end of M07.T5.01.S.01-C, sheet flow from the parking lot at the Lodge property drains directly into an underground culvert. It is recommended that the stormwater management plan for this area be reviewed to see if improvements could be made to water quality. The culvert under the Lodge driveway is significantly undersized and is contributing to reduced aquatic organism passage. The underground culverts are also barriers to AOP and are reducing available habitat for aquatic species.

Segment M07.T5.01.S1.01-C is a gravel dominated “Cb” channel in stage F-III that has experienced major historic incision due to the channel alteration. The RGA and the RHA were scored as “fair” in segment M07.T5.01.S1.01-C. The “fair” RGA score is a result of the major historic incision and minor aggradation, widening, and planform adjustment. The replacement of the stream channel with a culvert for much of the segment, limited large woody debris, pools, altered hydrologic characteristics, lack of variable bank vegetation, and small buffer widths have all contributed to the “fair” habitat condition. To improve the buffers within segment M07.T5.01.S1.01-C, streamside planting is recommended within the vicinity of The Lodge property.

Approximately 200 feet upstream of the driveway to The Lodge, M07.T5.01.S1.01 becomes a wetland in segment D. Therefore, segment M07.T5.01.S1.01-D was not assessed.

## **Pinnacle Brook**

### **Reach M07.T6.01** **River Corridor Easement** **Conservation**

Reach M07.T6.01 was divided into two segments based on differences in grade controls. The downstream segment, M07.T6.01-A, begins at the confluence with the West Branch and continues for 2,000 feet. Here the slope increases and the channel becomes more entrenched within a bedrock gorge and therefore was not assessed. The riparian corridor

in M07T6.01-A is well forested on both sides with wide buffers. Segment M07.T6.01-A is not incised, but the drop in slope and widening of the valley has caused major aggradation and planform adjustment (Figure 7.26).



**Figure 7.26. Deposition within segment M07.T6.01-A of Pinnacle Brook**

The channel in M07.T6.01-A is a cobble dominated type “Cb” that is in stage D-IIc since it is not incised and aggradation is the dominant process. There are three flood chutes within M07.T6.01-A with one flood chute approximately 500 feet long. Abundant depositional features are present including side bars, mid-channel bars, steep riffles, and a delta bar. Due to the major aggradation and planform adjustment, the RGA scored “fair”. Widening is a minor process in M07.T6.01-A. The RHA scored “good” as a result of the well forested and wide riparian areas, abundant large woody debris, pools, stable banks, and low embeddedness. A river corridor easement implemented within M07.T6.01-A would allow Inn Brook space to adjust and reach an equilibrium condition. M07.T6.01-B is a bedrock gorge, which is stable and naturally resistant to geomorphic adjustment. However, conservation within M07.T6.01-B would help preserve the habitat.

### **Big Spruce Brook**

With the exception of segment M08S1.02-B, all the segments on Big Spruce Brook are in stage F-III of the channel evolution model and are moderately to extremely incised. The upper and lower portion of the assessed area in Big Spruce Brook has a reference stream type of “Cb”, while the middle portion is “B” by reference.

**Reach M08.SI.01**  
**Floodplain Development Project**  
**Improve Stability of Mass Failure**

Reach M08.SI.01 was broken up into two segments due to differences in channel dimensions. The most downstream segment, M08.SI.01-A, starts at the confluence with the West Branch and continues 700 feet until just upstream of the bridge crossing at the ski hostel. The entire segment has been channelized and rerouted to enter the West Branch downstream from its original location on the other side of Route 108. There are roads along both banks causing entrenchment and a stream type departure from a “Cb” channel to an “Fb” channel. Most of the segment has a buffer width on both sides of less than 25 feet with a dominant corridor land use as residential due to the roads. Along Route 108, the stream bank is heavily armored with rip-rap (Figure 7.27). On the downstream end of the segment, Japanese knotweed is the dominant bank vegetation (Figure 7.28).



**Figure 7.27. Channel alteration and armoring along Route 108 in M08.SI.01-A**

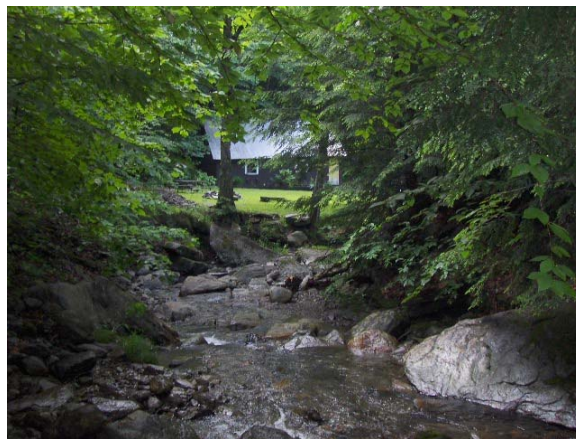


**Figure 7.28. Japanese knotweed on banks in M08.SI.01-A**

The modification of the natural channel to a man-made channel near the mouth of Big Spruce Brook has led to a series of events beginning with extreme historic incision (ratio of 3.4) and major historic widening. Planform adjustment is currently a major process due to the channel alteration. There are some depositional features, but aggradation is still minor. The channel is now in stage F-III of the channel evolution model. Channel alteration in M08.SI.01 has contributed to the low “fair” score for both the RGA and the RHA. The RHA also scored “fair” because of limited floodplain access, poor riparian areas, limited large woody debris and pools, high embeddedness, and armored banks.

Segment M08.SI.01-B begins just upstream of the bridge at the ski hostel and continues for 600 feet until just downstream of an unnamed tributary. Road encroachment from Route 108 is now absent, but there is still a minor human caused change in valley width due to the adjacent parking lot. This parking lot is a floodplain encroachment that is resulting in excessive shear stress on the banks and channel during high flow events. During a high flow

event in early August 2010, some of the riprap in this section was blown out by high velocities. A floodplain development project could be considered to reduce this excessive shear stress in this section along the parking lot, if land use is not a constraint. Except for near the parking lot and lawn area by the hostel (Figure 7.30), the buffers are well forested and have a dominant width of greater than 100 feet. There is a mass failure in the segment approximately 60 feet long and 40 feet high. Opportunities to reduce mass wasting in this area could be investigated.



**Figure 7.29. Riparian buffers within the corridor of lower M08.SI.01-B**

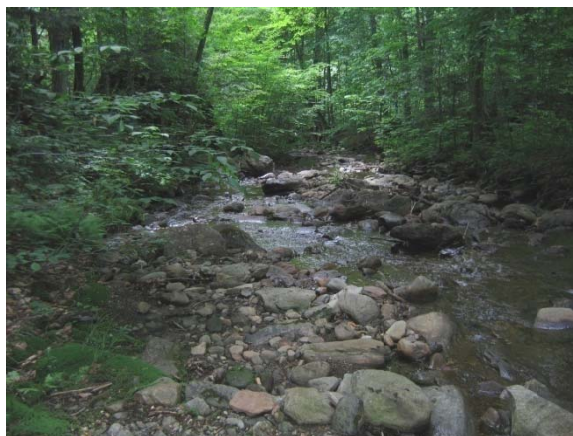
The stream channel within M08.SI.01-B has undergone major historic incision and is in stage F-III of the channel evolution model. The rest of the geomorphic processes are minor, but the RGA was scored as “fair” mostly due to the major historic incision. The RHA also resulted in a “fair” score due primarily to bank conditions and limited larger pools.

### **Reach M08.SI.02** **River Corridor Easement**

The second reach on Big Spruce Brook was segmented to account for differences in valley widths and channel dimension. Segment M08.SI.02-A begins just downstream of an unnamed tributary and continues for 1,255 feet. The stream type is a gravel and step-pool dominated “Cb” channel in stage F-III of channel evolution. There is a waterfall grade control causing a channel constriction and possibly preventing movement of aquatic organisms (Figure 7.30).



**Figure 7.30. Waterfall grade control in segment M08.S1.02-A**



**Figure 7.31. Well forested riparian area in segment M08.S1.02-B**

Both the RGA and RHA were scored as “fair”. The major historic incision mostly contributed to the “fair” geomorphic condition along with minor aggradation, widening, and planform adjustment. Limited large woody debris and pools were the major cause of the “fair” habitat condition.

Segment M08.S1.02-B begins where entrenchment changes and the stream type becomes a cobble dominated “Ba” channel in stage F-III. The length of the segment is approximately 600 feet. The buffer is well forested and wide on both sides providing a good riparian habitat. There is a mass failure within segment M08.S1.02-B that is 40 feet wide and 35 feet high.

Historic incision has occurred most likely as a result of land use changes within the watershed. The segment is in “good” geomorphic condition since the historic incision and other adjustment processes were minor. The habitat condition is also in “good” condition due to abundant habitat features and well forested riparian areas and wide buffers (Figure 7.31). M08.S1.02-B is in “good” condition and would benefit from a conservation or corridor easement. The adoption of fluvial erosion hazard zones could also help protect the corridor adjacent to Big Spruce Brook.

### **Reach M08.S1.03**

#### **River Corridor Easement**

#### **Culvert Replacement**

#### **Arrest Active Head Cuts**

Reach M08.S1.03 was divided into two segments based on differences in valley widths and channel dimensions. The downstream segment, M08.S1.03-A, is similar to M08.S1.02-B in that it is a cobble dominated “B” channel which has historically incised and in stage F-III of channel evolution. The segment begins about 400 feet downstream of a golf course bridge crossing and continues about one-quarter mile until the crossing of Spruce Peak Road. In the vicinity of the golf course bridge, the channel has been reconstructed. Large boulders

line both banks in the reconstructed section and buffers at the time of the Phase 2 stream geomorphic assessment in 2008 were less than 25 feet (Figure 7.32). Shrub willow has subsequently grown in creating a vegetated buffer within this section.



**Figure 7.32. Reconstructed channel in segment M08.SI.03-A**

Dominant buffer widths are greater than 100 feet on the eastern side and 51 to 100 feet on the western side. Forest is the dominant land use within both sides of the corridor. In the western side of the corridor, residential is the subdominant land use, while commercial land is subdominant in the eastern side.

The RGA and the RHA were both scored as “fair”. The geomorphic condition is due to major historic incision most likely from land use changes (such as clearing) within the watershed. Minor aggradation and planform adjustment are also contributing to the “fair” condition. Iron oxide precipitate covering the substrate, obstructions, limited refuge, and development within the western corridor were the major causes of the “fair” score for M08.SI.03-A.

Segment M08.SI.03-B begins at the culvert crossing at Spruce Peak Road and continues for another quarter mile to a waterfall that is acting as a significant grade control (Figure 7.33). Except for the most downstream segment, segment M08.SI.03-B is the most impacted segment assessed on Big Spruce Brook. Channel incision is extreme (ratio of 4.48) and has resulted in a stream type departure from a “C” to an “F” channel. Two active head cuts were identified in this segment (see Figure 7.34). Arresting the active head cuts is a high priority restoration project that has been identified in this plan. A rejuvenating tributary was mapped about half way up segment M08.SI.03-B on the west side providing further evidence of the extreme incision. The RGA scored 0.35, and was the lowest RGA score of all the segments assessed within the upper West Branch watershed. Continuous and laterally extensive scour and erosion were noted at the base of both banks, providing evidence of major widening. Major planform adjustment was also noted in the form of multiple islands, mid-channel bars and flood chutes. Extensive bank erosion, lack of undercuts, a narrow riparian buffer on the west side, unstable steps, the high incision ratio, limited refuge habitat, lack of large woody debris and major system obstructions (such as the culvert crossing on Spruce Peak Road at the downstream end of the segment and the

waterfall at the upstream end of the segment are parameters that contributed to the “fair” habitat condition.



**Figure 7.33. Waterfall grade control at upper end of segment M08.S1.03 of Big Spruce Brook**



**Figure 7.34. Active head cut and bank erosion in segment M08.S1.03 of Big Spruce Brook**

The culvert at the lower end of segment M08.S1.03-B is significantly undersized and is significantly impeding aquatic organism passage. The culvert is freefall and there is an outlet drop of 8.1 feet. A steep riffle is located upstream of the culvert. For these reasons, the culvert was given a high priority rating for replacement.

### **Longtrail Tributary**

#### **M09.S4.01**

#### **Culvert Replacement**

M09.S4.01 is 1,623 foot long reach on Longtrail Tributary. The lower section of the reach does not follow the Vermont Hydrography Dataset (VHD) layer. Longtrail Tributary has been re-routed to enter another tributary, which then flows into the West Branch. The dominant bedform is step-pool, although the lower part of the reach has some riffle-pool characteristics. The reach has good floodplain access up above (Figure 7.35) and becomes more incised near the straightened section, which starts just upstream of the access road to the Mansfield parking lot. The section below the culvert has likely been relocated. There is a perched tributary in the area where the main channel likely was located at one point.

The bank canopy along Longtrail Tributary was generally good (76-100%). The dominant buffer width was greater than 100 feet on the north bank with a few areas of buffers less than 25 feet. The south bank is in close vicinity to the parking areas at Stowe Mountain Resort, and has a dominant buffer width of 51 to 100 feet and a subdominant buffer width of zero to 25 feet.

The channel evolution stage varied on Longtrail Tributary. The middle section (where the cross section data was measured) had an incision ratio of 1.4 and appeared to be in stage F-

IV of the channel evolution model. The lower section where the channel had been altered was more incised and was likely in stage F-III. The RGA scored in the fair range, with major historic incision, major aggradation, minor widening and planform adjustment. Sediment build up, as shown in Figure 7.36, was evident at the inlet of the undersized culvert that crosses the access road to the Mansfield Parking. This structure has been identified as high priority for replacement. The RHA also scored in the “fair” range. Channel morphology, hydrologic characteristics, connectivity and the south riparian area are parameters that scored “fair”.



Figure 7.35. Upper end of Reach of M09.S4.01 (Longtrail Tributary)



Figure 7.36. Significant sediment deposition above undersized culvert on Longtrail tributary

### 7.3 Site Level Opportunities

Site specific projects were identified using the criteria outlined by the VANR in Chapter 6 – Preliminary Identification and Prioritization (Vermont Agency of Natural Resources 2007a). This planning guide is intended to aid in the development of projects that protect and restore river equilibrium. A project map (Figure 7.37) and Table 6 have been developed for the Upper West Branch watershed. The table provides information for each project, including the project strategy, technical feasibility, priority and general cost. A total of 23 projects were identified to promote the restoration or protection of channel stability and aquatic habitat in the upper West Branch Little River watershed. The projects are broken down by category as follows: 2 conservation (river corridor protection alone), 5 passive restoration (river corridor protection, stream cleanup, streamside plantings and buffer improvement projects); one stormwater improvement project; 15 active restoration (ten bridge or culvert replacement or retrofit projects, and one project to arrest active channel incision, one project to remove a relict abutment, two projects to reduce mass wasting, and one floodplain development project). The projects include:

#### West Branch Little River

- **Active Restoration** by removing old abutment about one-quarter mile upstream of Mountain Road crossing near Notchbrook Road (project #1);

- **Conservation** of river corridor from where stream goes away from Notchbrook Road to Bingham Falls property boundary and from just downstream of the Pinnacle Brook confluence) to about 760 feet downstream of snowmaking pond (project #2);
- **Active Restoration** by replacing undersized arch on Mountain Road (project #3);
- **Active Restoration by redirecting streamflow and using bioengineering techniques to reduce mass wasting (project #4).**
- **Active Restoration** by replacing undersized bridge on Mountain Road (project #5).

#### Inn Brook

- **Passive Restoration** with cleanup of garbage in stream and along banks downstream of Nordic Ski Center access road (project #6);
- **Passive Restoration** with river corridor easement from Ranch Brook confluence to cross country ski area (project #7);
- **Active Restoration** by replacing significantly undersized culvert at Ranch Brook Road that is causing localized geomorphic instability (project #8);
- **Active Restoration** by replacing undersized culvert at cross country ski center that is causing localized geomorphic instability and reducing AOP (project #9);
- **Passive Restoration** by allowing buffer to naturally regenerate within the vicinity of Nordic Ski Center (project #10);
- **Active Restoration** by replacing undersized culvert at Lintilhac Drive that is causing localized geomorphic instability and impeding AOP (project #11);
- **Active Restoration** by removing underground culverts at the hotels, The Inn at the Mountain and The Lodge (projects #12 and 13);
- **Active Restoration** by replacing undersized culvert at The Lodge driveway that is causing localized geomorphic instability and reducing AOP (project #14);
- **Passive Restoration** with streamside plantings at The Lodge (project #15);
- **Active Restoration** by managing stormwater coming off of parking lot at The Lodge (project #16);

#### Pinnacle Brook

- **Conservation** through river corridor easement or conservation easement of the Pinnacle Brook (project #17).

#### Big Spruce Brook

- **Active Restoration** through floodplain development adjacent to former Ski Hostel parking lot (project #18);
- **Active Restoration** by using bioengineering to reduce mass wasting upstream of former Ski Hostel (project #19);
- **Passive Restoration** with river corridor easement of Big Spruce from Little Spruce Brook to about one-quarter mile upstream of Spruce Peak Road (project #20);

- **Active Restoration** by replacing undersized culvert on Spruce Peak Road that is significantly undersized and is impeding aquatic organism passage (project #21);
- Active Restoration by arresting two active head cuts on Big Spruce Brook above Spruce Peak Road (project #22).

#### Long Trail Tributary

- Active Restoration by replacing undersized culvert on the access road to the Mount Mansfield parking lot (project #23).

High priority projects include river corridor protection to provide attenuation of sediment and floodwaters through conservation and corridor easements, riparian buffer improvement areas, and the replacement or retrofitting of undersized stream crossing structures. Information from the Phase 2 stream geomorphic assessment and VANR bridge and culvert assessment could be used to inform the Town of Stowe of which stream crossings are contributing to localized instability.

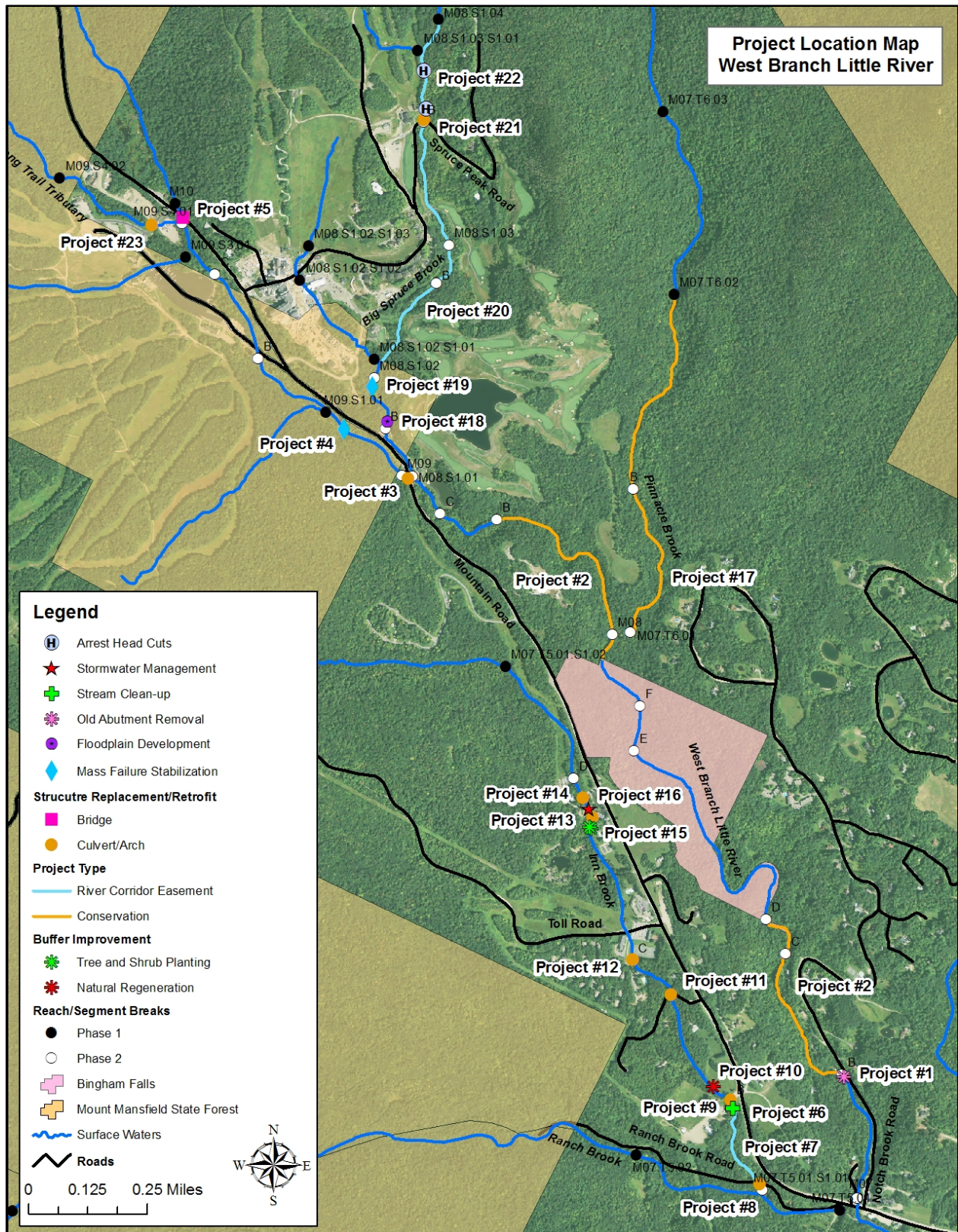


Figure 7.37. Proposed restoration and protection projects for the upper West Branch watershed

**Table 6. Upper West Branch Watershed  
 Site Level Opportunities for Restoration and Protection  
 Stowe, Vermont**

<b>Project # Segment</b>	<b>Type of Project</b>	<b>Site Description Including Stressors and Constraints</b>	<b>Project or Strategy Description</b>	<b>Technical Feasibility and Priority</b>	<b>Other Social Benefits</b>	<b>Costs</b>	<b>Land Use Conversion</b>	<b>Potential Partners</b>
#1 Upstream of Mountain Road M07 West Branch main stem	Active Restoration	An old abutment is causing a channel and floodprone constriction resulting in deposition upstream and downstream of the structure	Alternative analysis for abutment removal	Moderate priority	Improve geomorphic stability	Cost of alternative analysis and abutment removal	None	VANR, LCPC, Town of Stowe
#2 Approximately 1000 feet upstream of the Mountain Road where the West Branch bends away from Notchbrook Road to border of Stowe Land Trust Bingham Falls parcel and from just downstream of confluence with Pinnacle Brook to 760 feet below snowmaking Pond M07 and M08-A West Branch	Conservation	Continue conservation efforts begun by the Stowe Land Trust in the vicinity of Bingham Falls	Protect river corridor through conservation easements	High priority	Scenic location for recreation; preserve forested buffer for cool water temperatures for fish and other aquatic organisms	Cost of conservation easement	No new structures in corridor	VANR, LCPC, landowners, land trust
#3 Mountain Road Arch M08-C West Branch	Active Restoration	The Mountain Road arch is significantly undersized and is causing deposition and scour above and below the structure. There is material throughout the structure; therefore, this structure does not appear to be an issue in terms of AOP	Replace structure with a structure that accommodates at least the bankfull channel width	High priority	Improved habitat and geomorphic stability	High cost of replacement	Unknown	Town of Stowe, VANR, LCPC

**Table 6. Upper West Branch Watershed  
 Site Level Opportunities for Restoration and Protection  
 Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#4 Mountain Road Mass Failure  M09-A West Branch	Active Restoration	A mass failure on the south side of the West Branch is introducing significant amounts of sediment to the channel, especially during large flow events.	Evaluate different design options to redirect the Streamflow away from the banks. Possibly improve stability of mass failure using bioengineering techniques.	High priority	Improved habitat and geomorphic stability	High cost to design and implement a project to stabilize the mass failure	Unknown	LCNRCD, Vermont Geological survey, Stowe Mountain Resort, Town of Stowe, LCPC
#5 Mountain Road Bridge  M09-C West Branch	Active Restoration	The bridge crossing on the Mountain Road near the confluence of Long Trail Tributary is significantly undersized. The structure is causing scour below and has poor alignment	Replace with a structure that accommodates at least the bankfull channel width	High priority	Improved habitat and geomorphic stability	High cost of replacement	Unknown	Town of Stowe, VANR, LCPC
#6 Lower end of Inn Brook below Nordic center  M07.T5.01.S1.01-A Inn Brook	Passive Restoration	There is a significant amount of trash that has been dumped alongside Inn Brook	Stream clean-up to pick up garbage dumped along the banks	Low priority	Improved aesthetics and possibly habitat conditions	Low cost if volunteer labor is used for the clean-up	Not applicable	Town of Stowe, VANR, LCPC, volunteer group
#7 Lower end of Inn Brook below Nordic center  M07.T5.01.S1.01-A Inn Brook	Passive Restoration	The lower segment of Inn Brook is actively adjusting. This segment has an extreme sensitivity.	Implement a corridor easement to allow this section of Inn Brook to adjust and reach an equilibrium condition	High priority	Improved geomorphic stability	Cost of corridor easement	No new structures in corridor	VANR, LCPC, Town of Stowe

**Table 6. Upper West Branch Watershed  
 Site Level Opportunities for Restoration and Protection  
 Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#8 Ranch Brook Road Crossing  M07.T5.01.S1.01-A Inn Brook	Active Restoration	The culvert crossing on Ranch Brook Road is significantly undersized and is reducing AOP. The culvert was found to be partially compatible using the geomorphic screening tool. Deposition above and below and scour below the structure were noted.	Culvert replacement	High priority	Improved geomorphic stability and possibly AOP (if replaced with a bridge or arch)	High cost for replacement	Unknown	Town of Stowe, LCPC, ANR
#9 Culvert at Access Road to Nordic Ski Center  M07.T5.01.S1.01-A Inn Brook	Active Restoration	The culvert crossing the access road at the Nordic ski center is significantly undersized and is resulting in reduced AOP. The culvert was found to be mostly incompatible using the geomorphic screening tool. Deposition below and scour above the structure were noted.	Culvert replacement	High priority	Improved geomorphic stability and possibly AOP (if replaced with a bridge or arch)	High cost for replacement	Unknown	Nordic Ski Center, LCPC, ANR
#10 Mount Mansfield Nordic Ski Center just upstream of culvert crossing at the Nordic Ski Center Access Road  M07.T5.01.S1.01-B Inn Brook	Passive Restoration	Buffers are less than 25 feet on both sides of stream just upstream from the crossing of the access road to the Nordic Ski Center.	Buffer Improvement	Moderate priority	Improved water quality and habitat within reach	Low cost	Herbaceous to Forested	Nordic Ski Center, LCPC, ANR

**Table 6. Upper West Branch Watershed  
 Site Level Opportunities for Restoration and Protection  
 Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#11 Lintilhac Drive Culvert  M07.T5.01.S1.01-B Inn Brook	Active Restoration	The culvert crossing at Lintilhac Drive is significantly undersized and is resulting in no AOP including adult salmonids. The culvert was found to be mostly compatible using the geomorphic screening tool. Deposition above and below and scour below the structure were identified as problems.	Culvert replacement	High priority	Improved geomorphic stability and AOP	High cost for replacement	Unknown	Town of Stowe, LCPC, ANR
#12 Underground culvert at Toll Road  M07.T5.01.S1.01-C Inn Brook	Active Restoration	The underground culvert at the Toll Road is undersized and is 600 feet in length. This culvert and is resulting in no AOP including adult salmonids. The culvert was found to be mostly incompatible using the geomorphic screening tool. Scour below and alignment were identified as possible problems.	Culvert replacement	High priority; the culvert replacement may not be practical due to the length of the culvert and landuse constraints.	Improved geomorphic stability and AOP; there may be opportunity for creating a stream channel to provide habitat, where there are not current landuse constraints	High cost for replacement	Unknown	LCPC, ANR, and private property owner

**Table 6. Upper West Branch Watershed  
 Site Level Opportunities for Restoration and Protection  
 Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#13 Underground culvert the Lodge Parking Lot  M07.T5.01.S1.01-C Inn Brook	Active Restoration	The underground culvert at the Lodge Parking Lot is undersized and is 120 feet in length. This culvert and is resulting in no AOP including adult salmonids. The culvert was found to be partially compatible using the geomorphic screening tool. Scour below and alignment were identified as possible problems.	Culvert replacement	High priority; the culvert replacement may not be practical due to the length of the culvert and landuse constraints.	Improved geomorphic stability and AOP	High cost for replacement	Unknown	LCPC, ANR, and private property owner
#14 The Lodge Driveway  M07.T5.01.S1.01-C Inn Brook	Active Restoration	The culvert at the Lodge driveway is undersized and may be reducing AOP. The culvert was found to be partially compatible using the geomorphic screening tool. Deposition above, scour below, and alignment problems were noted.	Culvert replacement	High priority	Improved geomorphic stability and AOP	High cost for replacement	Unknown	LCPC, ANR, and private property owner
#15 The Lodge  M07.T5.01.S1.01-C Inn Brook	Passive Restoration	Streamside buffers are absent along much of The Lodge property	Streamside plantings; shrubs could be planted to provide a buffer without blocking the view of the stream	High priority	Prevent erosion, improve habitat and reduce water temperature	Low cost for plantings	Lawn to planted buffer	LCPC, ANR, and private property owner

**Table 6. Upper West Branch Watershed  
 Site Level Opportunities for Restoration and Protection  
 Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#16 The Lodge  M07.T5.01.S1.01-C Inn Brook	Stormwater Management	Sheet flow from The Lodge parking lot drains directly into an underground culvert.	The review of the stormwater management plan for this area is recommended	Moderate priority	Improve water quality in Inn Brook	Unknown	Unknown	LCPC, ANR, and private property owner
#17  Pinnacle Brook corridor  M07.T6.01 Pinnacle Brook	Conservation	The Pinnacle Brook corridor is well forested on both sides with wide buffers; the lower segment has major aggradation and planform adjustment	River Corridor Protection in the form of conservation or river corridor easements	High priority	Preserve area for recreation and wildlife habitat; forested buffer provides cool water temperatures and a food source for fish and other aquatic organisms	Cost of conservation or corridor easement	None	LCPC, ANR, and private property owner, land trust
#18  At former Ski Hostel  M08.S1.01-B Big Spruce Brook	Active Restoration	The parking lot adjacent to the former Ski Hostel is a floodplain encroachment. During a high flow event in early August 2010 riprap along the parking area was blown out. There is potential for a channel avulsion upstream of the Hostel, where there are large flood chutes.	Floodplain development	High priority	Improve geomorphic stability and water quality by reducing shear stress on the bed and banks of Big Spruce Brook.	High cost for design and implementation of project ; land use constraints may be a factor	Parking lot to floodplain	VANR, LCPC, Stowe Mountain Resort; LCNRC
#19  Mass Failure upstream of Ski Hostel  M08.S1.01-B Big Spruce Brook	Active Restoration	A mass failure on the west side of Big Spruce is introducing sediment to the channel. The mass failure	Investigate improving stability of mass failure using bioengineering techniques.	Low priority	Improved habitat and geomorphic stability	High cost to design and implement a project to stabilize the mass failure	Unknown	LCNRC, Vermont Geological survey, Stowe Mountain Resort, Town of Stowe, LCPC

**Table 6. Upper West Branch Watershed  
 Site Level Opportunities for Restoration and Protection  
 Stowe, Vermont**

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Other Social Benefits	Costs	Land Use Conversion	Potential Partners
#20 Big Spruce Brook corridor  M08.S1.02 and M08.S1.03 Big Spruce Brook	Passive Restoration	Much of Big Spruce Brook is in Stage F-III of the channel evolution model. A protected corridor would provide room for the channel to adjust and reach an equilibrium condition	Corridor easement	Low priority; The Big Spruce corridor is under the jurisdiction of Act 250 and is afforded protection through the land use permit held by Stowe Mountain Resort	Unknown	Cost of corridor easement	No new structures in corridor	VANR, LCPC, Stowe Mountain Resort
#21 Spruce Peak Road  M08S1.03-B Big Spruce Brook	Active Restoration	The culvert crossing at Spruce Peak Road on Big Spruce Brook is significantly undersized and is causing significant deposition upstream of the structure, as well as deposition below and scour below. The outlet drop is 8.1 feet, which acts as a barrier to AOP including adult salmonids.	Culvert replacement	High priority; Special design considerations are necessary for the possible replacement of this structure, given the active incision that is occurring upstream.	Improved geomorphic stability and AOP	High cost for replacement	Unknown	LCPC, ANR, and private landowner
#22 Spruce Peak Road  M08S1.03-B Big Spruce Brook	Active Restoration	Two active head cuts were mapped during the Phase 2 assessment; Segment M08.S1.03-B has an incision ratio of 4.48, indicating severe incision.	Arrest head cuts through rock weirs or other grade controls	High priority	Prevent further incision and reduce sediment to channel	High cost for design and construction	Unknown	LCPC, ANR, and private landowner

**Table 6. Upper West Branch Watershed  
 Site Level Opportunities for Restoration and Protection  
 Stowe, Vermont**

<b>Project # Segment</b>	<b>Type of Project</b>	<b>Site Description Including Stressors and Constraints</b>	<b>Project or Strategy Description</b>	<b>Technical Feasibility and Priority</b>	<b>Other Social Benefits</b>	<b>Costs</b>	<b>Land Use Conversion</b>	<b>Potential Partners</b>
#23 Entrance to Mansfield Parking Lot at Stowe Mountain Resort M09S4.01 Long Trail Tributary	Active Restoration	The culvert at the Mansfield parking lot access road has a width that is 50 percent of the bankfull channel width. There is significant deposition above the structure.	Culvert replacement	High priority	Improved geomorphic stability and AOP	High cost for replacement	Unknown	LCPC, ANR, and private property owner

## 7.4 Next Steps

There are many opportunities to restore the West Branch and its tributaries to a stable condition. Types of reach level and site level projects that have been identified in this plan include river corridor protection, streamside plantings, retrofit and/or replacement of stream crossings, arresting active incision of the channel, and the removal of a relict structure (abutment). On the watershed level, the development and implementation of fluvial erosion hazard zones is recommended to avoid conflicts regarding land use and to save money spent on flood damage and river maintenance. The Town of Stowe could pursue the opportunity to work with the LCPC and the Vermont River Management Program to develop fluvial erosion hazard zones for the land surrounding the upper West Branch watershed. The following are recommendations for next steps:

1. Outreach to private landowners and the public about the plan and potential restoration and protection opportunities to be completed by the State and/or LCPC.
2. Town, State, and LCPC representatives meet to discuss the various restoration and protection opportunities and set priorities for action.
3. Meetings to be held with additional partners (Lamoille County Natural Resources Conservation District, Department of Agriculture, Natural Resources Conservation Service, Vermont Agency of Transportation, etc.) to discuss implementation of priority projects.
4. Summary and prioritization of potential projects.
5. Implementation of priority projects with project partners and landowners.

For additional information about fluvial erosion hazard (FEH) zones or project development, please contact the LCPC:

Lamoille County Planning Commission  
632 LaPorte Road  
Morrisville, VT 05661  
(802)888-4548  
[lcpc@lcpcvt.org](mailto:lcpc@lcpcvt.org)



## 8.0 Glossary of Terms

Adapted from:

*Restoration Terms*, by Craig Fischenich, February, 2000, USAE Research and Development Center, Environmental Laboratory, 3909 Halls Ferry Rd., Vicksburg, MS 39180

And

Vermont Stream Geomorphic Assessment Handbook, Appendix Q, 2004, VT Agency of Natural Resources, Waterbury, VT. [http://www.vtwaterquality.org/rivers/docs/assessmenthandbooks/rv\\_apxglossary.pdf](http://www.vtwaterquality.org/rivers/docs/assessmenthandbooks/rv_apxglossary.pdf)

**Adjustment process** – type of change that is underway due to natural causes or human activity that has or will result in a change to the valley, floodplain, and/or channel condition (e.g., vertical, lateral, or channel plan form adjustment processes).

**Aggradation** - A progressive buildup or raising of the channel bed and floodplain due to sediment deposition. The geologic process by which streambeds are raised in elevation and floodplains are formed. Aggradation indicates that the stream discharge and/or bed load characteristics are changing. Opposite of degradation.

**Alluvial fan** – A fan-shaped accumulation of alluvium (alluvial soils) deposited at the mouth of a ravine or at the juncture of a tributary stream with the main stem where there is an abrupt change in slope.

**Alluvial soils** – Soil deposits from rivers.

**Alluvium** – A general term for detrital deposits made by streams on riverbeds, floodplains, and alluvial fans.

**Avulsion** – A change in channel course that occurs when a stream suddenly breaks through its banks, typically bisecting an overextended meander arc.

**Bank Stability** – The ability of a streambank to counteract erosion or gravity forces.

**Bankfull channel depth** - The maximum depth of a channel within a riffle segment when flowing at a bankfull discharge.

**Bankfull channel width** - The top surface width of a stream channel when flowing at a bankfull discharge.

**Bankfull discharge** - The stream discharge corresponding to the water stage that overtops the natural banks. This flow occurs, on average, about once every 1 to 2 years and given its frequency and magnitude is responsible for the shaping of most stream or river channels.

**Bar** – An accumulation of alluvium (usually gravel or sand) caused by a decrease in sediment transport capacity on the inside of meander bends or in the center of an over wide channel.

**Berms** – Mounds of dirt, earth, gravel or other fill built parallel to the stream banks designed to keep flood flows from entering the adjacent floodplain.

**Cascade** – River bed form where the channel is very steep with narrow confinement. There are often large boulders and bedrock with waterfalls.

**Channelization** – The process of changing (usually straightening) the natural path of a waterway.

**Culvert** – A buried pipe that allows flows to pass under a road.

**Degradation** – (1) A progressive lowering of the channel bed due to scour. Degradation is an indicator that the stream's discharge and/or sediment load is changing. The opposite of aggradation. (2) A decrease in value for a designated use.

**Delta bar** – A deposit of sediment where a tributary enters the mainstem of a river.

**Depositional features** – Types of sediment deposition and storage areas in a channel (e.g. mid-channel bars, point bars, side bars, diagonal bars, delta bars, and islands).

**Drainage Basin** – The total area of land from which water drains into a specific river.

**Dredging** – Removing material (usually sediments) from wetlands or waterways, usually to make them deeper or wider.

**Erosion** – Wearing away of rock or soil by the gradual detachment of soil or rock fragments by water, wind, ice, and other mechanical, chemical, or biological forces.

**Floodplain** – Land built of sediment that is regularly covered with water as a result of the flooding of a nearby stream.

**Gaging Station** – A particular site in a stream, lake, reservoir, etc., where hydrologic data are obtained.

**Grade control** - A fixed feature on the streambed that controls the bed elevation at that point, effectively fixing the bed elevation from potential incision; typically bedrock, dams or culverts.

**Gradient** – Vertical drop per unit of horizontal distance.

**Habitat** – The local environment in which organisms normally grow and live.

**Headwater** – Referring to the source of a stream or river.

**Head cut** – Sudden change in elevation or knickpoint at the leading edge of a gully

**Incised River** – A river that erodes its channel by the process of degradation to a lower base level than existed previously or is consistent with the current hydrology.

**Islands** – Mid-channel bars that are above the average water level and have established woody vegetation.

**Lacustrine soils**- Soil deposits from lakes.

**Meander** - The winding of a stream channel, usually in an erodible alluvial valley. A series of sine-generated curves characterized by curved flow and alternating banks and shoals.

**Meander migration** – The change of course or movement of a channel. The movement of a channel over time is natural in most alluvial systems. The rate of movement may be increased if the stream is out of balance with its watershed inputs.

**Meander belt width** – The horizontal distance between the opposite outside banks of fully developed meanders determined by extending two lines (one on each side of the channel) parallel to the valley from the lateral extent of each meander bend along both sides of the channel.

**Meander wavelength** - The lineal distance downvalley between two corresponding points of successive meanders of the same phase.

**Meander wavelength ratio** – The meander wavelength divided by the bankfull channel width.

**Meander width ratio** – The meander belt width divided by the bankfull channel width.

**Mid-channel bar** – Sediment deposits (bar) located in the channel away from the banks, generally found in areas where the channel runs straight. Mid-channel bars caused by recent channel instability are unvegetated.

**Planform** - The channel shape as if observed from the air. Changes in planform often involve shifts in large amount of sediment, bank erosion, or the migration of the channel.

**Plane bed** – Channel lacks discrete bed features (such as pools, riffles, and point bars) and may have long stretches of featureless bed.

**Point bar** –The convex side of a meander bend that is built up due to sediment deposition.

**Pool** -- A habitat feature (section of stream) that is characterized by deep, low-velocity water and a smooth surface.

**Reach** - Section of river with similar characteristics such as slope, confinement (valley width), and tributary influence.

**Restoration** – The return of an ecosystem to a close approximation of its condition prior to disturbance.

**Riffle** - A habitat feature (section of stream) that is characterized by shallow, fast-moving water broken by the presence of rocks and boulders.

**Riffle-pool** - Channel has undulating bed that defines a sequence of riffles, runs, pools, and point bars. Occurs in moderate to low gradient and moderately sinuous channels, generally in unconfined valleys with well-established floodplains.

**Riparian Buffer** – The width of naturally vegetated land adjacent to the stream between the top of the bank and the edge of other land uses. A buffer is largely undisturbed and consists of the trees, shrubs, groundcover plants, duff layer, and naturally uneven ground surface.

**Riparian Corridor** – Lands defined by the lateral extent of a stream’s meanders necessary to maintain a stable stream dimension, pattern, profile and sediment regime.

**Segment** – A relatively homogeneous section of stream contained within a reach that has the same reference stream characteristics but is distinct from other segments in the reach.

**Sensitivity** – The valley, floodplain and/or channel condition’s likelihood to change due to natural causes and/or anticipated human activity.

**Side bar** – Unvegetated sediment deposits located along the margins or the channel in locations other than the inside of channel meander bends.

**Step-pool** – Characterized by longitudinal steps formed by large particles (boulder/cobbles) organized into discrete channel-spanning accumulations that separate pools, which contain smaller sized materials. Often associated with steep channels in confined valleys.

**Surficial sediment/geology** – Sediment that lies on top of bedrock.

**Tributary** – A stream that flows into another stream, river, or lake.

**Urban runoff** – Storm water from city streets and gutters that usually carries a great deal of litter and organic and bacterial wastes into the receiving waters.

## 9.0 REFERENCES

- Barg, Lori. 2004. The Lamoille Watershed, Restoring the River: Recommendations to Protect Property, Respect the River, and Save Money. Step by Step Community Environmental Solutions. Plainfield, VT 05667.
- Doll, C. G. 1961. Centennial Geologic Map of Vermont.  
<http://www.anr.state.vt.us/dec/geo/centmap.htm>. Accessed May 12, 2010.
- Doolan, Barry L. 1996. The Geology of Vermont. Rocks and Minerals, Vol. 71, No.4. Washington, D.C.
- Foreman, R.T.T. and L.E. Alexander. 1998. Roads and Their Ecological Effects: Annual. Review of Ecological Systematics. Vol. 29: 207-231.
- Leopold, L.B. 1994. A View of the River. Cambridge, Massachusetts.
- Lamoille County Planning Commission. 2007. West Branch of the Little River Corridor Management Plan, Stowe, Vermont.
- Milone & MacBroom, Inc. 2008a. The Vermont Culvert Geomorphic Capability Screening Tool. South Burlington, Vermont.
- Milone & MacBroom, Inc. 2008b. The Vermont Culvert Aquatic Organism Passage Screening Tool, South Burlington, Vermont.
- Montgomery, David and Buffington, John. 1997. Channel Reach Morphology in Mountain Basins. GSA Bulletin. Boulder, Colorado.
- Olson, Scott., USGS. Personal communication 2004. (Cited in Lamoille County Planning Commission). 2007. West Branch of the Little River Corridor Management Plan, Stowe, Vermont.
- Rosgen, Dave. 1996. Applied River Morphology. Pagosa Springs, Colorado.
- Ryan, J. 2001. Stream stability assessment of Lamoille County, Vermont. Washington, Vermont.
- Stowe Land Trust. 2010a. Bingham Falls 2001.  
<http://www.stowelandtrust.org/conserved/properties/21/>. Accessed May 26, 2010.
- Thompson and Sorenson. 2005. Wetland, Woodland, Wildland: A guide to the natural communities of Vermont. Capital City Press, Montpelier, Vermont.

- Thompson, P. and Thompson, T.B. 2000. Bedrock Geology of the Mt. Mansfield Quadrangle. <http://www.anr.state.vt.us/dec/geo/images/digitalofrs/mtmansfieldweb.jpg>. Accessed May 12, 2010.
- United States Department of Agriculture. 1986. Urban Hydrology for Small Watersheds. Soil Conservation Service, Engineering Division, Technical Release 55. Washington, D.C.
- USGS. 2009. United States Geologic Survey website. <http://waterdata.usgs.gov/vt/nwis/rt>
- Van Driesche, R., et al., 2002, Biological Control of Invasive Plants in the Eastern United States, USDA Forest Service Publication FHTET-2002-04, 413 p. <http://www.invasive.org/eastern/biocontrol/I2Knotweed.html>. Accessed April 20, 2010. Last Updated November 5, 2003.
- Vermont Center for Geographic Information. 2008. Geologic Soils\_So. Soils – Natural Resources Conservation Service soil survey. <http://www.vcgi.org/dataaware/>
- Vermont Agency of Natural Resources. 2006. Vermont Stream Geomorphic Assessment Phase I Handbook: Watershed Assessment Using Maps, Existing Data, and Windshield Surveys. Waterbury, Vermont.
- Vermont Agency of Natural Resources. 2006. Fluvial Erosion Municipal Guide. Waterbury, Vermont.
- Vermont Agency of Natural Resources. 2007a. Vermont Agency of Natural Resources River Corridor Planning Guide to Identify and Develop River Corridor Protection and Restoration Projects. (Partially Drafted July 2007). Vermont Agency of Natural Resources, Department of Environmental Conservation, River Management Program, Waterbury, Vermont.
- Vermont Agency of Natural Resources. 2007b. Vermont Agency of Natural Resources Phase 2 Handbook, Rapid Stream Assessment Field Protocols. Vermont Agency of Natural Resources, Department of Environmental Conservation, River Management Program, Waterbury, Vermont.
- Vermont Agency of Natural Resources. (2008). River Corridor Protection Guide: Fluvial Geomorphic-Based Methodology to Reduce Flood Hazards and Protect Water Quality. DEC River Management Program. Waterbury, Vermont.
- Wemple, Beverly. 2002. Distributed Hydrology Soil Vegetation model for West Branch and Ranch Brook watersheds. University of Vermont. Department of Geology. Unpublished.
- Wright, Stephen. 2003. Glacial Geology of the Burlington and Colchester 7.5' Quads, VT. University of Vermont Burlington, Vermont. <http://www.anr.state.vt.us/DEC/GEO/pdfdocs/GlacGeoBurlwright.pdf>

# APPENDIX A

## STANDARD PHASE 2 DMS REPORTS



Phase 2 Segment Summary Report West Branch Little River

Stream:	West Branch	SGAT Version:	4.56
Reach:	M301-0	Organization:	Bear Creek Environmental
Segment Length(ft):	5,260	Observers:	Mary Nealon and Michael Blazewicz
Rain:	No	Completion Date:	10/3/2005
		Quality Control Status - Consultant:	Passed
		Quality Control Status - Staff:	Provisional

Step 0 - Location: Segment begins just above confluence with Little River and continues upstream to just above Weeks Hill Road.

Step 5 - Notes:

Step 7 - Narrative: Historic degradation; active aggradation, widening, and planform adjustment

Step 1. Valley and Floodplain

1.1 Segmentation:	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Hilly</b>	<b>Steep</b>	Valley Width (ft): <b>4,000</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Never</b>	<b>Never</b>	Width Determination:
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Never</b>	<b>Never</b>	Confinement Type: <b>VB</b>
Berm:	Texture:	<b>N.E.</b>	<b>N.E.</b>	In Rock Gorge: <b>No</b>
Road:				Human Caused Change in Valley Width?: <b>No</b>
Railroad:				
Imp. Path:				
Dev.:				
1.6 Grade Controls: <b>None</b>				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **West Branch** Reach: **M301-0**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>69.50</b>	2.11 Riffle/Step Spacing:	2.13 Average Largest Particle on
2.2 Max Depth (ft.):	<b>3.00</b>	2.12 Substrate Composition	Bed: <b>4 inches</b>
2.3 Mean Depth (ft):	<b>2.24</b>	Bedrock:	Bar: <b>4 inches</b>
2.4 Floodprone Width (ft.):	<b>131.00</b>	Boulder:	2.14 Stream Type
2.5 Aband. Floodpn (ft.):	<b>7.00</b>	Cobble:	Stream Type: <b>B</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	Bed Material: <b>Gravel</b>
2.6 Width/Depth Ratio:	<b>31.03</b>	Fine Gravel:	Subclass Slope: <b>c</b>
2.7 Entrenchment Ratio:	<b>1.88</b>	Sand:	Bed Form: <b>Plane Bed</b>
2.8 Incision Ratio:	<b>2.33</b>	Silt and Smaller:	Field Measured Slope:
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	2.15 Sub-reach Stream Type
2.9 Sinuosity:	<b>Low</b>	Detritus:	Reference Stream Type:
2.10 Riffles Type:	<b>Sedimented</b>	# Large Woody Debris:	Reference Bed Material:
			Reference Subclass Slope:
			Reference Bedform:

#### Step 3. Riparian Features

3.1 Stream Banks	Typical Bank Slope: <b>Steep</b>			
Bank Texture	Bank Erosion		Near Bank Vegetation Type	
Upper	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Material Type:			Dominant:	<b>Invasives</b>
Consistency:			Sub-dominant:	<b>Herbaceous</b>
Lower			Bank Canopy	<b>Herbaceous</b>
Material Type:			Canopy %:	<b>1-25</b>
Consistency:			Mid-Channel Canopy:	<b>Open</b>

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	<b>0-25</b>	<b>0-25</b>
Sub-Dominant		
W less than 25		
Buffer Vegetation Type		
Dominant	<b>Herbaceous</b>	<b>Herbaceous</b>
Sub-Dominant	<b>Deciduous</b>	<b>Deciduous</b>

#### 3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Hay</b>	<b>Hay</b>	Mass Failures	
Sub-dominant			Height	
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	
Failures	<b>None</b>		Gullies Length	
Gullies				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M301-0

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps:	<b>Minimal</b>	4.5 Flow Regulation Type	<b>None</b>	4.7 Stormwater Inputs	
4.2 Adjacent Wetlands:	<b>None</b>	Flow Reg. Use:		Field Ditch:	<b>0</b> Road Ditch: <b>0</b>
4.3 Flow Status:	<b>Moderate</b>	Impoundments:	<b>None</b>	Other:	<b>7</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams:	<b>0</b>	Impoundment Loc.:		Overland Flow:	<b>0</b> Urb Strm Wtr Pipe: <b>0</b>
		4.6 Up/Down Strm flow reg.:		4.9 # of Beaver Dams:	<b>1</b>
		(old) Upstrm Flow Reg.:	<b>None</b>	Affected Length (ft):	<b>500</b>

#### 4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Bridge		Yes	No	Yes	Yes	Deposition Above, Scour Below
Bridge		Yes	No	Yes	Yes	Deposition Below, Scour Above

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>2</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing:	<b>No</b>
Mid:	<b>2</b> Delta: <b>1</b>	Flood chutes:	<b>1</b>	5.5 Straightening:	<b>Straightening</b>
Point:	<b>2</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>0</b>	Straightening Length (ft.):	<b>0</b>
Side:	<b>2</b> Braiding: <b>0</b>	Steep Riffles:	<b>2</b>	5.5 Dredging:	<b>Gravel Mining</b>
			Trib Rejuv.: <b>No</b>		

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	<b>2</b>	6.4 Sediment Deposition:	<b>5</b>	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	<b>4</b>	6.5 Channel Flow Status:	<b>8</b>	6.8 Bank Stability:	<b>5</b>	<b>3</b>
6.3 Pool Variability:	<b>7</b>	6.6 Channel Alteration:	<b>6</b>	6.9 Bank Vegetation Protection	<b>2</b>	<b>2</b>
Total Score:	<b>54</b>	6.7 Channel Sinuosity:	<b>8</b>	6.10 Riparian Veg. Zone Width:	<b>1</b>	<b>1</b>
Habitat Rating:	<b>0.27</b>					
Habitat Stream Condition:	<b>Poor</b>					

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		<b>4</b>	<b>C to B</b>	<b>Yes</b>	Geomorphic Rating	<b>0.34</b>
7.2 Channel Aggradation		<b>7</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>8</b>		<b>No</b>	Channel Evolution Stage	<b>III</b>
7.4 Change in Planform		<b>8</b>		<b>No</b>	Geomorphic Condition	<b>Poor</b>
Total Score		<b>27</b>			Stream Sensitivity	<b>Very High</b>



Phase 2 Segment Summary Report West Branch Little River

Stream:	West Branch	SGAT Version:	4.56
Reach:	M302-0	Organization:	Bear Creek Environmental
Segment Length(ft):	12,528	Observers:	Michael Blazewicz and Pam DeAndrea
Rain:	Yes	Completion Date:	9/28/2005
		Quality Control Status - Consultant:	Passed
		Quality Control Status - Staff:	Provisional

Step 0 - Location: Segment begins just above Weeks Hill Rd. and continues until the confluence of M3.t2.01.

Step 5 - Notes:

Step 7 - Narrative: Historic incision and possible widening; aggrading and undergoing planform change

Step 1. Valley and Floodplain

1.1 Segmentation:	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Very Steep</b>	<b>Very Steep</b>	Valley Width (ft): <b>2,800</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Never</b>	<b>Never</b>	Width Determination:
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Never</b>	<b>Never</b>	Confinement Type: <b>VB</b>
Berm:	Texture:	<b>N.E.</b>	<b>N.E.</b>	In Rock Gorge: <b>No</b>
Road:				Human Caused Change in Valley Width?: <b>Yes</b>
Railroad:				
Imp. Path:				
Dev.:				
1.6 Grade Controls: <b>None</b>				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **West Branch** Reach: **M302-0**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>57.00</b>	2.11 Riffle/Step Spacing:	<b>700 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>4.25</b>	2.12 Substrate Composition		Bed:	<b>8 inches</b>
2.3 Mean Depth (ft.):	<b>2.85</b>	Bedrock:	<b>0.0 %</b>	Bar:	<b>8 inches</b>
2.4 Floodprone Width (ft.):	<b>225.00</b>	Boulder:	<b>0.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>8.15</b>	Cobble:	<b>14.0 %</b>	Stream Type:	<b>C</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	<b>46.0 %</b>	Bed Material:	<b>Gravel</b>
2.6 Width/Depth Ratio:	<b>20.00</b>	Fine Gravel:	<b>21.0 %</b>	Subclass Slope:	<b>None</b>
2.7 Entrenchment Ratio:	<b>3.95</b>	Sand:	<b>19.0 %</b>	Bed Form:	<b>Riffle-Pool</b>
2.8 Incision Ratio:	<b>1.92</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	<b>No</b>	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Moderate</b>	Detritus:	<b>5.0 %</b>	Reference Stream Type:	
2.10 Riffles Type:	<b>Sedimented</b>	# Large Woody Debris:	<b>32</b>	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope:	<b>Steep</b>				
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>2,125.0</b>	<b>1,690.0</b>	Dominant:	<b>Herbaceous</b>	<b>Herbaceous</b>
Material Type:			Erosion Height (ft.):	<b>6.0</b>	<b>6.0</b>	Sub-dominant:	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>
Consistency:			Revetment Type:	<b>Rip-Rap</b>	<b>Rip-Rap</b>	Bank Canopy		
Lower			Revetment Length:	<b>4,260.0</b>	<b>5,110.0</b>	Canopy %:	<b>1-25</b>	<b>1-25</b>
Material Type:						Mid-Channel Canopy:	<b>Open</b>	
Consistency:								

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	<b>26-50</b>	<b>0-25</b>
Sub-Dominant	<b>0-25</b>	<b>26-50</b>
W less than 25		
Buffer Vegetation Type		
Dominant	<b>Deciduous</b>	<b>Deciduous</b>
Sub-Dominant	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>

#### 3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Commercial</b>	<b>Residential</b>	Mass Failures	
Sub-dominant	<b>Residential</b>	<b>Forest</b>	Height	
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	
Failures	<b>None</b>		Gullies Length	
Gullies				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010

### Phase 2 Segment Summary Report

### West Branch Little River

Page3

Stream: West Branch

Reach: M302-0

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>None</b>	4.5 Flow Regulation Type <b>None</b>	4.7 Stormwater Inputs
4.2 Adjacent Wetlands: <b>None</b>	Flow Reg. Use:	Field Ditch: <b>0</b> Road Ditch: <b>0</b>
4.3 Flow Status: <b>Moderate</b>	Impoundments: <b>None</b>	Other: <b>5</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams: <b>0</b>	Impoundment Loc.:	Overland Flow: <b>0</b> Urb Strm Wtr Pipe: <b>0</b>
	4.6 Up/Down Strm flow reg.:	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.: <b>None</b>	Affected Length (ft):

#### 4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Bridge		Yes	No	Yes	Yes	Deposition Above, Deposition Below, Alignment
Bridge		Yes	No	Yes	Yes	Deposition Above, Scour Below, Alignment

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>2</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: <b>1</b>	Delta: <b>0</b>	Flood chutes: <b>2</b>	Avulsion: <b>0</b>	5.5 Straightening: <b>Straightening</b>
Point: <b>2</b>	Island: <b>0</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>0</b>	Straightening Length (ft.): <b>0</b>
Side: <b>2</b>	Braiding: <b>1</b>	Steep Riffles: <b>2</b>	Trib Rejuv.: <b>No</b>	5.5 Dredging: <b>Gravel Mining</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.: <b>2</b>	6.4 Sediment Deposition: <b>7</b>	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate: <b>11</b>	6.5 Channel Flow Status: <b>8</b>	6.8 Bank Stability: <b>4</b>	<b>4</b>	<b>4</b>
6.3 Pool Variability: <b>13</b>	6.6 Channel Alteration: <b>6</b>	6.9 Bank Vegetation Protection: <b>1</b>	<b>1</b>	<b>1</b>
Total Score: <b>75</b>	6.7 Channel Sinuosity: <b>13</b>	6.10 Riparian Veg. Zone Width: <b>4</b>	<b>4</b>	<b>1</b>
Habitat Rating: <b>0.38</b>				
Habitat Stream Condition: <b>Fair</b>				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		<b>7</b>	<b>None</b>	<b>Yes</b>	Geomorphic Rating	<b>0.38</b>
7.2 Channel Aggradation		<b>9</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>7</b>		<b>Yes</b>	Channel Evolution Stage	<b>IV</b>
7.4 Change in Planform		<b>7</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>30</b>			Stream Sensitivity	<b>Very High</b>



Phase 2 Segment Summary Report **West Branch Little River**

Stream:	<b>West Branch</b>	SGAT Version:	<b>4.56</b>
Reach:	<b>M303-A</b>	Organization:	<b>Bear Creek Environmental</b>
Segment Length(ft):	<b>550</b>	Observers:	<b>Mary Nealon, Mike Blazewicz, Mike Kline, Pete Spatz</b>
Rain:	<b>No</b>	Completion Date:	<b>9/23/2005</b>
		Quality Control Status - Consultant:	<b>Passed</b>
		Quality Control Status - Staff:	<b>Provisional</b>

Step 0 - Location: **Segment begins at confluence with M3.T2.01 and ends about 550 feet upstream at rock cross vane.**

Step 5 - Notes: **Bike path bridge is not a constriction.**

Step 7 - Narrative: **historic degradation, existing aggradation**

Step 1. Valley and Floodplain

1.1 Segmentation:	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Steep</b>	<b>Steep</b>	Valley Width (ft): <b>1,200</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Never</b>	<b>Never</b>	Width Determination:
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Never</b>	<b>Never</b>	Confinement Type: <b>VB</b>
Berm:	Texture:	<b>N.E.</b>	<b>N.E.</b>	In Rock Gorge: <b>No</b>
Road:				Human Caused Change in Valley Width?: <b>Yes</b>
Railroad:				
Imp. Path:				
Dev.:				

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
<b>Weir</b>	<b>Upstream</b>				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **West Branch** Reach: **M303-A**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>62.50</b>	2.11 Riffle/Step Spacing:	2.13 Average Largest Particle on
2.2 Max Depth (ft.):	<b>4.20</b>	2.12 Substrate Composition	Bed: <b>12 inches</b>
2.3 Mean Depth (ft.):	<b>2.63</b>	Bedrock:	Bar: <b>12 inches</b>
2.4 Floodprone Width (ft.):	<b>76.00</b>	Boulder:	2.14 Stream Type
2.5 Aband. Floodpn (ft.):	<b>10.40</b>	Cobble:	Stream Type: <b>F</b>
Human Elev FloodPIn (ft.):		Coarse Gravel:	Bed Material: <b>Cobble</b>
2.6 Width/Depth Ratio:	<b>23.76</b>	Fine Gravel:	Subclass Slope: <b>None</b>
2.7 Entrenchment Ratio:	<b>1.22</b>	Sand:	Bed Form: <b>Plane Bed</b>
2.8 Incision Ratio:	<b>2.48</b>	Silt and Smaller:	Field Measured Slope:
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	2.15 Sub-reach Stream Type
2.9 Sinuosity:	<b>Low</b>	Detritus:	Reference Stream Type:
2.10 Riffles Type:	<b>Sedimented</b>	# Large Woody Debris:	Reference Bed Material:
			Reference Subclass Slope:
			Reference Bedform:

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope: <b>Steep</b>	
Bank Texture		Bank Erosion	<u>Left</u>	<u>Right</u>
Upper	<u>Left</u>	Erosion Length (ft.):	<b>0.0</b>	<b>75.0</b>
Material Type:		Erosion Height (ft.):	<b>0.0</b>	<b>6.0</b>
Consistency:		Revetment Type:	<b>Rip-Rap</b>	<b>None</b>
Lower		Revetment Length:	<b>400.0</b>	<b>0.0</b>
Material Type:		Canopy %:	<b>1-25</b>	<b>51-75</b>
Consistency:		Mid-Channel Canopy:	<b>Open</b>	

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	<b>0-25</b>	<b>&gt;100</b>
Sub-Dominant		
W less than 25		
Buffer Vegetation Type		
Dominant	<b>Deciduous</b>	<b>Deciduous</b>
Sub-Dominant		

#### 3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Commercial</b>	<b>Forest</b>	Mass Failures	
Sub-dominant			Height	
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	
Failures	<b>None</b>		Gullies Length	
Gullies				



# Stream Geomorphic Assessment

## Agency of Natural Resources

VT DEC

Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M303-A

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>None</b>	4.5 Flow Regulation Type <b>None</b>	4.7 Stormwater Inputs <b>None</b>
4.2 Adjacent Wetlands: <b>None</b>	Flow Reg. Use:	Field Ditch: Road Ditch:
4.3 Flow Status: <b>Moderate</b>	Impoundments: <b>None</b>	Other: Tile Drain:
4.4 # of Debris Jams: <b>0</b>	Impoundment Loc.:	Overland Flow: Urb Strm Wtr Pipe:
	4.6 Up/Down Strm flow reg.:	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.: <b>None</b>	Affected Length (ft):
4.8 Channel Constrictions: <b>None</b>		

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types Diagonal: <b>0</b>	5.2 Other Features Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: <b>0</b> Delta: <b>0</b>	Flood chutes: <b>0</b> Avulsion: <b>0</b>	5.5 Straightening: <b>Straightening</b>
Point: <b>1</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts Head Cuts: <b>0</b>	Straightening Length (ft.): <b>0</b>
Side: <b>0</b> Braiding: <b>0</b>	Steep Riffles: <b>1</b> Trib Rejuv.: <b>Yes</b>	5.5 Dredging: <b>Dredging, Gravel Mining</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.: <b>7</b>	6.4 Sediment Deposition: <b>8</b>	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate: <b>11</b>	6.5 Channel Flow Status: <b>9</b>	6.8 Bank Stability: <b>10</b>	<b>7</b>	
6.3 Pool Variability: <b>8</b>	6.6 Channel Alteration: <b>2</b>	6.9 Bank Vegetation Protection: <b>0</b>	<b>4</b>	
Total Score: <b>84</b>	6.7 Channel Sinuosity: <b>8</b>	6.10 Riparian Veg. Zone Width: <b>0</b>	<b>10</b>	
Habitat Rating: <b>0.42</b>				
Habitat Stream Condition: <b>Fair</b>				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		<b>3</b>	<b>C to F</b>	<b>Yes</b>	Geomorphic Rating	<b>0.47</b>
7.2 Channel Aggradation		<b>9</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>12</b>		<b>No</b>	Channel Evolution Stage	<b>II</b>
7.4 Change in Planform		<b>14</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>38</b>			Stream Sensitivity	<b>Extreme</b>



Phase 2 Segment Summary Report West Branch Little River

Stream:	West Branch	SGAT Version:	4.56
Reach:	M303-B	Organization:	Bear Creek Environmental
Segment Length(ft):	1,427	Observers:	Mary Nealon, Mike Blazewicz, Mike Kline, Pete Spatz
Rain:	No	Completion Date:	9/23/2005
		Quality Control Status - Consultant:	Passed
		Quality Control Status - Staff:	Provisional

Step 0 - Location: Segment begins about 550 feet upstream from confluence with M3.T2.01 at rock cross vane and continues until near bike path parking lot off of RT 108 just downstream from corn maze.

Step 5 - Notes: Weak riffle pool - mostly plane bed

Step 7 - Narrative: historic degradation, currently aggradation; widening process stopped due to rip-rap.

Step 1. Valley and Floodplain

1.1 Segmentation:	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: None	Hillside Slope:	Steep	Steep	Valley Width (ft): 1,200
1.3 Corridor Encroachments:	Continuous w/ Bank:	Never	Never	Width Determination:
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	Never	Never	Confinement Type: VB
Berm:	Texture:	N.E.	N.E.	In Rock Gorge: No
Road:				Human Caused Change in Valley Width?: Yes
Railroad:				
Imp. Path:				
Dev.:				
1.6 Grade Controls: None				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **West Branch** Reach: **M303-B**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>60.00</b>	2.11 Riffle/Step Spacing:	2.13 Average Largest Particle on
2.2 Max Depth (ft.):	<b>3.40</b>	2.12 Substrate Composition	Bed: <b>12 inches</b>
2.3 Mean Depth (ft.):	<b>2.52</b>	Bedrock:	Bar: <b>11 inches</b>
2.4 Floodprone Width (ft.):	<b>96.00</b>	Boulder:	2.14 Stream Type
2.5 Aband. Floodpn (ft.):	<b>8.10</b>	Cobble:	Stream Type: <b>B</b>
Human Elev FloodPIn (ft.):		Coarse Gravel:	Bed Material: <b>Gravel</b>
2.6 Width/Depth Ratio:	<b>23.81</b>	Fine Gravel:	Subclass Slope: <b>c</b>
2.7 Entrenchment Ratio:	<b>1.60</b>	Sand:	Bed Form: <b>Plane Bed</b>
2.8 Incision Ratio:	<b>2.38</b>	Silt and Smaller:	Field Measured Slope:
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	2.15 Sub-reach Stream Type
2.9 Sinuosity:	<b>Low</b>	Detritus:	Reference Stream Type:
2.10 Riffles Type:	<b>Sedimented</b>	# Large Woody Debris:	Reference Bed Material:
			Reference Subclass Slope:
			Reference Bedform:

#### Step 3. Riparian Features

3.1 Stream Banks	Typical Bank Slope: <b>Steep</b>			
Bank Texture	Bank Erosion		Near Bank Vegetation Type	
Upper	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Material Type:			<b>Herbaceous</b>	<b>Herbaceous</b>
Consistency:			<b>Bare</b>	<b>Bare</b>
Lower			Bank Canopy	
Material Type:			Canopy %:	<b>1-25</b> <b>1-25</b>
Consistency:			Mid-Channel Canopy:	<b>Open</b>

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	<b>51-100</b>	<b>0-25</b>
Sub-Dominant	<b>0-25</b>	<b>51-100</b>
W less than 25		
Buffer Vegetation Type		
Dominant	<b>Deciduous</b>	<b>Herbaceous</b>
Sub-Dominant		<b>Deciduous</b>

#### 3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Forest</b>	<b>Crop</b>	Mass Failures	
Sub-dominant	<b>Commercial</b>		Height	
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	
Failures	<b>None</b>		Gullies Length	
Gullies				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M303-B

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps:	<b>None</b>	4.5 Flow Regulation Type	<b>None</b>	4.7 Stormwater Inputs	
4.2 Adjacent Wetlands:	<b>None</b>	Flow Reg. Use:		Field Ditch:	<b>0</b> Road Ditch: <b>0</b>
4.3 Flow Status:	<b>Moderate</b>	Impoundments:	<b>None</b>	Other:	<b>1</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams:	<b>0</b>	Impoundment Loc.:		Overland Flow:	<b>0</b> Urb Strm Wtr Pipe: <b>0</b>
		4.6 Up/Down Strm flow reg.:		4.9 # of Beaver Dams:	<b>0</b>
		(old) Upstrm Flow Reg.:	<b>None</b>	Affected Length (ft):	
4.8 Channel Constrictions:	<b>None</b>				

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>0</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing:	<b>No</b>
Mid:	<b>0</b> Delta: <b>0</b>	Flood chutes:	<b>2</b> Avulsion: <b>0</b>	5.5 Straightening:	<b>Straightening</b>
Point:	<b>1</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>0</b>	Straightening Length (ft.):	<b>0</b>
Side:	<b>1</b> Braiding: <b>0</b>	Steep Riffles:	<b>2</b> Trib Rejuv.: <b>No</b>	5.5 Dredging:	<b>Gravel Mining</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	<b>10</b>	6.4 Sediment Deposition:	<b>11</b>	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	<b>11</b>	6.5 Channel Flow Status:	<b>8</b>	6.8 Bank Stability:	<b>8</b>	<b>8</b>
6.3 Pool Variability:	<b>11</b>	6.6 Channel Alteration:	<b>8</b>	6.9 Bank Vegetation Protection	<b>2</b>	<b>7</b>
Total Score:	<b>104</b>	6.7 Channel Sinuosity:	<b>10</b>	6.10 Riparian Veg. Zone Width:	<b>7</b>	<b>3</b>
Habitat Rating:	<b>0.52</b>					
Habitat Stream Condition:	<b>Fair</b>					

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	<u>Unconfined</u>	<u>Score</u>	<u>STD</u>	<u>Historic</u>		
7.1 Channel Degradation		<b>5</b>	<b>C to B</b>	<b>Yes</b>	Geomorphic Rating	<b>0.46</b>
7.2 Channel Aggradation		<b>7</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>12</b>		<b>No</b>	Channel Evolution Stage	<b>III</b>
7.4 Change in Planform		<b>13</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>37</b>			Stream Sensitivity	<b>Very High</b>



Phase 2 Segment Summary Report West Branch Little River

Stream:	West Branch	SGAT Version:	4.56
Reach:	M304-A	Organization:	Bear Creek Environmental
Segment Length(ft):	3,000	Observers:	Michael Blacewicz and Pam DeAndrea
Rain:	No	Completion Date:	10/4/2005
		Quality Control Status - Consultant:	Passed
		Quality Control Status - Staff:	Provisional

Step 0 - Location: Segment begins near bike path parking lot off of Rt 108 (near corn maze) and continues another 3000 feet.

Step 5 - Notes:

Step 7 - Narrative: Historic incision; currently aggrading , widening and planform change

Step 1. Valley and Floodplain

1.1 Segmentation:	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Hilly</b>	<b>Very Steep</b>	Valley Width (ft): <b>1,050</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Never</b>	<b>Never</b>	Width Determination:
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Never</b>	<b>Never</b>	Confinement Type: <b>VB</b>
Berm:	Texture:	<b>N.E.</b>	<b>N.E.</b>	In Rock Gorge: <b>No</b>
Road:				Human Caused Change in Valley Width?: <b>Yes</b>
Railroad:				
Imp. Path:				
Dev.:				
1.6 Grade Controls: <b>None</b>				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **West Branch**

Reach: **M304-A**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>77.00</b>	2.11 Riffle/Step Spacing:	2.13 Average Largest Particle on
2.2 Max Depth (ft.):	<b>2.95</b>	2.12 Substrate Composition	Bed: <b>24 inches</b>
2.3 Mean Depth (ft.):	<b>1.80</b>	Bedrock:	Bar: <b>16 inches</b>
2.4 Floodprone Width (ft.):	<b>118.00</b>	Boulder:	2.14 Stream Type
2.5 Aband. Floodpn (ft.):	<b>8.45</b>	Cobble:	Stream Type: <b>B</b>
Human Elev FloodPIn (ft.):		Coarse Gravel:	Bed Material: <b>Gravel</b>
2.6 Width/Depth Ratio:	<b>42.78</b>	Fine Gravel:	Subclass Slope: <b>c</b>
2.7 Entrenchment Ratio:	<b>1.53</b>	Sand:	Bed Form: <b>Plane Bed</b>
2.8 Incision Ratio:	<b>2.86</b>	Silt and Smaller:	Field Measured Slope:
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	2.15 Sub-reach Stream Type
2.9 Sinuosity:	<b>Low</b>	Detritus:	Reference Stream Type:
2.10 Riffles Type:	<b>Not Applicable</b>	# Large Woody Debris:	Reference Bed Material:
			Reference Subclass Slope:
			Reference Bedform:

#### Step 3. Riparian Features

3.1 Stream Banks	Typical Bank Slope: <b>Steep</b>			
Bank Texture			Bank Erosion	<u>Left</u> <u>Right</u> Near Bank Vegetation Type <u>Left</u> <u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>125.0</b> <b>850.0</b> Dominant: <b>Invasives</b> <b>Deciduous</b>
Material Type:			Erosion Height (ft.):	<b>4.0</b> <b>4.0</b> Sub-dominant: <b>Herbaceous</b> <b>Shrubs/Sapling</b>
Consistency:			Revetment Type:	<b>Rip-Rap</b> <b>Rip-Rap</b> Bank Canopy
Lower			Revetment Length:	<b>1,850.0</b> <b>600.0</b> Canopy %: <b>0</b> <b>1-25</b>
Material Type:				Mid-Channel Canopy: <b>Open</b>
Consistency:				

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	<b>0-25</b>	<b>&gt;100</b>
Sub-Dominant		<b>0-25</b>
W less than 25		(Legacy)
Buffer Vegetation Type		Failures
Dominant	<b>Deciduous</b>	<b>Deciduous</b>
Sub-Dominant		Gullies

#### 3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Commercial</b>	<b>Crop</b>	Mass Failures	
Sub-dominant	<b>Residential</b>		Height	
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	
Failures	<b>None</b>		Gullies Length	



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M304-A

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps:	<b>None</b>	4.5 Flow Regulation Type	<b>None</b>	4.7 Stormwater Inputs	
4.2 Adjacent Wetlands:	<b>None</b>	Flow Reg. Use:		Field Ditch:	<b>0</b> Road Ditch: <b>0</b>
4.3 Flow Status:	<b>Moderate</b>	Impoundments:	<b>None</b>	Other:	<b>1</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams:	<b>0</b>	Impoundment Loc.:		Overland Flow:	<b>0</b> Urb Strm Wtr Pipe: <b>0</b>
		4.6 Up/Down Strm flow reg.:		4.9 # of Beaver Dams:	<b>0</b>
		(old) Upstrm Flow Reg.:	<b>None</b>	Affected Length (ft):	
4.8 Channel Constrictions:	<b>None</b>				

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>2</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing:	<b>No</b>
Mid:	<b>1</b> Delta: <b>0</b>	Flood chutes: <b>2</b>	Avulsion: <b>0</b>	5.5 Straightening:	<b>Straightening</b>
Point:	<b>2</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>0</b>	Straightening Length (ft.):	<b>0</b>
Side:	<b>2</b> Braiding: <b>0</b>	Steep Riffles: <b>2</b>	Trib Rejuv.: <b>No</b>	5.5 Dredging:	<b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	<b>5</b>	6.4 Sediment Deposition:	<b>1</b>	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	<b>9</b>	6.5 Channel Flow Status:	<b>7</b>	6.8 Bank Stability:	<b>8</b>	<b>4</b>
6.3 Pool Variability:	<b>7</b>	6.6 Channel Alteration:	<b>8</b>	6.9 Bank Vegetation Protection	<b>4</b>	<b>4</b>
Total Score:	<b>68</b>	6.7 Channel Sinuosity:	<b>3</b>	6.10 Riparian Veg. Zone Width:	<b>1</b>	<b>7</b>
Habitat Rating:	<b>0.34</b>					
Habitat Stream Condition:	<b>Poor</b>					

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	<u>Unconfined</u>	<u>Score</u>	<u>STD</u>	<u>Historic</u>		
7.1 Channel Degradation		<b>3</b>	<b>C to B</b>	<b>Yes</b>	Geomorphic Rating	<b>0.30</b>
7.2 Channel Aggradation		<b>7</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>6</b>		<b>No</b>	Channel Evolution Stage	<b>IV</b>
7.4 Change in Planform		<b>8</b>		<b>No</b>	Geomorphic Condition	<b>Poor</b>
Total Score		<b>24</b>			Stream Sensitivity	<b>Very High</b>



Phase 2 Segment Summary Report West Branch Little River

Stream:	West Branch	SGAT Version:	4.56
Reach:	M304-B	Organization:	Bear Creek Environmental
Segment Length(ft):	1,875	Observers:	Michael Blazewicz and Pam DeAndrea
Rain:	No	Completion Date:	10/4/2005
		Quality Control Status - Consultant:	Passed
		Quality Control Status - Staff:	Provisional

Step 0 - Location: Segment begins about 3000 feet upstream from beginning of reach M3.04 and continues another 1500 feet just upstream from where hay fields end in left corridor.

Step 5 - Notes:

Step 7 - Narrative: Historic incision; current aggradation and widening.

Step 1. Valley and Floodplain

1.1 Segmentation:	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Hilly</b>	<b>Extr.Steep</b>	Valley Width (ft): <b>900</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Never</b>	<b>Sometimes</b>	Width Determination:
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Never</b>	<b>Always</b>	Confinement Type: <b>VB</b>
Berm:	Texture:	<b>Other</b>	<b>N.E.</b>	In Rock Gorge: <b>No</b>
Road:				Human Caused Change in Valley Width?: <b>Yes</b>
Railroad:				
Imp. Path:				
Dev.:				
1.6 Grade Controls: <b>None</b>				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **West Branch**

Reach: **M304-B**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>60.00</b>	2.11 Riffle/Step Spacing:	2.13 Average Largest Particle on
2.2 Max Depth (ft.):	<b>3.30</b>	2.12 Substrate Composition	Bed: <b>36 inches</b>
2.3 Mean Depth (ft.):	<b>2.34</b>	Bedrock:	Bar: <b>18 inches</b>
2.4 Floodprone Width (ft.):	<b>84.00</b>	Boulder:	2.14 Stream Type
2.5 Aband. Floodpn (ft.):	<b>11.80</b>	Cobble:	Stream Type: <b>F</b>
Human Elev FloodPIn (ft.):		Coarse Gravel:	Bed Material: <b>Gravel</b>
2.6 Width/Depth Ratio:	<b>25.64</b>	Fine Gravel:	Subclass Slope: <b>None</b>
2.7 Entrenchment Ratio:	<b>1.40</b>	Sand:	Bed Form: <b>Plane Bed</b>
2.8 Incision Ratio:	<b>3.58</b>	Silt and Smaller:	Field Measured Slope:
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	2.15 Sub-reach Stream Type
2.9 Sinuosity:	<b>Low</b>	Detritus:	Reference Stream Type:
2.10 Riffles Type:	<b>Not Applicable</b>	# Large Woody Debris:	Reference Bed Material:
			Reference Subclass Slope:
			Reference Bedform:

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope: <b>Steep</b>	
Bank Texture		Bank Erosion	<u>Left</u>	<u>Right</u>
Upper	<u>Left</u>	Erosion Length (ft.):	<b>775.0</b>	<b>325.0</b>
Material Type:		Erosion Height (ft.):	<b>4.0</b>	<b>4.0</b>
Consistency:		Revetment Type:	<b>None</b>	<b>Rip-Rap</b>
Lower		Revetment Length:	<b>50.0</b>	
Material Type:				
Consistency:				

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	<b>51-100</b>	<b>&gt;100</b>
Sub-Dominant		
W less than 25		
Buffer Vegetation Type		
Dominant	<b>Mixed Trees</b>	<b>Mixed Trees</b>
Sub-Dominant		

#### 3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Hay</b>	<b>Forest</b>	Mass Failures	
Sub-Dominant			Height	
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	
Failures	<b>None</b>		Gullies Length	
Gullies				



# Stream Geomorphic Assessment

## Agency of Natural Resources

VT DEC

Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M304-B

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps:	<b>Minimal</b>	4.5 Flow Regulation Type	<b>None</b>	4.7 Stormwater Inputs	
4.2 Adjacent Wetlands:	<b>None</b>	Flow Reg. Use:		Field Ditch:	<b>0</b> Road Ditch: <b>0</b>
4.3 Flow Status:	<b>Moderate</b>	Impoundments:	<b>None</b>	Other:	<b>1</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams:	<b>0</b>	Impoundment Loc.:		Overland Flow:	<b>0</b> Urb Strm Wtr Pipe: <b>0</b>
		4.6 Up/Down Strm flow reg.:		4.9 # of Beaver Dams:	<b>0</b>
		(old) Upstrm Flow Reg.:	<b>None</b>	Affected Length (ft):	
4.8 Channel Constrictions:	<b>None</b>				

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>0</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing:	<b>No</b>
Mid:	<b>0</b> Delta: <b>0</b>	Flood chutes:	<b>0</b> Avulsion: <b>0</b>	5.5 Straightening:	<b>Straightening</b>
Point:	<b>0</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>0</b>	Straightening Length (ft.):	<b>0</b>
Side:	<b>1</b> Braiding: <b>0</b>	Steep Riffles:	<b>2</b> Trib Rejuv.: <b>Yes</b>	5.5 Dredging:	<b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	<b>3</b>	6.4 Sediment Deposition:	<b>2</b>	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	<b>8</b>	6.5 Channel Flow Status:	<b>7</b>	6.8 Bank Stability:	<b>3</b>	<b>7</b>
6.3 Pool Variability:	<b>8</b>	6.6 Channel Alteration:	<b>1</b>	6.9 Bank Vegetation Protection	<b>3</b>	<b>6</b>
Total Score:	<b>65</b>	6.7 Channel Sinuosity:	<b>3</b>	6.10 Riparian Veg. Zone Width:	<b>7</b>	<b>7</b>
Habitat Rating:	<b>0.32</b>					
Habitat Stream Condition:	<b>Poor</b>					

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	<u>Unconfined</u>	<u>Score</u>	<u>STD</u>	<u>Historic</u>		
7.1 Channel Degradation		<b>3</b>	<b>C to F</b>	<b>Yes</b>	Geomorphic Rating	<b>0.40</b>
7.2 Channel Aggradation		<b>8</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>8</b>		<b>No</b>	Channel Evolution Stage	<b>II</b>
7.4 Change in Planform		<b>13</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>32</b>			Stream Sensitivity	<b>Extreme</b>



Phase 2 Segment Summary Report West Branch Little River

Stream:	West Branch	SGAT Version:	4.56
Reach:	M304-C	Organization:	Bear Creek Environmental
Segment Length(ft):	1,750	Observers:	Michael Blazewicz and Pam DeAndrea
Rain:	No	Completion Date:	10/4/2005
		Quality Control Status - Consultant:	Passed
		Quality Control Status - Staff:	Provisional

Step 0 - Location: Segment begins approximately where hay fields end in left corridor and continues about 1450 feet upstream to where M3.t3.01 enters the West Branch (just upstream from the transformer station).

Step 5 - Notes:

Step 7 - Narrative: Historic incision; current aggradation and change in planform

Step 1. Valley and Floodplain

1.1 Segmentation:	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Hilly</b>	<b>Extr.Steep</b>	Valley Width (ft): <b>900</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Never</b>	<b>Never</b>	Width Determination:
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Never</b>	<b>Sometimes</b>	Confinement Type: <b>VB</b>
Berm:	Texture:	<b>Sand</b>	<b>N.E.</b>	In Rock Gorge: <b>No</b>
Road:				Human Caused Change in Valley Width?: <b>Yes</b>
Railroad:				
Imp. Path:				
Dev.:				
1.6 Grade Controls: <b>None</b>				



### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **West Branch** Reach: **M304-C**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>57.00</b>	2.11 Riffle/Step Spacing:	<b>900 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>2.90</b>	2.12 Substrate Composition		Bed:	<b>36 inches</b>
2.3 Mean Depth (ft.):	<b>2.28</b>	Bedrock:	<b>0.0 %</b>	Bar:	<b>18 inches</b>
2.4 Floodprone Width (ft.):	<b>145.00</b>	Boulder:	<b>7.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>4.40</b>	Cobble:	<b>35.0 %</b>	Stream Type:	<b>C</b>
Human Elev FloodPIn (ft.):		Coarse Gravel:	<b>33.0 %</b>	Bed Material:	<b>Gravel</b>
2.6 Width/Depth Ratio:	<b>25.00</b>	Fine Gravel:	<b>15.0 %</b>	Subclass Slope:	<b>None</b>
2.7 Entrenchment Ratio:	<b>2.54</b>	Sand:	<b>10.0 %</b>	Bed Form:	<b>Riffle-Pool</b>
2.8 Incision Ratio:	<b>1.52</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	<b>Yes</b>	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Low</b>	Detritus:	<b>5.0 %</b>	Reference Stream Type:	
2.10 Riffles Type:	<b>Sedimented</b>	# Large Woody Debris:	<b>8</b>	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope:	<b>Steep</b>				
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>700.0</b>	<b>125.0</b>	Dominant:	<b>Deciduous</b>	<b>Deciduous</b>
Material Type:			Erosion Height (ft.):	<b>4.0</b>	<b>4.0</b>	Sub-dominant:	<b>Invasives</b>	<b>Invasives</b>
Consistency:			Revetment Type:	<b>Rip-Rap</b>	<b>None</b>	Bank Canopy		
Lower			Revetment Length:	<b>225.0</b>		Canopy %:	<b>51-75</b>	<b>26-50</b>
Material Type:						Mid-Channel Canopy:	<b>Closed</b>	
Consistency:								

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	<b>&gt;100</b>	<b>&gt;100</b>
Sub-Dominant		
W less than 25		
Buffer Vegetation Type		
Dominant	<b>Mixed Trees</b>	<b>Mixed Trees</b>
Sub-Dominant		

#### 3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Forest</b>	<b>Forest</b>	Mass Failures	
Sub-dominant			Height	
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	
Failures	<b>None</b>		Gullies Length	
Gullies				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M304-C

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps:	<b>None</b>	4.5 Flow Regulation Type	<b>None</b>	4.7 Stormwater Inputs	
4.2 Adjacent Wetlands:	<b>None</b>	Flow Reg. Use:		Field Ditch:	<b>0</b> Road Ditch: <b>0</b>
4.3 Flow Status:	<b>Moderate</b>	Impoundments:	<b>None</b>	Other:	<b>2</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams:	<b>0</b>	Impoundment Loc.:		Overland Flow:	<b>0</b> Urb Strm Wtr Pipe: <b>0</b>
		4.6 Up/Down Strm flow reg.:		4.9 # of Beaver Dams:	<b>0</b>
		(old) Upstrm Flow Reg.:	<b>None</b>	Affected Length (ft):	
4.8 Channel Constrictions:	<b>None</b>				

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>0</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing:	<b>No</b>
Mid:	<b>1</b> Delta: <b>0</b>	Flood chutes:	<b>1</b> Avulsion: <b>0</b>	5.5 Straightening:	<b>Straightening</b>
Point:	<b>2</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>0</b>	Straightening Length (ft.):	<b>0</b>
Side:	<b>2</b> Braiding: <b>0</b>	Steep Riffles:	<b>2</b> Trib Rejuv.: <b>Yes</b>	5.5 Dredging:	<b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	<b>8</b>	6.4 Sediment Deposition:	<b>12</b>	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	<b>13</b>	6.5 Channel Flow Status:	<b>8</b>	6.8 Bank Stability:	<b>3</b>	<b>9</b>
6.3 Pool Variability:	<b>9</b>	6.6 Channel Alteration:	<b>2</b>	6.9 Bank Vegetation Protection	<b>7</b>	<b>7</b>
Total Score:	<b>105</b>	6.7 Channel Sinuosity:	<b>9</b>	6.10 Riparian Veg. Zone Width:	<b>9</b>	<b>9</b>
Habitat Rating:	<b>0.52</b>					
Habitat Stream Condition:	<b>Fair</b>					

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	<u>Unconfined</u>	<u>Score</u>	<u>STD</u>	<u>Historic</u>		
7.1 Channel Degradation		<b>7</b>	<b>None</b>	<b>Yes</b>	Geomorphic Rating	<b>0.49</b>
7.2 Channel Aggradation		<b>11</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>11</b>		<b>No</b>	Channel Evolution Stage	<b>IV</b>
7.4 Change in Planform		<b>10</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>39</b>			Stream Sensitivity	<b>Very High</b>



Phase 2 Segment Summary Report West Branch Little River

Stream: West Branch  
Reach: M305-0  
Segment Length(ft): 4,514  
Rain: Yes

SGAT Version: 4.56  
Organization: Bear Creek Environmental  
Observers: Mary Nealon, Mike Blazewicz  
Completion Date: 10/21/2005  
Quality Control Status - Consultant: Passed  
Quality Control Status - Staff: Provisional

Step 0 - Location: Segment begins at confluence with M3.T3.01 and continues for 4514 feet.

Step 5 - Notes: Weak riffle-pool system

Step 7 - Narrative: Historic degradation, currently major planform adjustment. Lots of flood chutes, rebuilding of C3 floodplain.

Step 1. Valley and Floodplain

1.1 Segmentation:	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Steep</b>	<b>Extr.Steep</b>	Valley Width (ft): <b>850</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Never</b>	<b>Sometimes</b>	Width Determination:
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Never</b>	<b>Sometimes</b>	Confinement Type: <b>VB</b>
Berm:	Texture:	<b>N.E.</b>	<b>Sand</b>	In Rock Gorge: <b>No</b>
Road:				Human Caused Change in Valley Width?: <b>Yes</b>
Railroad:				
Imp. Path:				
Dev.:				
1.6 Grade Controls: <b>None</b>				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **West Branch** Reach: **M305-0**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>63.00</b>	2.11 Riffle/Step Spacing:	<b>1000 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>3.30</b>	2.12 Substrate Composition		Bed:	<b>400 mm</b>
2.3 Mean Depth (ft.):	<b>2.52</b>	Bedrock:	<b>1.0 %</b>	Bar:	<b>230 mm</b>
2.4 Floodprone Width (ft.):	<b>222.50</b>	Boulder:	<b>21.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>4.10</b>	Cobble:	<b>50.0 %</b>	Stream Type:	<b>C</b>
Human Elev FloodPIn (ft.):		Coarse Gravel:	<b>23.0 %</b>	Bed Material:	<b>Cobble</b>
2.6 Width/Depth Ratio:	<b>25.00</b>	Fine Gravel:	<b>5.0 %</b>	Subclass Slope:	<b>None</b>
2.7 Entrenchment Ratio:	<b>3.53</b>	Sand:	<b>0.0 %</b>	Bed Form:	<b>Riffle-Pool</b>
2.8 Incision Ratio:	<b>1.24</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	<b>No</b>	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Moderate</b>	Detritus:	<b>1.0 %</b>	Reference Stream Type:	
2.10 Riffles Type:	<b>Complete</b>	# Large Woody Debris:	<b>16</b>	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope:	<b>Steep</b>				
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>650.0</b>	<b>775.0</b>	Dominant:	<b>Deciduous</b>	<b>Deciduous</b>
Material Type:			Erosion Height (ft.):	<b>4.0</b>	<b>5.0</b>	Sub-dominant:	<b>Invasives</b>	<b>Invasives</b>
Consistency:			Revetment Type:	<b>Rip-Rap</b>	<b>Rip-Rap</b>	Bank Canopy		
Lower			Revetment Length:	<b>510.0</b>	<b>100.0</b>	Canopy %:	<b>51-75</b>	<b>51-75</b>
Material Type:						Mid-Channel Canopy:	<b>Open</b>	
Consistency:								

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	<b>&gt;100</b>	<b>&gt;100</b>
Sub-Dominant	<b>0-25</b>	
W less than 25		
Buffer Vegetation Type		
Dominant	<b>Mixed Trees</b>	<b>Mixed Trees</b>
Sub-Dominant		

#### 3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Commercial</b>	<b>Residential</b>	Mass Failures	
Sub-dominant		<b>Forest</b>	Height	<b>25.0 25.0</b>
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	
Failures	<b>One</b>	<b>25.0</b>	Gullies Length	
Gullies				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M305-0

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Minimal</b>	4.5 Flow Regulation Type <b>None</b>	4.7 Stormwater Inputs
4.2 Adjacent Wetlands: <b>None</b>	Flow Reg. Use:	Field Ditch: <b>0</b> Road Ditch: <b>0</b>
4.3 Flow Status: <b>High</b>	Impoundments: <b>None</b>	Other: <b>1</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams: <b>0</b>	Impoundment Loc.:	Overland Flow: <b>0</b> Urb Strm Wtr Pipe: <b>0</b>
	4.6 Up/Down Strm flow reg.:	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.: <b>None</b>	Affected Length (ft):

#### 4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Bridge		Yes	No	Yes	Yes	Deposition Above, Scour Below

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>0</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>Yes</b>
Mid: <b>0</b>	Delta: <b>1</b>	Flood chutes: <b>2</b>	Avulsion: <b>0</b>	5.5 Straightening: <b>Straightening</b>
Point: <b>2</b>	Island: <b>0</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>0</b>	Straightening Length (ft.): <b>0</b>
Side: <b>2</b>	Braiding: <b>0</b>	Steep Riffles: <b>2</b>	Trib Rejuv.: <b>Yes</b>	5.5 Dredging: <b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	<b>12</b>	6.4 Sediment Deposition:	<b>15</b>	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	<b>15</b>	6.5 Channel Flow Status:	<b>13</b>	6.8 Bank Stability:	<b>8</b>	<b>7</b>
6.3 Pool Variability:	<b>11</b>	6.6 Channel Alteration:	<b>13</b>	6.9 Bank Vegetation Protection	<b>5</b>	<b>5</b>
Total Score:	<b>127</b>	6.7 Channel Sinuosity:	<b>9</b>	6.10 Riparian Veg. Zone Width:	<b>6</b>	<b>8</b>
Habitat Rating:	<b>0.63</b>					
Habitat Stream Condition:	<b>Fair</b>					

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		<b>11</b>	<b>None</b>	<b>Yes</b>	Geomorphic Rating	<b>0.55</b>
7.2 Channel Aggradation		<b>13</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>12</b>		<b>No</b>	Channel Evolution Stage	<b>IV</b>
7.4 Change in Planforml		<b>8</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>44</b>			Stream Sensitivity	<b>High</b>



Phase 2 Segment Summary Report West Branch Little River

Stream:	West Branch	SGAT Version:	4.56
Reach:	M306-0	Organization:	Bear Creek Environmental
Segment Length(ft):	1,607	Observers:	Michael Blazewicz and Pam DeAndrea
Rain:	Yes	Completion Date:	9/29/2005
		Quality Control Status - Consultant:	Passed
		Quality Control Status - Staff:	Provisional

Step 0 - Location: Segment begins approximately 1500 feet downstream from Rt 108 bridge and continues until just upstream from bridge.

Step 5 - Notes:

Step 7 - Narrative: Historic incision; currently widening

Step 1. Valley and Floodplain

1.1 Segmentation:	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Very Steep</b>	<b>Very Steep</b>	Valley Width (ft): <b>200</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Sometimes</b>	<b>Always</b>	Width Determination:
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Always</b>	<b>Always</b>	Confinement Type: <b>SC</b>
Berm:	Texture:	<b>N.E.</b>	<b>N.E.</b>	In Rock Gorge: <b>No</b>
Road:				Human Caused Change in Valley Width?: <b>Yes</b>
Railroad:				
Imp. Path:				
Dev.:				
1.6 Grade Controls: <b>None</b>				





# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M306-0

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps:	<b>Minimal</b>	4.5 Flow Regulation Type	<b>None</b>	4.7 Stormwater Inputs	
4.2 Adjacent Wetlands:	<b>None</b>	Flow Reg. Use:		Field Ditch:	<b>0</b> Road Ditch: <b>0</b>
4.3 Flow Status:	<b>Moderate</b>	Impoundments:	<b>None</b>	Other:	<b>4</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams:	<b>0</b>	Impoundment Loc.:		Overland Flow:	<b>0</b> Urb Strm Wtr Pipe: <b>0</b>
		4.6 Up/Down Strm flow reg.:		4.9 # of Beaver Dams:	<b>0</b>
		(old) Upstrm Flow Reg.:	<b>None</b>	Affected Length (ft):	
4.8 Channel Constrictions:	<b>None</b>				

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>0</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing:	<b>No</b>
Mid:	<b>0</b> Delta: <b>0</b>	Flood chutes:	<b>0</b> Avulsion: <b>0</b>	5.5 Straightening:	<b>Straightening</b>
Point:	<b>0</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>0</b>	Straightening Length (ft.):	<b>0</b>
Side:	<b>1</b> Braiding: <b>0</b>	Steep Riffles:	<b>0</b> Trib Rejuv.: <b>No</b>	5.5 Dredging:	<b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	<b>9</b>	6.4 Sediment Deposition:	<b>13</b>	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	<b>13</b>	6.5 Channel Flow Status:	<b>15</b>	6.8 Bank Stability:	<b>7</b>	<b>7</b>
6.3 Pool Variability:	<b>12</b>	6.6 Channel Alteration:	<b>2</b>	6.9 Bank Vegetation Protection	<b>1</b>	<b>6</b>
Total Score:	<b>98</b>	6.7 Channel Sinuosity:	<b>2</b>	6.10 Riparian Veg. Zone Width:	<b>2</b>	<b>9</b>
Habitat Rating:	<b>0.49</b>					
Habitat Stream Condition:	<b>Fair</b>					

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	<u>Unconfined</u>	<u>Score</u>	<u>STD</u>	<u>Historic</u>		
7.1 Channel Degradation		<b>3</b>	<b>C to F</b>	<b>Yes</b>	Geomorphic Rating	<b>0.38</b>
7.2 Channel Aggradation		<b>8</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>8</b>		<b>No</b>	Channel Evolution Stage	<b>II</b>
7.4 Change in Planform		<b>11</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>30</b>			Stream Sensitivity	<b>Extreme</b>



Phase 2 Segment Summary Report West Branch Little River

Stream:	West Branch	SGAT Version:	4.56
Reach:	M01-0	Organization:	Bear Creek Environmental
Segment Length(ft):	5,260	Observers:	Mary Nealon and Michael Blazewicz
Rain:	No	Completion Date:	10/3/2005
		Quality Control Status - Consultant:	Provisional
		Quality Control Status - Staff:	Provisional

Step 0 - Location: Segment begins just above confluence with Little River and continues upstream to just above Weeks Hill Road.

Step 5 - Notes:

Step 7 - Narrative: Historic degradation; active aggradation, widening, and planform adjustment

Step 1. Valley and Floodplain

1.1 Segmentation:	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan:	Hillside Slope:	<b>Hilly</b>	<b>Steep</b>	Valley Width (ft): <b>4,000</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Never</b>	<b>Never</b>	Width Determination:
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Never</b>	<b>Never</b>	Confinement Type: <b>VB</b>
Berm:	Texture:	<b>N.E.</b>	<b>N.E.</b>	In Rock Gorge: <b>No</b>
Road:				Human Caused Change in Valley Width?: <b>No</b>
Railroad:				
Imp. Path:				
Dev.:				
1.6 Grade Controls:	<b>None</b>			



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **West Branch** Reach: **M01-0**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>70.00</b>	2.11 Riffle/Step Spacing:	2.13 Average Largest Particle on
2.2 Max Depth (ft.):	<b>3.00</b>	2.12 Substrate Composition	Bed: <b>4 inches</b>
2.3 Mean Depth (ft):	<b>2.20</b>	Bedrock:	Bar: <b>4 inches</b>
2.4 Floodprone Width (ft.):	<b>131.00</b>	Boulder:	2.14 Stream Type
2.5 Aband. Floodpn (ft.):	<b>7.00</b>	Cobble:	Stream Type: <b>B</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	Bed Material: <b>Gravel</b>
2.6 Width/Depth Ratio:	<b>31.82</b>	Fine Gravel:	Subclass Slope: <b>c</b>
2.7 Entrenchment Ratio:	<b>1.87</b>	Sand:	Bed Form: <b>Plane Bed</b>
2.8 Incision Ratio:	<b>2.33</b>	Silt and Smaller:	Field Measured Slope:
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	2.15 Sub-reach Stream Type
2.9 Sinuosity:	<b>Low</b>	Detritus:	Reference Stream Type:
2.10 Riffles Type:	<b>Sedimented</b>	# Large Woody Debris:	Reference Bed Material:
			Reference Subclass Slope:
			Reference Bedform:

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope: <b>Steep</b>	
Bank Texture		Bank Erosion	<u>Left</u>	<u>Right</u>
Upper	<u>Left</u>	Erosion Length (ft.):	Near Bank Vegetation Type	<u>Left</u>
Material Type:		Erosion Height (ft.):	Dominant:	<b>Invasives</b>
Consistency:		Revetment Type:	Sub-dominant:	<b>Herbaceous</b>
Lower		Revetment Length:	Bank Canopy	<b>Herbaceous</b>
Material Type:			Canopy %:	<b>1-25</b>
Consistency:			Mid-Channel Canopy:	<b>Open</b>

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	<b>0-25</b>	<b>0-25</b>
Sub-Dominant	<b>None</b>	<b>None</b>
W less than 25		
Buffer Vegetation Type		
Dominant	<b>Herbaceous</b>	<b>Herbaceous</b>
Sub-Dominant	<b>Deciduous</b>	<b>Deciduous</b>

#### 3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Hay</b>	<b>Hay</b>	Mass Failures	
Sub-dominant	<b>None</b>	<b>None</b>	Height	
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	
Failures			Gullies Length	
Gullies				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M01-0

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Minimal</b>	4.5 Flow Regulation Type	4.7 Stormwater Inputs <b>None</b>
4.2 Adjacent Wetlands: <b>None</b>	Flow Reg. Use:	Field Ditch: Road Ditch:
4.3 Flow Status: <b>Moderate</b>	Impoundments: <b>None</b>	Other: Tile Drain:
4.4 # of Debris Jams:	Impoundment Loc.:	Overland Flow: Urb Strm Wtr Pipe:
	4.6 Up/Down Strm flow reg.:	4.9 # of Beaver Dams:
	(old) Upstrm Flow Reg.: <b>None</b>	Affected Length (ft):
4.8 Channel Constrictions:		

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Bridge		Yes	No	Yes	Yes	Deposition Above, Scour Below
Bridge		Yes	No	Yes	Yes	Deposition Below, Scour Above

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>2</b>	5.2 Other Features	Neck Cutoff:	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid:	<b>2</b> Delta: <b>1</b>	Flood chutes:	Avulsion:	5.5 Straightening:
Point:	<b>2</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts	Head Cuts:	Straightening Length (ft.): <b>0</b>
Side:	<b>2</b> Braiding:	Steep Riffles:	Trib Rejuv.: <b>No</b>	5.5 Dredging:

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	<b>2</b>	6.4 Sediment Deposition:	<b>5</b>	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	<b>4</b>	6.5 Channel Flow Status:	<b>8</b>	6.8 Bank Stability:	<b>5</b>	<b>3</b>
6.3 Pool Variability:	<b>7</b>	6.6 Channel Alteration:	<b>6</b>	6.9 Bank Vegetation Protection	<b>2</b>	<b>2</b>
Total Score:	<b>54</b>	6.7 Channel Sinuosity:	<b>8</b>	6.10 Riparian Veg. Zone Width:	<b>1</b>	<b>1</b>
Habitat Rating:	<b>0.27</b>					
Habitat Stream Condition:	<b>Poor</b>					

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		<b>4</b>	<b>C to B</b>	<b>Yes</b>	Geomorphic Rating	<b>0.34</b>
7.2 Channel Aggradation		<b>7</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>8</b>		<b>No</b>	Channel Evolution Stage	<b>III</b>
7.4 Change in Planform		<b>8</b>		<b>No</b>	Geomorphic Condition	<b>Poor</b>
Total Score		<b>27</b>			Stream Sensitivity	<b>Very High</b>



**Phase 2 Segment Summary Report West Branch Little River**

Stream:	<b>West Branch</b>	SGAT Version:	<b>4.56</b>
Reach:	<b>M07-A</b>	Organization:	<b>Bear Creek Environmental</b>
Segment Length(ft):	<b>1,523</b>	Observers:	<b>MN, PD</b>
Rain:	<b>No</b>	Completion Date:	<b>9/26/2008</b>
		Quality Control Status - Consultant:	<b>Provisional</b>
		Quality Control Status - Staff:	<b>Provisional</b>

Step 0 - Location: **Segment begins just upstream of Vt route 108 just upstream from the confluence of Ranch Brook and continues until stream begins to go away from road.**

Step 5 - Notes: **Japanese knotweed in section near Route 100 bridge. Bank erosion immediately below old abutment on left bank. Phase 2 channel width was used to determine phase 2 confinement type because of the uncertainty associated with reference channel width (see phase 1 step 7).**

Step 7 - Narrative: **Major historic incision, maybe some widening; bankfull is much greater than reference. Not confidence in RAF given possible road fill on the left side and yard on the right side of cross section.**

**Step 1. Valley and Floodplain**

1.1 Segmentation: <b>Channel Dimensions</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Very Steep</b>	<b>Very Steep</b>	Valley Width (ft): <b>206</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Never</b>	<b>Sometimes</b>	Width Determination: <b>Measured</b>
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Never</b>	<b>Sometimes</b>	Confinement Type: <b>NW</b>
Berm: <b>0</b> <b>0</b>	Texture:	<b>N.E.</b>	<b>N.E.</b>	In Rock Gorge: <b>No</b>
Road: <b>1,502</b> <b>0</b> <b>0</b>				Human Caused Change in Valley Width?: <b>Yes</b>
Railroad: <b>0</b> <b>0</b>				
Imp. Path: <b>0</b> <b>0</b>				
Dev.: <b>174</b> <b>112</b>				

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
Ledge	Mid-segment	3.0	2.0	Yes	



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **West Branch**

Reach: **M07-A**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>55.50</b>	2.11 Riffle/Step Spacing:	<b>190 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>2.70</b>	2.12 Substrate Composition		Bed:	<b>17 inches</b>
2.3 Mean Depth (ft):	<b>1.84</b>	Bedrock:	<b>0.0 %</b>	Bar:	<b>12.4 inches</b>
2.4 Floodprone Width (ft.):	<b>93.50</b>	Boulder:	<b>30.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>5.90</b>	Cobble:	<b>36.0 %</b>	Stream Type:	<b>B</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	<b>14.0 %</b>	Bed Material:	<b>Cobble</b>
2.6 Width/Depth Ratio:	<b>30.16</b>	Fine Gravel:	<b>11.0 %</b>	Subclass Slope:	<b>None</b>
2.7 Entrenchment Ratio:	<b>1.68</b>	Sand:	<b>9.0 %</b>	Bed Form:	<b>Riffle-Pool</b>
2.8 Incision Ratio:	<b>2.19</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	<b>No</b>	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Low</b>	Detritus:	<b>0.0 %</b>	Reference Stream Type:	
2.10 Riffles Type:	<b>Complete</b>	# Large Woody Debris:	<b>7</b>	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

#### Step 3. Riparian Features

3.1 Stream Banks				Typical Bank Slope:	<b>Steep</b>
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>288.9</b>	<b>265.8</b>
Material Type:	<b>Sand</b>	<b>Sand</b>	Erosion Height (ft.):	<b>5.2</b>	<b>5.1</b>
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>	Revetment Type:	<b>Multiple</b>	<b>Hard Bank</b>
Lower			Revetment Length:	<b>708.8</b>	<b>55.6</b>
Material Type:	<b>Boulder/Cobbles</b>	<b>Boulder/Cobbles</b>	Canopy %:	<b>1-25</b>	<b>51-75</b>
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>	Mid-Channel Canopy:	<b>Open</b>	

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>	Corridor Land
Dominant	<b>0-25</b>	<b>51-100</b>	Dominant
Sub-Dominant	<b>51-100</b>	<b>&gt;100</b>	Sub-dominant
W less than 25	<b>1,502</b>	<b>474</b>	(Legacy)
Buffer Vegetation Type			Failures
Dominant	<b>Deciduous</b>	<b>Deciduous</b>	Gullies
Sub-Dominant	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>	

#### 3.3 Riparian Corridor

	<u>Left</u>	<u>Right</u>		<u>Left</u>	<u>Right</u>
Dominant	<b>Residential</b>	<b>Forest</b>	Mass Failures		
Sub-Dominant	<b>Forest</b>	<b>Residential</b>	Height		
W less than 25	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	<b>0</b>	
Failures	<b>None</b>		Gullies Length	<b>0</b>	
Gullies	<b>None</b>				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M07-A

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Abundant</b>	4.5 Flow Regulation Type <b>None</b>	4.7 Stormwater Inputs
4.2 Adjacent Wetlands: <b>None</b>	Flow Reg. Use:	Field Ditch: <b>0</b> Road Ditch: <b>2</b>
4.3 Flow Status: <b>Moderate</b>	Impoundments:	Other: <b>0</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams: <b>0</b>	Impoundment Loc.:	Overland Flow: <b>2</b> Urb Strm Wtr Pipe: <b>0</b>
	4.6 Up/Down Strm flow reg.: <b>Up Stream</b>	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.:	Affected Length (ft): <b>0</b>

#### 4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Old Abutment	46	Yes	No	Yes	Yes	Deposition Above, Scour Below

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types Diagonal: <b>0</b>	5.2 Other Features Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: <b>1</b> Delta: <b>0</b>	Flood chutes: <b>1</b> Avulsion: <b>0</b>	5.5 Straightening: <b>Straightening</b>
Point: <b>0</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts Head Cuts: <b>0</b>	Straightening Length (ft.): <b>1,502</b>
Side: <b>13</b> Braiding: <b>0</b>	Steep Riffles: <b>0</b> Trib Rejuv.: <b>No</b>	5.5 Dredging: <b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:		
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection		
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:		
Habitat Rating:				
Habitat Stream Condition:				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		<b>7</b>	<b>None</b>	<b>Yes</b>	Geomorphic Rating	<b>0.56</b>
7.2 Channel Aggradation		<b>13</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>12</b>		<b>No</b>	Channel Evolution Stage	<b>III</b>
7.4 Change in Planforml		<b>13</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>45</b>			Stream Sensitivity	<b>High</b>



**Phase 2 Segment Summary Report West Branch Little River**

Stream:	<b>West Branch</b>	SGAT Version:	<b>4.56</b>
Reach:	<b>M07-B</b>	Organization:	<b>Bear Creek Environmental</b>
Segment Length(ft):	<b>1,750</b>	Observers:	<b>MN, PD</b>
Rain:	<b>No</b>	Completion Date:	<b>9/26/2008</b>
		Quality Control Status - Consultant:	<b>Provisional</b>
		Quality Control Status - Staff:	<b>Provisional</b>

Step 0 - Location: **Segment begins when reach begins to go away from road and continues until valley gets narrower.**

Step 5 - Notes: **The valley wall on the right bank was not distinct. The ground gently sloped up for awhile and then got really steep. Bankfull was difficult to identify in the field and the bankfull elevation may be high relative to adjacent cross section (M07-A and M07-D).  
Phase 2 channel width was used to determine phase 2 confinement type because of the uncertainty associated with reference channel width (see phase 1 step 7).**

Step 7 - Narrative: **Some aggradation; phase 2 bankfull is much greater than reference, however width-depth ratio is only 14; little planform change; minimal erosion.**

**Step 1. Valley and Floodplain**

1.1 Segmentation: <b>Channel Dimensions</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Very Steep</b>	<b>Very Steep</b>	Valley Width (ft): <b>198</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Never</b>	<b>Sometimes</b>	Width Determination: <b>Measured</b>
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Never</b>	<b>Sometimes</b>	Confinement Type: <b>NW</b>
Berm: <b>0</b> <b>0</b> <b>0</b>	Texture:	<b>N.E.</b>	<b>Sand</b>	In Rock Gorge: <b>No</b>
Road: <b>85</b> <b>0</b> <b>0</b>				Human Caused Change in Valley Width?: <b>Yes</b>
Railroad: <b>0</b> <b>0</b>				
Imp. Path: <b>0</b> <b>0</b>				
Dev.: <b>331</b> <b>0</b>				

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
Ledge	Mid-segment	4.0	3.0	Yes	



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **West Branch**

Reach: **M07-B**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>49.00</b>	2.11 Riffle/Step Spacing:	<b>129 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>5.30</b>	2.12 Substrate Composition		Bed:	<b>30 inches</b>
2.3 Mean Depth (ft.):	<b>3.42</b>	Bedrock:	<b>0.0 %</b>	Bar:	<b>6.7 inches</b>
2.4 Floodprone Width (ft.):	<b>69.50</b>	Boulder:	<b>27.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>5.30</b>	Cobble:	<b>33.0 %</b>	Stream Type:	<b>B</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	<b>18.0 %</b>	Bed Material:	<b>Cobble</b>
2.6 Width/Depth Ratio:	<b>14.33</b>	Fine Gravel:	<b>13.0 %</b>	Subclass Slope:	<b>None</b>
2.7 Entrenchment Ratio:	<b>1.42</b>	Sand:	<b>9.0 %</b>	Bed Form:	<b>Step-Pool</b>
2.8 Incision Ratio:	<b>1.00</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	<b>No</b>	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Low</b>	Detritus:	<b>0.0 %</b>	Reference Stream Type:	
2.10 Riffles Type:	<b>Complete</b>	# Large Woody Debris:	<b>13</b>	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

#### Step 3. Riparian Features

3.1 Stream Banks				Typical Bank Slope:	<b>Steep</b>	
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>126.0</b>	<b>99.4</b>	
Material Type:	<b>Sand</b>	<b>Sand</b>	Erosion Height (ft.):	<b>9.1</b>	<b>7.1</b>	
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>	Revetment Type:	<b>Hard Bank</b>	<b>None</b>	
Lower			Revetment Length:	<b>57.5</b>	<b>0.0</b>	
Material Type:	<b>Boulder/Cobbles</b>	<b>Boulder/Cobbles</b>				
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>				
				Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
				Dominant:	<b>Coniferous</b>	<b>Coniferous</b>
				Sub-dominant:	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>
				Bank Canopy		
				Canopy %:	<b>51-75</b>	<b>51-75</b>
				Mid-Channel Canopy:	<b>Open</b>	

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	<b>&gt;100</b>	<b>&gt;100</b>
Sub-Dominant	<b>26-50</b>	<b>None</b>
W less than 25	<b>467</b>	<b>0</b>
Buffer Vegetation Type		
Dominant	<b>Deciduous</b>	<b>Coniferous</b>
Sub-Dominant	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>

#### 3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Forest</b>	<b>Forest</b>	Mass Failures	
Sub-dominant	<b>Residential</b>	<b>None</b>	Height	
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	<b>0</b>
Failures	<b>None</b>		Gullies Length	<b>0</b>
Gullies	<b>None</b>			



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M07-B

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps:	<b>Abundant</b>	4.5 Flow Regulation Type	<b>None</b>	4.7 Stormwater Inputs	
4.2 Adjacent Wetlands:	<b>None</b>	Flow Reg. Use:		Field Ditch:	<b>0</b> Road Ditch: <b>1</b>
4.3 Flow Status:	<b>Moderate</b>	Impoundments:		Other:	<b>0</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams:	<b>0</b>	Impoundment Loc.:		Overland Flow:	<b>0</b> Urb Strm Wtr Pipe: <b>0</b>
		4.6 Up/Down Strm flow reg.:	<b>Up Stream</b>	4.9 # of Beaver Dams:	<b>0</b>
		(old) Upstrm Flow Reg.:		Affected Length (ft):	<b>0</b>

#### 4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
<b>Bedrock Outcrops</b>	<b>44</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Deposition Above, Deposition Below, Scour Below</b>

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>0</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing:	<b>No</b>
Mid:	<b>6</b> Delta: <b>1</b>	Flood chutes:	<b>0</b> Avulsion: <b>0</b>	5.5 Straightening:	<b>Straightening</b>
Point:	<b>0</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>0</b>	Straightening Length (ft.):	<b>61</b>
Side:	<b>16</b> Braiding: <b>0</b>	Steep Riffles:	<b>0</b> Trib Rejuv.: <b>No</b>	5.5 Dredging:	<b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	<b>0</b>	6.4 Sediment Deposition:	<b>0</b>	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	<b>0</b>	6.5 Channel Flow Status:	<b>0</b>	6.8 Bank Stability:	<b>0</b>	<b>0</b>
6.3 Pool Variability:	<b>0</b>	6.6 Channel Alteration:	<b>0</b>	6.9 Bank Vegetation Protection	<b>0</b>	<b>0</b>
Total Score:	<b>0</b>	6.7 Channel Sinuosity:	<b>0</b>	6.10 Riparian Veg. Zone Width:	<b>0</b>	<b>0</b>
Habitat Rating:	<b>0.00</b>					
Habitat Stream Condition:						

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		<b>16</b>	<b>None</b>	<b>No</b>	Geomorphic Rating	<b>0.74</b>
7.2 Channel Aggradation		<b>11</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>14</b>		<b>No</b>	Channel Evolution Stage	<b>I</b>
7.4 Change in Planform		<b>18</b>		<b>No</b>	Geomorphic Condition	<b>Good</b>
Total Score		<b>59</b>			Stream Sensitivity	<b>Moderate</b>



**Phase 2 Segment Summary Report West Branch Little River**

Stream:	<b>West Branch</b>	SGAT Version:	<b>4.56</b>
Reach:	<b>M07-C</b>	Organization:	<b>Bear Creek Environmental</b>
Segment Length(ft):	<b>575</b>	Observers:	<b>MN, PD</b>
Rain:	<b>No</b>	Completion Date:	<b>9/26/2008</b>
		Quality Control Status - Consultant:	<b>Provisional</b>
		Quality Control Status - Staff:	<b>Provisional</b>
		Why Not Assessed:	<b>bedrock gorge</b>

Step 0 - Location: **Segment begins where bedrock gorge begins and channel is very entrenched and continues for another 700 feet approximately.**

Step 5 - Notes:

Step 7 - Narrative:

**Step 1. Valley and Floodplain**

1.1 Segmentation:	<b>Grade Controls</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan:	<b>None</b>	Hillside Slope:	<b>Extr.Steep</b>	<b>Extr.Steep</b>	Valley Width (ft): <b>75</b>
1.3 Corridor Encroachments:		Continuous w/ Bank:	<b>Always</b>	<b>Always</b>	Width Determination: <b>Measured</b>
<u>Length (ft)</u>	<u>One</u>	<u>Height</u>	<u>Both</u>	<u>Height</u>	Within 1 Bankfull W:
Berm:	<b>0</b>		<b>0</b>		<b>Always</b>
Road:	<b>0</b>		<b>0</b>		<b>Always</b>
Railroad:	<b>0</b>		<b>0</b>		Texture:
Imp. Path:	<b>0</b>		<b>0</b>		<b>N.E.</b>
Dev.:	<b>59</b>		<b>0</b>		<b>N.E.</b>
					In Rock Gorge: <b>Yes</b>
					Human Caused Change in Valley Width?: <b>No</b>

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
Ledge	Mid-segment	7.0	4.0	Yes	
Ledge	Mid-segment	7.0	5.0	Yes	



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M07-C

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):		2.11 Riffle/Step Spacing:		2.13 Average Largest Particle on	
2.2 Max Depth (ft.):		2.12 Substrate Composition		Bed:	
2.3 Mean Depth (ft):		Bedrock:	%	Bar:	
2.4 Floodprone Width (ft.):		Boulder:	%	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):		Cobble:	%	Stream Type:	<b>F</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	%	Bed Material:	<b>Cobble</b>
2.6 Width/Depth Ratio:	<b>0.00</b>	Fine Gravel:	%	Subclass Slope:	<b>None</b>
2.7 Entrenchment Ratio:	<b>0.00</b>	Sand:	%	Bed Form:	<b>Step-Pool</b>
2.8 Incision Ratio:	<b>0.00</b>	Silt and Smaller:	%	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:		2.15 Sub-reach Stream Type	
2.9 Sinuosity:		Detritus:	%	Reference Stream Type:	<b>F</b>
2.10 Riffles Type:		# Large Woody Debris:		Reference Bed Material:	<b>Cobble</b>
				Reference Subclass Slope:	<b>None</b>
				Reference Bedform:	<b>Step-Pool</b>

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope: <b>Steep</b>					
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type <u>Left</u>	<u>Right</u>	
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>0.0</b>	<b>0.0</b>	Dominant:	<b>Deciduous</b>	<b>Deciduous</b>
Material Type:	<b>Bedrock</b>	<b>Bedrock</b>	Erosion Height (ft.):	<b>0.0</b>	<b>0.0</b>	Sub-dominant:	<b>Herbaceous</b>	<b>Herbaceous</b>
Consistency:	<b>Cohesive</b>	<b>Cohesive</b>	Revetment Type:	<b>Hard Bank</b>	<b>None</b>	Bank Canopy		
Lower			Revetment Length:	<b>34.2</b>	<b>0.0</b>	Canopy %:	<b>76-100</b>	<b>76-100</b>
Material Type:	<b>Bedrock</b>	<b>Bedrock</b>				Mid-Channel Canopy:	<b>Closed</b>	
Consistency:	<b>Cohesive</b>	<b>Cohesive</b>						

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	<b>&gt;100</b>	<b>&gt;100</b>
Sub-Dominant	<b>26-50</b>	<b>None</b>
W less than 25	<b>0</b>	<b>0</b>
Buffer Vegetation Type		
Dominant	<b>Deciduous</b>	<b>Deciduous</b>
Sub-Dominant	<b>Herbaceous</b>	<b>Shrubs/Sapling</b>

#### 3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Forest</b>	<b>Forest</b>	Mass Failures	
Sub-dominant	<b>Residential</b>	<b>None</b>	Height	
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	<b>0</b>
Failures	<b>None</b>		Gullies Length	<b>0</b>
Gullies	<b>None</b>			



# Stream Geomorphic Assessment

## Agency of Natural Resources

VT DEC

Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M07-C

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Minimal</b>	4.5 Flow Regulation Type <b>None</b>	4.7 Stormwater Inputs <b>None</b>
4.2 Adjacent Wetlands: <b>None</b>	Flow Reg. Use:	Field Ditch: Road Ditch:
4.3 Flow Status: <b>Moderate</b>	Impoundments:	Other: Tile Drain:
4.4 # of Debris Jams: <b>0</b>	Impoundment Loc.:	Overland Flow: Urb Strm Wtr Pipe:
	4.6 Up/Down Strm flow reg.: <b>None</b>	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.:	Affected Length (ft): <b>0</b>

#### 4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Bedrock Outcrops	30	No	No	Yes	Yes	Deposition Above, Deposition Below, Scour Below
Bedrock Outcrops	35	Yes	No	Yes	Yes	Deposition Below, Scour Below

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types Diagonal: <b>0</b>	5.2 Other Features Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: <b>2</b> Delta: <b>0</b>	Flood chutes: <b>1</b> Avulsion: <b>0</b>	5.5 Straightening: <b>None</b>
Point: <b>0</b> Island: <b>1</b>	5.3 Steep Riffles and Head Cuts Head Cuts: <b>0</b>	Straightening Length (ft.): <b>0</b>
Side: <b>2</b> Braiding: <b>0</b>	Steep Riffles: <b>0</b> Trib Rejuv.: <b>No</b>	5.5 Dredging: <b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:		
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection:		
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:		
Habitat Rating:				
Habitat Stream Condition:				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Score	STD	Historic	Geomorphic Rating
7.1 Channel Degradation				Geomorphic Rating
7.2 Channel Aggradation				Channel Evolution Model
7.3 Widening Channel				Channel Evolution Stage
7.4 Change in Planform				Geomorphic Condition <b>Good</b>
Total Score				Stream Sensitivity



**Phase 2 Segment Summary Report West Branch Little River**

Stream:	<b>West Branch</b>	SGAT Version:	<b>4.56</b>
Reach:	<b>M07-D</b>	Organization:	<b>Bear Creek Environmental</b>
Segment Length(ft):	<b>3,250</b>	Observers:	<b>MN, PD</b>
Rain:	<b>No</b>	Completion Date:	<b>9/26/2008</b>
		Quality Control Status - Consultant:	<b>Provisional</b>
		Quality Control Status - Staff:	<b>Provisional</b>

Step 0 - Location: **Segment begins where valley opens up again and continues 3,250 feet until next bedrock gorge.**

Step 5 - Notes: **Phase 2 channel width was used to determine phase 2 confinement type because of the uncertainty associated with reference channel width (see phase 1 step 7).**

Step 7 - Narrative: **Historic incision, some widening, minor aggradation; Valley width is variable. River scientists were not confident that a recently abandoned floodplain is present. There is a very narrow floodplain, and the evidence of an abandoned floodplain was difficult to discern. Segment "C" and "E" are bedrock gorges that are providing upstream and downstream grade controls for segment "D".**

**Step 1. Valley and Floodplain**

1.1 Segmentation:	<b>Grade Controls</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan:	<b>None</b>	Hillside Slope:	<b>Extr.Steep</b>	<b>Extr.Steep</b>	Valley Width (ft): <b>166</b>
1.3 Corridor Encroachments:		Continuous w/ Bank:	<b>Sometimes</b>	<b>Sometimes</b>	Width Determination: <b>Measured</b>
<u>Length (ft)</u>	<u>One</u>	<u>Height</u>	<u>Both</u>	<u>Height</u>	Within 1 Bankfull W:
Berm:	<b>0</b>		<b>0</b>		<b>Sometimes</b>
Road:	<b>0</b>		<b>0</b>		<b>Sometimes</b>
Railroad:	<b>0</b>		<b>0</b>		Texture:
Imp. Path:	<b>0</b>		<b>0</b>		<b>N.E.</b>
Dev.:	<b>0</b>		<b>0</b>		<b>N.E.</b>
					In Rock Gorge: <b>No</b>
					Human Caused Change in Valley Width?: <b>No</b>

1.6 Grade Controls: **None**





# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M07-D

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Abundant</b>	4.5 Flow Regulation Type <b>None</b>	4.7 Stormwater Inputs <b>None</b>
4.2 Adjacent Wetlands: <b>None</b>	Flow Reg. Use:	Field Ditch: Road Ditch:
4.3 Flow Status: <b>Moderate</b>	Impoundments:	Other: Tile Drain:
4.4 # of Debris Jams: <b>0</b>	Impoundment Loc.:	Overland Flow: Urb Strm Wtr Pipe:
	4.6 Up/Down Strm flow reg.: <b>Up Stream</b>	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.:	Affected Length (ft): <b>0</b>
4.8 Channel Constrictions: <b>None</b>		

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types Diagonal: <b>1</b>	5.2 Other Features Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: <b>8</b> Delta: <b>3</b>	Flood chutes: <b>3</b> Avulsion: <b>0</b>	5.5 Straightening: <b>None</b>
Point: <b>1</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts Head Cuts: <b>0</b>	Straightening Length (ft.): <b>0</b>
Side: <b>25</b> Braiding: <b>0</b>	Steep Riffles: <b>1</b> Trib Rejuv.: <b>Yes</b>	5.5 Dredging: <b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.: <b>0</b>	6.4 Sediment Deposition: <b>0</b>	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate: <b>0</b>	6.5 Channel Flow Status: <b>0</b>	6.8 Bank Stability:	<b>0</b>	<b>0</b>
6.3 Pool Variability: <b>0</b>	6.6 Channel Alteration: <b>0</b>	6.9 Bank Vegetation Protection	<b>0</b>	<b>0</b>
Total Score: <b>0</b>	6.7 Channel Sinuosity: <b>0</b>	6.10 Riparian Veg. Zone Width:	<b>0</b>	<b>0</b>
Habitat Rating: <b>0.00</b>				
Habitat Stream Condition: <b>Good</b>				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	<u>Confined</u>	<u>Score</u>	<u>STD</u>	<u>Historic</u>		
7.1 Channel Degradation		<b>8</b>	<b>None</b>	<b>Yes</b>	Geomorphic Rating	<b>0.64</b>
7.2 Channel Aggradation		<b>14</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>12</b>		<b>No</b>	Channel Evolution Stage	<b>III</b>
7.4 Change in Planform		<b>17</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>51</b>			Stream Sensitivity	<b>High</b>



Phase 2 Segment Summary Report **West Branch Little River**

Stream:	<b>West Branch</b>	SGAT Version:	<b>4.56</b>
Reach:	<b>M07-E</b>	Organization:	<b>Bear Creek Environmental</b>
Segment Length(ft):	<b>520</b>	Observers:	<b>PD, TL</b>
Rain:	<b>Yes</b>	Completion Date:	<b>10/3/2008</b>
		Quality Control Status - Consultant:	<b>Provisional</b>
		Quality Control Status - Staff:	<b>Provisional</b>
		Why Not Assessed:	<b>bedrock gorge</b>

Step 0 - Location: **Segment is located where next bedrock gorge begins and continues for another 520 feet until valley widens again. Bingham Falls segment.**

Step 5 - Notes:

Step 7 - Narrative:

**Step 1. Valley and Floodplain**

1.1 Segmentation:	<b>Grade Controls</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan:	<b>None</b>	Hillside Slope:	<b>Extr.Steep</b>	<b>Extr.Steep</b>	Valley Width (ft): <b>50</b>
1.3 Corridor Encroachments:		Continuous w/ Bank:	<b>Always</b>	<b>Always</b>	Width Determination: <b>Measured</b>
<u>Length (ft)</u>	<u>One</u>	<u>Height</u>	<u>Both</u>	<u>Height</u>	Within 1 Bankfull W:
Berm:	<b>0</b>		<b>0</b>		<b>Always</b>
Road:	<b>0</b>		<b>0</b>		<b>Always</b>
Railroad:	<b>0</b>		<b>0</b>		Texture:
Imp. Path:	<b>0</b>		<b>0</b>		<b>Bedrock</b>
Dev.:	<b>0</b>		<b>0</b>		<b>Bedrock</b>
					In Rock Gorge: <b>Yes</b>
					Human Caused Change in Valley Width?: <b>No</b>

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
<b>Waterfall</b>	<b>Mid-segment</b>	<b>60.0</b>	<b>50.0</b>	<b>Yes</b>	



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M07-E

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):		2.11 Riffle/Step Spacing:		2.13 Average Largest Particle on	
2.2 Max Depth (ft.):		2.12 Substrate Composition		Bed:	
2.3 Mean Depth (ft):		Bedrock:	%	Bar:	
2.4 Floodprone Width (ft.):		Boulder:	%	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):		Cobble:	%	Stream Type:	<b>A</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	%	Bed Material:	<b>Bedrock</b>
2.6 Width/Depth Ratio:	<b>0.00</b>	Fine Gravel:	%	Subclass Slope:	<b>None</b>
2.7 Entrenchment Ratio:	<b>0.00</b>	Sand:	%	Bed Form:	<b>Cascade</b>
2.8 Incision Ratio:	<b>0.00</b>	Silt and Smaller:	%	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:		2.15 Sub-reach Stream Type	
2.9 Sinuosity:		Detritus:	%	Reference Stream Type:	<b>A</b>
2.10 Riffles Type:		# Large Woody Debris:		Reference Bed Material:	<b>Bedrock</b>
				Reference Subclass Slope:	<b>None</b>
				Reference Bedform:	<b>Cascade</b>

#### Step 3. Riparian Features

3.1 Stream Banks				Typical Bank Slope:	<b>Steep</b>	
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>0.0</b>	<b>0.0</b>	
Material Type:	<b>Bedrock</b>	<b>Bedrock</b>	Erosion Height (ft.):	<b>0.0</b>	<b>0.0</b>	
Consistency:	<b>Cohesive</b>	<b>Cohesive</b>	Revetment Type:	<b>None</b>	<b>None</b>	
Lower			Revetment Length:	<b>0.0</b>	<b>0.0</b>	
Material Type:	<b>Bedrock</b>	<b>Bedrock</b>				
Consistency:	<b>Cohesive</b>	<b>Cohesive</b>				
				Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
				Dominant:	<b>Coniferous</b>	<b>Coniferous</b>
				Sub-dominant:	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>
				Bank Canopy		
				Canopy %:	<b>76-100</b>	<b>76-100</b>
				Mid-Channel Canopy:	<b>Open</b>	

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	<b>&gt;100</b>	<b>&gt;100</b>
Sub-Dominant	<b>None</b>	<b>None</b>
W less than 25	<b>0</b>	<b>0</b>
Buffer Vegetation Type		
Dominant	<b>Coniferous</b>	<b>Coniferous</b>
Sub-Dominant	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>

#### 3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Forest</b>	<b>Forest</b>	Mass Failures	
Sub-dominant	<b>None</b>	<b>None</b>	Height	
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	<b>0</b>
Failures	<b>None</b>		Gullies Length	<b>0</b>
Gullies	<b>None</b>			



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M07-E

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps:	4.5 Flow Regulation Type	<b>None</b>	4.7 Stormwater Inputs	<b>None</b>
4.2 Adjacent Wetlands:	Flow Reg. Use:		Field Ditch:	Road Ditch:
4.3 Flow Status:	Impoundments:		Other:	Tile Drain:
4.4 # of Debris Jams: <b>0</b>	Impoundment Loc.:		Overland Flow:	Urb Strm Wtr Pipe:
4.8 Channel Constrictions:	4.6 Up/Down Strm flow reg.:	<b>None</b>	4.9 # of Beaver Dams:	<b>0</b>
	(old) Upstrm Flow Reg.:		Affected Length (ft):	<b>0</b>

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal:	5.2 Other Features	Neck Cutoff:	<b>0</b>	5.4 Stream Ford or Animal Crossing:	<b>No</b>
Mid:	Delta:	Flood chutes:	Avulsion:	<b>0</b>	5.5 Straightening:	<b>None</b>
Point:	Island:	5.3 Steep Riffles and Head Cuts	Head Cuts:	<b>0</b>	Straightening Length (ft.):	<b>0</b>
Side:	Braiding:	Steep Riffles:	Trib Rejuv.:		5.5 Dredging:	<b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:		
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection		
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:		
Habitat Rating:				
Habitat Stream Condition:				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	<u>Score</u>	<u>STD</u>	<u>Historic</u>	
7.1 Channel Degradation				Geomorphic Rating
7.2 Channel Aggradation				Channel Evolution Model
7.3 Widening Channel				Channel Evolution Stage
7.4 Change in Planform				Geomorphic Condition
Total Score				Stream Sensitivity
				<b>Reference</b>



Phase 2 Segment Summary Report West Branch Little River

Stream:	West Branch	SGAT Version:	4.56
Reach:	M07-F	Organization:	Bear Creek Environmental
Segment Length(ft):	1,030	Observers:	PD, TL
Rain:	Yes	Completion Date:	10/3/2008
		Quality Control Status - Consultant:	Provisional
		Quality Control Status - Staff:	Provisional

Step 0 - Location: Segment begins at the top of Bingham Falls and continues up to the confluence with Pinnacle Brook.

Step 5 - Notes: Phase 2 channel width was used to determine phase 2 confinement type

Step 7 - Narrative: Historic incision. Minor aggradation and widening. River scientists were not confident in the RAF selected in the field. The floodplain is narrow and the RAF is difficult to discern. Both upstream and downstream segments contain ledge grade controls.

Step 1. Valley and Floodplain

1.1 Segmentation: <b>Grade Controls</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Very Steep</b>	<b>Extr. Steep</b>	Valley Width (ft): <b>330</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Never</b>	<b>Sometimes</b>	Width Determination: <b>Measured</b>
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Never</b>	<b>Sometimes</b>	Confinement Type: <b>NW</b>
Berm: <b>0</b> <b>0</b>	Texture:	<b>N.E.</b>	<b>Sand</b>	In Rock Gorge: <b>No</b>
Road: <b>0</b> <b>0</b>				Human Caused Change in Valley Width?: <b>No</b>
Railroad: <b>0</b> <b>0</b>				
Imp. Path: <b>0</b> <b>0</b>				
Dev.: <b>0</b> <b>0</b>				
1.6 Grade Controls: <b>None</b>				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **West Branch** Reach: **M07-F**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>65.00</b>	2.11 Riffle/Step Spacing:	<b>405 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>3.90</b>	2.12 Substrate Composition		Bed:	<b>23 inches</b>
2.3 Mean Depth (ft):	<b>2.63</b>	Bedrock:	<b>0.0 %</b>	Bar:	<b>9.2 inches</b>
2.4 Floodprone Width (ft.):	<b>93.50</b>	Boulder:	<b>20.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>5.70</b>	Cobble:	<b>45.0 %</b>	Stream Type:	<b>B</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	<b>26.0 %</b>	Bed Material:	<b>Cobble</b>
2.6 Width/Depth Ratio:	<b>24.71</b>	Fine Gravel:	<b>6.0 %</b>	Subclass Slope:	<b>None</b>
2.7 Entrenchment Ratio:	<b>1.44</b>	Sand:	<b>3.0 %</b>	Bed Form:	<b>Riffle-Pool</b>
2.8 Incision Ratio:	<b>1.46</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	<b>No</b>	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Low</b>	Detritus:	<b>%</b>	Reference Stream Type:	
2.10 Riffles Type:	<b>Complete</b>	# Large Woody Debris:	<b>12</b>	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

#### Step 3. Riparian Features

3.1 Stream Banks				Typical Bank Slope:	<b>Steep</b>	
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>12.6</b>	<b>0.0</b>	
Material Type:	<b>Sand</b>	<b>Sand</b>	Erosion Height (ft.):	<b>5.0</b>	<b>0.0</b>	
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>	Revetment Type:	<b>None</b>	<b>None</b>	
Lower			Revetment Length:	<b>0.0</b>	<b>0.0</b>	
Material Type:	<b>Boulder/Cobbles</b>	<b>Boulder/Cobbles</b>				
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>				
				Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
				Dominant:	<b>Deciduous</b>	<b>Deciduous</b>
				Sub-dominant:	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>
				Bank Canopy		
				Canopy %:	<b>76-100</b>	<b>76-100</b>
				Mid-Channel Canopy:	<b>Open</b>	

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>	Corridor Land
Dominant	<b>&gt;100</b>	<b>&gt;100</b>	Dominant
Sub-Dominant	<b>None</b>	<b>None</b>	Sub-dominant
W less than 25	<b>0</b>	<b>0</b>	(Legacy)
Buffer Vegetation Type			Failures
Dominant	<b>Mixed Trees</b>	<b>Mixed Trees</b>	Gullies
Sub-Dominant	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>	

#### 3.3 Riparian Corridor

	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Forest</b>	<b>Forest</b>	Mass Failures	
Sub-Dominant	<b>None</b>	<b>None</b>	Height	
W less than 25	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	<b>0</b>
Buffer Vegetation Type			Gullies Length	<b>0</b>
Dominant	<b>None</b>			
Sub-Dominant	<b>None</b>			



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M07-F

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Minimal</b>	4.5 Flow Regulation Type <b>None</b>	4.7 Stormwater Inputs <b>None</b>
4.2 Adjacent Wetlands: <b>None</b>	Flow Reg. Use:	Field Ditch: Road Ditch:
4.3 Flow Status: <b>Moderate</b>	Impoundments:	Other: Tile Drain:
4.4 # of Debris Jams: <b>0</b>	Impoundment Loc.:	Overland Flow: Urb Strm Wtr Pipe:
	4.6 Up/Down Strm flow reg.: <b>Up Stream</b>	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.:	Affected Length (ft): <b>0</b>
4.8 Channel Constrictions: <b>None</b>		

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types Diagonal: <b>0</b>	5.2 Other Features Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: <b>3</b> Delta: <b>2</b>	Flood chutes: <b>0</b> Avulsion: <b>0</b>	5.5 Straightening: <b>None</b>
Point: <b>0</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts Head Cuts: <b>0</b>	Straightening Length (ft.): <b>0</b>
Side: <b>8</b> Braiding: <b>0</b>	Steep Riffles: <b>0</b> Trib Rejuv.: <b>No</b>	5.5 Dredging: <b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.: <b>0</b>	6.4 Sediment Deposition: <b>0</b>	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate: <b>0</b>	6.5 Channel Flow Status: <b>0</b>	6.8 Bank Stability:	<b>0</b>	<b>0</b>
6.3 Pool Variability: <b>0</b>	6.6 Channel Alteration: <b>0</b>	6.9 Bank Vegetation Protection	<b>0</b>	<b>0</b>
Total Score: <b>0</b>	6.7 Channel Sinuosity: <b>0</b>	6.10 Riparian Veg. Zone Width:	<b>0</b>	<b>0</b>
Habitat Rating: <b>0.00</b>				
Habitat Stream Condition: <b>Good</b>				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		<b>10</b>	<b>None</b>	<b>Yes</b>	Geomorphic Rating	<b>0.71</b>
7.2 Channel Aggradation		<b>14</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>14</b>		<b>No</b>	Channel Evolution Stage	<b>III</b>
7.4 Change in Planform		<b>19</b>		<b>No</b>	Geomorphic Condition	<b>Good</b>
Total Score		<b>57</b>			Stream Sensitivity	<b>Moderate</b>



**Phase 2 Segment Summary Report West Branch Little River**

Stream:	<b>Sterling brook</b>	SGAT Version:	<b>4.56</b>
Reach:	<b>M07.T6.01-A</b>	Organization:	<b>Bear Creek Environmental</b>
Segment Length(ft):	<b>2,000</b>	Observers:	<b>PD, TL</b>
Rain:	<b>No</b>	Completion Date:	<b>9/19/2008</b>
		Quality Control Status - Consultant:	<b>Provisional</b>
		Quality Control Status - Staff:	<b>Provisional</b>

Step 0 - Location: **Segment begins at the mouth of Pinnacle Brook and continues 2000 feet until reach contains multiple waterfalls and bedrock grade controls.**

Step 5 - Notes: **Bankfull width was much wider than reference width. Stream has either been widened or reference channel width is too narrow. Phase 2 channel width was used to determine phase 2 confinement type because of the uncertainty associated with reference channel width. Valley wall is variable along reach. Right side of stream the valley wall was beyond a high terrace at times and other times seemed continuous with the bank. Slope of segment is high due to bedrock gorge section in reach. Segment A has lower slope than upper portion of reach. Walked segment A again on 5/5/10 to look for RAF. RAF not clear in the field. There are areas with a terrace adjacent to channel, but this was not consistent throughout the segment. Decided to select RAF to be the same as the bankfull elevation based on 5/5/10 field work.**

Step 7 - Narrative: **Dominant process in segment is aggradation and planform adjustment. At locations where the valley widens there is deposition in the form of large mid channel bars. There active flood chutes throughout the segment. One flood chute was estimated to be over 500 feet in length.**

**Step 1. Valley and Floodplain**

1.1 Segmentation:	<b>Grade Controls</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan:	<b>None</b>	Hillside Slope:	<b>Very Steep</b>	<b>Very Steep</b>	Valley Width (ft): <b>160</b>
1.3 Corridor Encroachments:		Continuous w/ Bank:	<b>Sometimes</b>	<b>Sometimes</b>	Width Determination: <b>Measured</b>
<u>Length (ft)</u>	<u>One</u>	<u>Height</u>	<u>Both</u>	<u>Height</u>	Within 1 Bankfull W: <b>Sometimes</b>
Berm:	<b>0</b>		<b>0</b>		Texture: <b>Sand</b>
Road:	<b>0</b>		<b>0</b>		<b>Sand</b>
Railroad:	<b>0</b>		<b>0</b>		In Rock Gorge: <b>No</b>
Imp. Path:	<b>0</b>		<b>0</b>		Human Caused Change in Valley Width?: <b>No</b>
Dev.:	<b>0</b>		<b>0</b>		

1.6 Grade Controls: **None**



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **Sterling brook**      Reach: **M07.T6.01-A**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>39.00</b>	2.11 Riffle/Step Spacing:	<b>80 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>2.70</b>	2.12 Substrate Composition		Bed:	<b>20 inches</b>
2.3 Mean Depth (ft):	<b>1.53</b>	Bedrock:	<b>0.0 %</b>	Bar:	<b>13 inches</b>
2.4 Floodprone Width (ft.):	<b>101.00</b>	Boulder:	<b>12.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>2.70</b>	Cobble:	<b>47.0 %</b>	Stream Type:	<b>C</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	<b>35.0 %</b>	Bed Material:	<b>Cobble</b>
2.6 Width/Depth Ratio:	<b>25.49</b>	Fine Gravel:	<b>6.0 %</b>	Subclass Slope:	<b>b</b>
2.7 Entrenchment Ratio:	<b>2.59</b>	Sand:	<b>0.0 %</b>	Bed Form:	<b>Riffle-Pool</b>
2.8 Incision Ratio:	<b>1.00</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	<b>No</b>	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Low</b>	Detritus:	<b>0.0 %</b>	Reference Stream Type:	<b>C</b>
2.10 Riffles Type:	<b>Complete</b>	# Large Woody Debris:	<b>55</b>	Reference Bed Material:	<b>Cobble</b>
				Reference Subclass Slope:	<b>b</b>
				Reference Bedform:	<b>Riffle-Pool</b>

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope:	<b>Steep</b>		
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type <u>Left</u> <u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>272.3</b>	<b>306.7</b>	Dominant: <b>Coniferous</b> <b>Coniferous</b>
Material Type:	<b>Sand</b>	<b>Sand</b>	Erosion Height (ft.):	<b>4.0</b>	<b>5.1</b>	Sub-dominant: <b>Shrubs/Sapling</b> <b>Shrubs/Sapling</b>
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>	Revetment Type:	<b>None</b>	<b>None</b>	Bank Canopy
Lower			Revetment Length:	<b>0.0</b>	<b>0.0</b>	Canopy %: <b>76-100</b> <b>76-100</b>
Material Type:	<b>Boulder/Cobbles</b>	<b>Boulder/Cobbles</b>				Mid-Channel Canopy: <b>Closed</b>
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>				

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>	Corridor Land
Dominant	<b>&gt;100</b>	<b>&gt;100</b>	Dominant
Sub-Dominant	<b>None</b>	<b>None</b>	Sub-dominant
W less than 25	<b>0</b>	<b>0</b>	(Legacy)
Buffer Vegetation Type			Failures
Dominant	<b>Mixed Trees</b>	<b>Mixed Trees</b>	Gullies
Sub-Dominant	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>	

#### 3.3 Riparian Corridor

	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Forest</b>	<b>Forest</b>	Mass Failures	<b>37.12</b>
Sub-Dominant	<b>None</b>	<b>None</b>	Height	<b>12.0</b>
W less than 25	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	<b>0</b>
Failures	<b>One</b>	<b>12.0</b>	Gullies Length	<b>0</b>
Gullies	<b>None</b>			





Phase 2 Segment Summary Report **West Branch Little River**

Stream:	<b>Sterling brook</b>	SGAT Version:	<b>4.56</b>
Reach:	<b>M07.T6.01-B</b>	Organization:	<b>Bear Creek Environmental</b>
Segment Length(ft):	<b>2,275</b>	Observers:	<b>PD, TL</b>
Rain:	<b>No</b>	Completion Date:	<b>9/19/2008</b>
		Quality Control Status - Consultant:	<b>Provisional</b>
		Quality Control Status - Staff:	<b>Provisional</b>
		Why Not Assessed:	<b>bedrock gorge</b>

Step 0 - Location: **Segment begins where multiple waterfalls and bedrock grade controls occur and valley becomes very confined.**

Step 5 - Notes:

Step 7 - Narrative:

**Step 1. Valley and Floodplain**

1.1 Segmentation: <b>Grade Controls</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Extr.Steep</b>	<b>Extr.Steep</b>	Valley Width (ft):
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Always</b>	<b>Always</b>	Width Determination:
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Always</b>	<b>Always</b>	Confinement Type: <b>NC</b>
Berm: <b>0</b> <b>0</b>	Texture:	<b>Bedrock</b>	<b>Bedrock</b>	In Rock Gorge: <b>Yes</b>
Road: <b>0</b> <b>0</b>				Human Caused Change in Valley Width?: <b>No</b>
Railroad: <b>0</b> <b>0</b>				
Imp. Path: <b>0</b> <b>0</b>				
Dev.: <b>0</b> <b>0</b>				

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
<b>Waterfall</b>	<b>Mid-segment</b>	<b>13.0</b>	<b>10.0</b>	<b>Yes</b>	



### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **Sterling brook**                      Reach: **M07.T6.01-B**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):		2.11 Riffle/Step Spacing:		2.13 Average Largest Particle on	
2.2 Max Depth (ft.):		2.12 Substrate Composition		Bed:	
2.3 Mean Depth (ft):		Bedrock:	%	Bar:	
2.4 Floodprone Width (ft.):		Boulder:	%	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):		Cobble:	%	Stream Type:	<b>A</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	%	Bed Material:	<b>Boulder</b>
2.6 Width/Depth Ratio:	<b>0.00</b>	Fine Gravel:	%	Subclass Slope:	<b>None</b>
2.7 Entrenchment Ratio:	<b>0.00</b>	Sand:	%	Bed Form:	<b>Cascade</b>
2.8 Incision Ratio:	<b>0.00</b>	Silt and Smaller:	%	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:		2.15 Sub-reach Stream Type	
2.9 Sinuosity:		Detritus:	%	Reference Stream Type:	
2.10 Riffles Type:		# Large Woody Debris:		Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

#### Step 3. Riparian Features

3.1 Stream Banks				Typical Bank Slope:	<b>Steep</b>	
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>0.0</b>	<b>0.0</b>	
Material Type:	<b>Bedrock</b>	<b>Bedrock</b>	Erosion Height (ft.):	<b>0.0</b>	<b>0.0</b>	
Consistency:	<b>Cohesive</b>	<b>Cohesive</b>	Revetment Type:	<b>None</b>	<b>None</b>	
Lower			Revetment Length:	<b>0.0</b>	<b>0.0</b>	
Material Type:	<b>Bedrock</b>	<b>Bedrock</b>				
Consistency:	<b>Cohesive</b>	<b>Cohesive</b>				
				Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
				Dominant:	<b>Coniferous</b>	<b>Coniferous</b>
				Sub-dominant:	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>
				Bank Canopy		
				Canopy %:	<b>76-100</b>	<b>76-100</b>
				Mid-Channel Canopy:	<b>Closed</b>	

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	<b>&gt;100</b>	<b>&gt;100</b>
Sub-Dominant	<b>None</b>	<b>None</b>
W less than 25	<b>0</b>	<b>0</b>
Buffer Vegetation Type		
Dominant	<b>Mixed Trees</b>	<b>Mixed Trees</b>
Sub-Dominant	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>

#### 3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Forest</b>	<b>Forest</b>	Mass Failures	
Sub-dominant	<b>None</b>	<b>None</b>	Height	
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	<b>0</b>
Failures	<b>None</b>		Gullies Length	<b>0</b>
Gullies	<b>None</b>			



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: Sterling brook

Reach: M07.T6.01-B

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps:	4.5 Flow Regulation Type	<b>None</b>	4.7 Stormwater Inputs	<b>None</b>
4.2 Adjacent Wetlands:	Flow Reg. Use:		Field Ditch:	Road Ditch:
4.3 Flow Status:	Impoundments:		Other:	Tile Drain:
4.4 # of Debris Jams: <b>0</b>	Impoundment Loc.:		Overland Flow:	Urb Strm Wtr Pipe:
4.8 Channel Constrictions:	4.6 Up/Down Strm flow reg.:	<b>None</b>	4.9 # of Beaver Dams:	<b>0</b>
	(old) Upstrm Flow Reg.:		Affected Length (ft):	<b>0</b>

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal:	5.2 Other Features	Neck Cutoff:	<b>0</b>	5.4 Stream Ford or Animal Crossing:	<b>No</b>	
Mid:	Delta:	Flood chutes:	<b>0</b>	Avulsion:	<b>0</b>	5.5 Straightening:	<b>None</b>
Point:	Island:	5.3 Steep Riffles and Head Cuts	Head Cuts:	<b>0</b>	Straightening Length (ft.):	<b>0</b>	
Side:	Braiding:	<b>0</b>	Trib Rejuv.:		5.5 Dredging:	<b>None</b>	

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:		
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection		
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:		
Habitat Rating:				
Habitat Stream Condition:				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	<u>Score</u>	<u>STD</u>	<u>Historic</u>	
7.1 Channel Degradation				Geomorphic Rating
7.2 Channel Aggradation				Channel Evolution Model
7.3 Widening Channel				Channel Evolution Stage
7.4 Change in Planform				Geomorphic Condition
Total Score				Stream Sensitivity
				<b>Reference</b>



Phase 2 Segment Summary Report West Branch Little River

Stream:	West Branch	SGAT Version:	4.56
Reach:	M08-A	Organization:	Bear Creek Environmental
Segment Length(ft):	2,237	Observers:	PD, CS
Rain:	No	Completion Date:	8/14/2008
		Quality Control Status - Consultant:	Provisional
		Quality Control Status - Staff:	Provisional

Step 0 - Location: Segment begins just upstream of confluence with Pinnacle Brook and continues 2,237 feet until valley widens.

Step 5 - Notes: The upstream end of this segment is a very short bedrock gorge with two grade controls. It was lumped into the segment due to its short length. Then the stream is more riffle-pool over all with some short sections of step-pool features. It becomes somewhat plane-bed just upstream of the confluence with Pinnacle Brook, but due to its short length, it was included in this segment. Channel is naturally entrenched, therefore entrenchment less than 1.4 under degradation step 7.1 was ignored. Phase 2 channel width was used to determine phase 2 confinement type. Two cross sections were measured (one on 8/14/10 and one on 6/22/10). The two cross sections are similar with the exception of entrenchment. The first cross section showed the stream type was on the cut-off between "F" and "B". Based on the the second cross section, a "B" existing and reference stream type was assigned.

Step 7 - Narrative: Aggradation is a major process (25 side bars and 7 mid-channel bars). Some of this aggradation may be due to a drop in slope near the Pinnacle Brook confluence. Channel has minor historic incision. Minor widening and planform adjustment were noted.

Step 1. Valley and Floodplain

1.1 Segmentation: Valley Width	1.4 Adjacent Side	Left	Right	1.5 Valley Features
1.2 Alluvial Fan: None	Hillside Slope:	Extr. Steep	Extr. Steep	Valley Width (ft): 58
1.3 Corridor Encroachments:	Continuous w/ Bank:	Sometimes	Sometimes	Width Determination: Measured
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	Sometimes	Sometimes	Confinement Type: NC
Berm: 0 0	Texture:	Sand	Sand	In Rock Gorge: No
Road: 0 0				Human Caused Change in Valley Width?: No
Railroad: 0 0				
Imp. Path: 0 0				
Dev.: 0 0				

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
Ledge	Mid-segment	6.0	2.0	Yes	
Waterfall	Mid-segment	7.0	5.0	No	



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **West Branch**

Reach: **M08-A**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>42.00</b>	2.11 Riffle/Step Spacing:	<b>93 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>3.00</b>	2.12 Substrate Composition		Bed:	<b>23 inches</b>
2.3 Mean Depth (ft):	<b>2.20</b>	Bedrock:	<b>1.0 %</b>	Bar:	<b>21 inches</b>
2.4 Floodprone Width (ft.):	<b>50.50</b>	Boulder:	<b>27.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>3.20</b>	Cobble:	<b>33.0 %</b>	Stream Type:	<b>B</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	<b>22.0 %</b>	Bed Material:	<b>Cobble</b>
2.6 Width/Depth Ratio:	<b>19.09</b>	Fine Gravel:	<b>11.0 %</b>	Subclass Slope:	<b>None</b>
2.7 Entrenchment Ratio:	<b>1.20</b>	Sand:	<b>6.0 %</b>	Bed Form:	<b>Riffle-Pool</b>
2.8 Incision Ratio:	<b>1.07</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:		2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Low</b>	Detritus:	<b>0.0 %</b>	Reference Stream Type:	
2.10 Riffles Type:	<b>Complete</b>	# Large Woody Debris:	<b>18</b>	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope:	<b>Steep</b>				
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>16.0</b>	<b>23.2</b>	Dominant:	<b>Coniferous</b>	<b>Coniferous</b>
Material Type:	<b>Sand</b>	<b>Sand</b>	Erosion Height (ft.):	<b>3.0</b>	<b>4.0</b>	Sub-dominant:	<b>Herbaceous</b>	<b>Herbaceous</b>
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>	Revetment Type:	<b>None</b>	<b>None</b>	Bank Canopy		
Lower			Revetment Length:	<b>0.0</b>	<b>0.0</b>	Canopy %:	<b>76-100</b>	<b>76-100</b>
Material Type:	<b>Boulder/Cobbles</b>	<b>Boulder/Cobbles</b>				Mid-Channel Canopy:	<b>Closed</b>	
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>						

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>	Corridor Land
Dominant	<b>&gt;100</b>	<b>&gt;100</b>	Dominant
Sub-Dominant	<b>None</b>	<b>None</b>	Sub-dominant
W less than 25	<b>0</b>	<b>0</b>	(Legacy)
Buffer Vegetation Type			Failures
Dominant	<b>Mixed Trees</b>	<b>Mixed Trees</b>	Gullies
Sub-Dominant	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>	

#### 3.3 Riparian Corridor

	<u>Left</u>	<u>Right</u>		<u>Left</u>	<u>Right</u>
Dominant	<b>Forest</b>	<b>Forest</b>	Mass Failures		
Sub-Dominant	<b>None</b>	<b>None</b>	Height		
W less than 25	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	<b>0</b>	
Buffer Vegetation Type			Gullies Length	<b>0</b>	
Dominant	<b>None</b>				
Sub-Dominant					



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M08-A

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Abundant</b>	4.5 Flow Regulation Type <b>None</b>	4.7 Stormwater Inputs <b>None</b>
4.2 Adjacent Wetlands: <b>None</b>	Flow Reg. Use:	Field Ditch: Road Ditch:
4.3 Flow Status: <b>Moderate</b>	Impoundments:	Other: Tile Drain:
4.4 # of Debris Jams: <b>0</b>	Impoundment Loc.:	Overland Flow: Urb Strm Wtr Pipe:
	4.6 Up/Down Strm flow reg.: <b>Up Stream</b>	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.:	Affected Length (ft): <b>0</b>

4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
<b>Bedrock Outcrops</b>	<b>14</b>	<b>Yes</b>	<b>No</b>	<b>Yes</b>	<b>Yes</b>	<b>Deposition Above, Deposition Below, Scour Below</b>

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types Diagonal: <b>0</b>	5.2 Other Features Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: <b>7</b> Delta: <b>0</b>	Flood chutes: <b>0</b>	Avulsion: <b>0</b>
Point: <b>3</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts Head Cuts: <b>0</b>	5.5 Straightening: <b>None</b>
Side: <b>25</b> Braiding: <b>0</b>	5.3 Steep Riffles and Head Cuts Steep Riffles: <b>1</b>	Trib Rejuv.: <b>No</b>
		5.5 Straightening Length (ft.): <b>0</b>
		5.5 Dredging: <b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:		
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection		
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:		
Habitat Rating:				
Habitat Stream Condition:				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Confined	Score	STD	Historic		
7.1 Channel Degradation		<b>17</b>	<b>None</b>	<b>No</b>	Geomorphic Rating	<b>0.65</b>
7.2 Channel Aggradation		<b>9</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>D</b>
7.3 Widening Channel		<b>12</b>		<b>No</b>	Channel Evolution Stage	<b>IIc</b>
7.4 Change in Planform		<b>14</b>		<b>No</b>	Geomorphic Condition	<b>Good</b>
Total Score		<b>52</b>			Stream Sensitivity	<b>Moderate</b>



Phase 2 Segment Summary Report West Branch Little River

Stream:	West Branch	SGAT Version:	4.56
Reach:	M08-B	Organization:	Bear Creek Environmental
Segment Length(ft):	720	Observers:	PD, MA
Rain:	Yes	Completion Date:	7/10/2008
		Quality Control Status - Consultant:	Provisional
		Quality Control Status - Staff:	Provisional

Step 0 - Location: Segment begins where reach becomes less entrenched just upstream from waterfall.

Step 5 - Notes: This segment is better buffered than upstream section, but is experiencing some increase in aggradation. Water from the snowmaking pond re-enters in this segment also.

Step 7 - Narrative: Major historic incision and major aggradation in the form of diagonal bars and steep riffles. Minor widening and planform adjustment.

Step 1. Valley and Floodplain

1.1 Segmentation: <b>Valley Width</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Extr.Steep</b>	<b>Extr.Steep</b>	Valley Width (ft): <b>298</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Never</b>	<b>Sometimes</b>	Width Determination: <b>Measured</b>
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Never</b>	<b>Sometimes</b>	Confinement Type: <b>BD</b>
Berm: <b>0</b> <b>0</b>	Texture:	<b>N.E.</b>	<b>N.E.</b>	In Rock Gorge: <b>No</b>
Road: <b>0</b> <b>0</b>				Human Caused Change in Valley Width?: <b>No</b>
Railroad: <b>0</b> <b>0</b>				
Imp. Path: <b>0</b> <b>0</b>				
Dev.: <b>0</b> <b>0</b>				
1.6 Grade Controls: <b>None</b>				



### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **West Branch**

Reach: **M08-B**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>38.00</b>	2.11 Riffle/Step Spacing:	<b>200 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>3.80</b>	2.12 Substrate Composition		Bed:	<b>24 inches</b>
2.3 Mean Depth (ft.):	<b>2.50</b>	Bedrock:	<b>0.0 %</b>	Bar:	<b>10 inches</b>
2.4 Floodprone Width (ft.):	<b>210.70</b>	Boulder:	<b>14.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>6.60</b>	Cobble:	<b>34.0 %</b>	Stream Type:	<b>C</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	<b>29.0 %</b>	Bed Material:	<b>Gravel</b>
2.6 Width/Depth Ratio:	<b>15.20</b>	Fine Gravel:	<b>12.0 %</b>	Subclass Slope:	<b>b</b>
2.7 Entrenchment Ratio:	<b>5.54</b>	Sand:	<b>11.0 %</b>	Bed Form:	<b>Riffle-Pool</b>
2.8 Incision Ratio:	<b>1.74</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	<b>No</b>	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Low</b>	Detritus:	<b>0.0 %</b>	Reference Stream Type:	<b>C</b>
2.10 Riffles Type:	<b>Complete</b>	# Large Woody Debris:	<b>10</b>	Reference Bed Material:	<b>Gravel</b>
				Reference Subclass Slope:	<b>b</b>
				Reference Bedform:	<b>Riffle-Pool</b>

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope:	<b>Steep</b>		
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type <u>Left</u> <u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>64.8</b>	<b>112.7</b>	Dominant: <b>Deciduous</b> <b>Deciduous</b>
Material Type:	<b>Sand</b>	<b>Sand</b>	Erosion Height (ft.):	<b>5.0</b>	<b>5.0</b>	Sub-dominant: <b>Shrubs/Sapling</b> <b>Shrubs/Sapling</b>
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>	Revetment Type:	<b>Rip-Rap</b>	<b>None</b>	Bank Canopy
Lower			Revetment Length:	<b>52.4</b>	<b>0.0</b>	Canopy %: <b>76-100</b> <b>76-100</b>
Material Type:	<b>Gravel</b>	<b>Gravel</b>				Mid-Channel Canopy: <b>Closed</b>
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>				

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>	Corridor Land
Dominant	<b>&gt;100</b>	<b>&gt;100</b>	Dominant
Sub-Dominant	<b>None</b>	<b>None</b>	Sub-dominant
W less than 25	<b>0</b>	<b>0</b>	(Legacy)
Buffer Vegetation Type			Failures
Dominant	<b>Mixed Trees</b>	<b>Mixed Trees</b>	Gullies
Sub-Dominant	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>	

#### 3.3 Riparian Corridor

	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Forest</b>	<b>Forest</b>	Mass Failures	
Sub-Dominant	<b>None</b>	<b>None</b>	Height	
W less than 25	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	<b>0</b>
Buffer Vegetation Type			Gullies Length	<b>0</b>
Dominant	<b>None</b>			
Sub-Dominant				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M08-B

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps:	<b>Abundant</b>	4.5 Flow Regulation Type	<b>None</b>	4.7 Stormwater Inputs	
4.2 Adjacent Wetlands:	<b>Abundant</b>	Flow Reg. Use:		Field Ditch:	<b>0</b> Road Ditch: <b>0</b>
4.3 Flow Status:	<b>Moderate</b>	Impoundments:		Other:	<b>1</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams:	<b>0</b>	Impoundment Loc.:		Overland Flow:	<b>0</b> Urb Strm Wtr Pipe: <b>0</b>
4.8 Channel Constrictions:	<b>None</b>	4.6 Up/Down Strm flow reg.:	<b>Up Stream</b>	4.9 # of Beaver Dams:	<b>0</b>
		(old) Upstrm Flow Reg.:		Affected Length (ft):	<b>0</b>

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>1</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing:	<b>No</b>
Mid:	<b>1</b> Delta: <b>1</b>	Flood chutes: <b>1</b>	Avulsion: <b>0</b>	5.5 Straightening:	<b>None</b>
Point:	<b>1</b> Island: <b>1</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>0</b>	Straightening Length (ft.):	<b>0</b>
Side:	<b>4</b> Braiding: <b>0</b>	Steep Riffles: <b>3</b>	Trib Rejuv.: <b>Yes</b>	5.5 Dredging:	<b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:		
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection		
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:		
Habitat Rating:				
Habitat Stream Condition:				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	<u>Unconfined</u>	<u>Score</u>	<u>STD</u>	<u>Historic</u>		
7.1 Channel Degradation		<b>8</b>	<b>None</b>	<b>Yes</b>	Geomorphic Rating	<b>0.57</b>
7.2 Channel Aggradation		<b>10</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>13</b>		<b>No</b>	Channel Evolution Stage	<b>III</b>
7.4 Change in Planform		<b>15</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>46</b>			Stream Sensitivity	<b>Very High</b>



**Phase 2 Segment Summary Report West Branch Little River**

Stream:	<b>West Branch</b>	SGAT Version:	<b>4.56</b>
Reach:	<b>M08-C</b>	Organization:	<b>Bear Creek Environmental</b>
Segment Length(ft):	<b>700</b>	Observers:	<b>PD, MA</b>
Rain:	<b>Yes</b>	Completion Date:	<b>7/10/2008</b>
		Quality Control Status - Consultant:	<b>Provisional</b>
		Quality Control Status - Staff:	<b>Provisional</b>

Step 0 - Location: **Segment begins at downstream end of snowmaking pond and continues until confluence with Big Spruce Brook.**

Step 5 - Notes: **This segment is experiencing flow alterations from the snowmaking pond. While assessing we saw an increase in flow in the channel downstream of the pond during a storm event. Entrenchment in the cross section was 1.95, adjacent to the pond. An STD of C to B was assigned because of the pond's affect on entrenchment at the cross sections location. However, a "C" stream type best characterizes this segment. Phase 2 channel width was used to determine phase 2 confinement type because of the uncertainty associated with reference channel width (see phase 1 step 7).**

Step 7 - Narrative: **Historic incision and widening, currently aggradation, minor planform adjustment.**

**Step 1. Valley and Floodplain**

1.1 Segmentation: <b>Banks and Buffers</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Extr.Steep</b>	<b>Extr.Steep</b>	Valley Width (ft): <b>360</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Never</b>	<b>Sometimes</b>	Width Determination: <b>Measured</b>
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Never</b>	<b>Sometimes</b>	Confinement Type: <b>BD</b>
Berm: <b>0</b> <b>0</b> <b>0</b>	Texture:	<b>N.E.</b>	<b>N.E.</b>	In Rock Gorge: <b>No</b>
Road: <b>95</b> <b>0</b> <b>0</b>				Human Caused Change in Valley Width?: <b>Yes</b>
Railroad: <b>0</b> <b>0</b>				
Imp. Path: <b>0</b> <b>0</b>				
Dev.: <b>60</b> <b>0</b>				

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
Weir	Mid-segment	5.0	2.0	Yes	



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **West Branch** Reach: **M08-C**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>44.00</b>	2.11 Riffle/Step Spacing:	<b>110 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>4.10</b>	2.12 Substrate Composition		Bed:	<b>20.4 inches</b>
2.3 Mean Depth (ft.):	<b>2.60</b>	Bedrock:	<b>0.0 %</b>	Bar:	<b>13 inches</b>
2.4 Floodprone Width (ft.):	<b>86.00</b>	Boulder:	<b>11.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>5.10</b>	Cobble:	<b>34.0 %</b>	Stream Type:	<b>B</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	<b>44.0 %</b>	Bed Material:	<b>Gravel</b>
2.6 Width/Depth Ratio:	<b>16.92</b>	Fine Gravel:	<b>7.0 %</b>	Subclass Slope:	<b>None</b>
2.7 Entrenchment Ratio:	<b>1.95</b>	Sand:	<b>4.0 %</b>	Bed Form:	<b>Riffle-Pool</b>
2.8 Incision Ratio:	<b>1.24</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	<b>No</b>	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Low</b>	Detritus:	<b>0.0 %</b>	Reference Stream Type:	<b>C</b>
2.10 Riffles Type:	<b>Complete</b>	# Large Woody Debris:	<b>1</b>	Reference Bed Material:	<b>Gravel</b>
				Reference Subclass Slope:	<b>b</b>
				Reference Bedform:	<b>Riffle-Pool</b>

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope:	<b>Steep</b>				
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>0.0</b>	<b>0.0</b>	Dominant:	<b>Coniferous</b>	<b>Herbaceous</b>
Material Type:	<b>Sand</b>	<b>Sand</b>	Erosion Height (ft.):	<b>0.0</b>	<b>0.0</b>	Sub-dominant:	<b>Herbaceous</b>	<b>Coniferous</b>
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>	Revetment Type:	<b>Rip-Rap</b>	<b>Rip-Rap</b>	Bank Canopy		
Lower			Revetment Length:	<b>232.8</b>	<b>353.2</b>	Canopy %:	<b>26-50</b>	<b>1-25</b>
Material Type:	<b>Gravel</b>	<b>Gravel</b>				Mid-Channel Canopy:	<b>Open</b>	
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>						

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	<b>0-25</b>	<b>51-100</b>
Sub-Dominant	<b>26-50</b>	<b>0-25</b>
W less than 25	<b>289</b>	<b>149</b>
Buffer Vegetation Type		
Dominant	<b>Herbaceous</b>	<b>Herbaceous</b>
Sub-Dominant	<b>Coniferous</b>	<b>Coniferous</b>

#### 3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Commercial</b>	<b>Forest</b>	Mass Failures	
Sub-dominant	<b>Forest</b>	<b>Residential</b>	Height	
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	<b>0</b>
Failures	<b>None</b>		Gullies Length	<b>0</b>
Gullies	<b>None</b>			



# Stream Geomorphic Assessment

## Agency of Natural Resources

VT DEC

Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M08-C

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Abundant</b>	4.5 Flow Regulation Type: <b>Large Withdrawal</b>	4.7 Stormwater Inputs: <b>None</b>
4.2 Adjacent Wetlands: <b>Abundant</b>	Flow Reg. Use: <b>Recreation</b>	Field Ditch: Road Ditch:
4.3 Flow Status: <b>Moderate</b>	Impoundments:	Other: Tile Drain:
4.4 # of Debris Jams: <b>0</b>	Impoundment Loc.:	Overland Flow: Urb Strm Wtr Pipe:
	4.6 Up/Down Strm flow reg.: <b>None</b>	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.:	Affected Length (ft): <b>0</b>

#### 4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Culvert	16	Yes	Yes	Yes	Yes	Deposition Above, Deposition Below, Scour Above, Scour Below
Other	6	Yes	No	Yes	Yes	Deposition Above, Deposition Below

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types: Diagonal: <b>1</b>	5.2 Other Features: Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: <b>3</b> Delta: <b>0</b>	Flood chutes: <b>0</b> Avulsion: <b>0</b>	5.5 Straightening: <b>Straightening</b>
Point: <b>1</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts: Head Cuts: <b>0</b>	Straightening Length (ft.): <b>406</b>
Side: <b>5</b> Braiding: <b>0</b>	Steep Riffles: <b>2</b> Trib Rejuv.: <b>No</b>	5.5 Dredging: <b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type: <u>Left</u> <u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection:
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:
Habitat Rating:		
Habitat Stream Condition:		

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		13	C to B	Yes	Geomorphic Rating	0.64
7.2 Channel Aggradation		11	None	No	Channel Evolution Model	F
7.3 Widening Channel		13		Yes	Channel Evolution Stage	III
7.4 Change in Planform		14		No	Geomorphic Condition	Fair
Total Score		51			Stream Sensitivity	Very High



Phase 2 Segment Summary Report West Branch Little River

Stream:	<b>Big Spruce Brook</b>	SGAT Version:	<b>4.56</b>
Reach:	<b>M08.S1.01-A</b>	Organization:	<b>Bear Creek Environmental</b>
Segment Length(ft):	<b>706</b>	Observers:	<b>CS, PD, SP</b>
Rain:	<b>Yes</b>	Completion Date:	<b>6/24/2008</b>
		Quality Control Status - Consultant:	<b>Provisional</b>
		Quality Control Status - Staff:	<b>Provisional</b>

Step 0 - Location: **Segment begins at confluence with West Branch and continues until just upstream of bridge to dormitory.**

Step 5 - Notes: **Entire segment channelized, roads along both banks causing entrenchment and STD. Big Spruce likely used to enter West Branch upstream of current confluence. This made defining old valley walls difficult, as there was no old valley for Big Spruce in this area (we designated the road as the old valley wall on the RB). No RAF was noted in the field, but both banks have been built up with fill for the roads so incision ratio was very high (considered Rt 108 road to be RAF) since we had an F stream type it must be incised. We did not include this as a human elevated floodplain though since the roads are acting as the new valley walls (as per the protocol addendum). Overwide channel may be due to channelization and not necessarily due to stream widening.**

Step 7 - Narrative: **Major historic incision and widening (stream was relocated) and is currently undergoing major planform adjustment and minor aggradation. Channel has not gone through typical evolution process, given it was likely constructed.**

Step 1. Valley and Floodplain

1.1 Segmentation: <b>Channel Dimensions</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Extr.Steep</b>	<b>Extr.Steep</b>	Valley Width (ft): <b>90</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Never</b>	<b>Never</b>	Width Determination: <b>Measured</b>
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Never</b>	<b>Sometimes</b>	Confinement Type: <b>NW</b>
Berm: <b>0</b> <b>0</b>	Texture:	<b>N.E.</b>	<b>N.E.</b>	In Rock Gorge: <b>No</b>
Road: <b>0</b> <b>627</b> <b>0</b>				Human Caused Change in Valley Width?: <b>Yes</b>
Railroad: <b>0</b> <b>0</b>				
Imp. Path: <b>0</b> <b>0</b>				
Dev.: <b>217</b> <b>0</b>				
1.6 Grade Controls: <b>None</b>				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **Big Spruce Brook**      Reach: **M08.S1.01-A**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>28.50</b>	2.11 Riffle/Step Spacing:	<b>153 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>1.80</b>	2.12 Substrate Composition		Bed:	<b>11 inches</b>
2.3 Mean Depth (ft.):	<b>1.32</b>	Bedrock:	<b>0.0 %</b>	Bar:	<b>7 inches</b>
2.4 Floodprone Width (ft.):	<b>38.20</b>	Boulder:	<b>3.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>6.10</b>	Cobble:	<b>25.0 %</b>	Stream Type:	<b>F</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	<b>50.0 %</b>	Bed Material:	<b>Gravel</b>
2.6 Width/Depth Ratio:	<b>21.59</b>	Fine Gravel:	<b>18.0 %</b>	Subclass Slope:	<b>b</b>
2.7 Entrenchment Ratio:	<b>1.34</b>	Sand:	<b>4.0 %</b>	Bed Form:	<b>Plane Bed</b>
2.8 Incision Ratio:	<b>3.39</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	<b>No</b>	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Low</b>	Detritus:	<b>3.0 %</b>	Reference Stream Type:	
2.10 Riffles Type:	<b>Complete</b>	# Large Woody Debris:	<b>2</b>	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope: <b>Steep</b>			
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type <u>Left</u> <u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>0.0</b>	<b>0.0</b>	Dominant: <b>Herbaceous</b> <b>Herbaceous</b>
Material Type:	<b>Sand</b>	<b>Sand</b>	Erosion Height (ft.):	<b>0.0</b>	<b>0.0</b>	Sub-dominant: <b>Deciduous</b> <b>Deciduous</b>
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>	Revetment Type:	<b>Rip-Rap</b>	<b>Rip-Rap</b>	Bank Canopy
Lower			Revetment Length:	<b>155.2</b>	<b>128.6</b>	Canopy %: <b>76-100</b> <b>26-50</b>
Material Type:	<b>Gravel</b>	<b>Gravel</b>				Mid-Channel Canopy: <b>Open</b>
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>				

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	<b>0-25</b>	<b>0-25</b>
Sub-Dominant	<b>None</b>	<b>None</b>
W less than 25	<b>646</b>	<b>646</b>
Buffer Vegetation Type		
Dominant	<b>Deciduous</b>	<b>Herbaceous</b>
Sub-Dominant	<b>Herbaceous</b>	<b>Deciduous</b>

#### 3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Residential</b>	<b>Residential</b>	Mass Failures	
Sub-dominant	<b>Forest</b>	<b>Forest</b>	Height	
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	<b>0</b>
Failures	<b>None</b>		Gullies Length	<b>0</b>
Gullies	<b>None</b>			



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **Big Spruce Brook**

Reach: **M08.S1.01-A**

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Minimal</b>	4.5 Flow Regulation Type <b>None</b>	4.7 Stormwater Inputs <b>None</b>
4.2 Adjacent Wetlands: <b>None</b>	Flow Reg. Use:	Field Ditch: Road Ditch:
4.3 Flow Status: <b>Moderate</b>	Impoundments:	Other: Tile Drain:
4.4 # of Debris Jams: <b>0</b>	Impoundment Loc.:	Overland Flow: Urb Strm Wtr Pipe:
	4.6 Up/Down Strm flow reg.: <b>None</b>	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.:	Affected Length (ft): <b>0</b>

4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Bridge	15	Yes	Yes	No	Yes	Deposition Above, Deposition Below, Scour Below

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types Diagonal: <b>0</b>	5.2 Other Features Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: <b>2</b> Delta: <b>0</b>	Flood chutes: <b>2</b> Avulsion: <b>0</b>	5.5 Straightening: <b>Straightening</b>
Point: <b>0</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts Head Cuts: <b>0</b>	Straightening Length (ft.): <b>646</b>
Side: <b>9</b> Braiding: <b>0</b>	Steep Riffles: <b>1</b> Trib Rejuv.: <b>No</b>	5.5 Dredging: <b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:		
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection		
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:		
Habitat Rating:				
Habitat Stream Condition:				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		<b>3</b>	<b>C to F</b>	<b>Yes</b>	Geomorphic Rating	<b>0.35</b>
7.2 Channel Aggradation		<b>11</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>8</b>		<b>Yes</b>	Channel Evolution Stage	<b>III</b>
7.4 Change in Planform		<b>6</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>28</b>			Stream Sensitivity	<b>Extreme</b>



Phase 2 Segment Summary Report West Branch Little River

Stream:	<b>Big Spruce Brook</b>	SGAT Version:	<b>4.56</b>
Reach:	<b>M08.S1.01-B</b>	Organization:	<b>Bear Creek Environmental</b>
Segment Length(ft):	<b>600</b>	Observers:	<b>CS, PD, SP</b>
Rain:	<b>Yes</b>	Completion Date:	<b>6/20/2008</b>
		Quality Control Status - Consultant:	<b>Provisional</b>
		Quality Control Status - Staff:	<b>Provisional</b>

Step 0 - Location: **Segment begins just upstream of bridge for driveway to dormitory and continues 600 feet to just downstream of tributary confluence.**

Step 5 - Notes: **Bridge that is floodprone constriction in this segment is a wooden foodbridge with wooden footers. We did not conduct a full bridge and culvert survey on this structure since it is not a permanent structure, but it is acting as a floodprone constriction although there were no noted problems associated with it.**

**Downstream end of segment (where parking lot runs along LB) is more entrenched. Parking area may have been filled in and river may have had old channels or floodchutes on LB terrace and where parking area is located. The lower end of this segment is more of a transitional area from riffle pool to step pool bedform.**

**There is one large mass failure on the RB, also construction activities upstream of segment may be contributing fines to Big Spruce. One large bedrock grade control (waterfall) at upstream end of reach (just DS of confluence with Little Spruce) not a constriction.**

**Segment is in late stage III... we did not observe a well developed bench (as was seen in upstream reach) and there were some areas of minor erosion and a large mass failure.**

**Although bankfull width was much wider than phase 1 width, w/d ratio was low and widening score was rated in good. May just be that high altitude mountain streams are not as easily defined by regional curve? Phase 2 channel width was used to determine phase 2 confinement type because of the uncertainty associated with reference channel width.**

Step 7 - Narrative: **Major historic degradation, minor aggradation, widening and planform adjustment.**

Step 1. Valley and Floodplain

1.1 Segmentation: <b>Channel Dimensions</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Extr.Steep</b>	<b>Extr.Steep</b>	Valley Width (ft): <b>98</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Never</b>	<b>Sometimes</b>	Width Determination: <b>Measured</b>
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Never</b>	<b>Sometimes</b>	Confinement Type: <b>NW</b>
Berm: <b>0</b> <b>0</b>	Texture:	<b>N.E.</b>	<b>N.E.</b>	In Rock Gorge: <b>No</b>
Road: <b>0</b> <b>0</b>				Human Caused Change in Valley Width?: <b>Yes</b>
Railroad: <b>0</b> <b>0</b>				
Imp. Path: <b>0</b> <b>0</b>				
Dev.: <b>154</b> <b>0</b>				

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
Ledge	Mid-segment	11.0	9.0	Yes	



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **Big Spruce Brook**      Reach: **M08.S1.01-B**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>22.00</b>	2.11 Riffle/Step Spacing:	<b>55 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>2.20</b>	2.12 Substrate Composition		Bed:	<b>13 inches</b>
2.3 Mean Depth (ft.):	<b>1.63</b>	Bedrock:	<b>0.0 %</b>	Bar:	<b>8 inches</b>
2.4 Floodprone Width (ft.):	<b>105.00</b>	Boulder:	<b>10.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>3.70</b>	Cobble:	<b>27.0 %</b>	Stream Type:	<b>C</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	<b>39.0 %</b>	Bed Material:	<b>Gravel</b>
2.6 Width/Depth Ratio:	<b>13.50</b>	Fine Gravel:	<b>16.0 %</b>	Subclass Slope:	<b>b</b>
2.7 Entrenchment Ratio:	<b>4.77</b>	Sand:	<b>8.0 %</b>	Bed Form:	<b>Step-Pool</b>
2.8 Incision Ratio:	<b>1.68</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	<b>No</b>	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Low</b>	Detritus:	<b>5.0 %</b>	Reference Stream Type:	
2.10 Riffles Type:	<b>Complete</b>	# Large Woody Debris:	<b>22</b>	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope:	<b>Steep</b>				
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>98.9</b>	<b>14.3</b>	Dominant:	<b>Deciduous</b>	<b>Deciduous</b>
Material Type:	<b>Sand</b>	<b>Sand</b>	Erosion Height (ft.):	<b>5.3</b>	<b>10.0</b>	Sub-dominant:	<b>Herbaceous</b>	<b>Herbaceous</b>
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>	Revetment Type:	<b>Rip-Rap</b>	<b>Rip-Rap</b>	Bank Canopy		
Lower			Revetment Length:	<b>252.1</b>	<b>28.1</b>	Canopy %:	<b>51-75</b>	<b>76-100</b>
Material Type:	<b>Gravel</b>	<b>Gravel</b>				Mid-Channel Canopy:	<b>Closed</b>	
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>						

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	<b>&gt;100</b>	<b>&gt;100</b>
Sub-Dominant	<b>0-25</b>	<b>None</b>
W less than 25	<b>189</b>	<b>5</b>
Buffer Vegetation Type		
Dominant	<b>Deciduous</b>	<b>Deciduous</b>
Sub-Dominant	<b>Herbaceous</b>	<b>Herbaceous</b>

#### 3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	Mass Failures	<u>Left</u>	<u>Right</u>
Dominant	<b>Forest</b>	<b>Forest</b>	Height		<b>58.48</b>
Sub-dominant	<b>Residential</b>	<b>None</b>	Gullies Number	<b>0</b>	
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Length	<b>0</b>	
Failures	<b>One</b>	<b>40.0</b>			
Gullies	<b>None</b>				



### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **Big Spruce Brook**

Reach: **M08.S1.01-B**

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Minimal</b>	4.5 Flow Regulation Type <b>None</b>	4.7 Stormwater Inputs
4.2 Adjacent Wetlands: <b>None</b>	Flow Reg. Use:	Field Ditch: <b>0</b> Road Ditch: <b>1</b>
4.3 Flow Status: <b>Moderate</b>	Impoundments:	Other: <b>0</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams: <b>1</b>	Impoundment Loc.:	Overland Flow: <b>0</b> Urb Strm Wtr Pipe: <b>0</b>
	4.6 Up/Down Strm flow reg.: <b>None</b>	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.:	Affected Length (ft): <b>0</b>

#### 4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Bridge	24	Yes	No	No	Yes	None

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>0</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: <b>2</b>	Delta: <b>0</b>	Flood chutes: <b>2</b>	Avulsion: <b>0</b>	5.5 Straightening: <b>Straightening</b>
Point: <b>1</b>	Island: <b>0</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>0</b>	Straightening Length (ft.): <b>190</b>
Side: <b>8</b>	Braiding: <b>0</b>	Steep Riffles: <b>0</b>	Trib Rejuv.: <b>No</b>	5.5 Dredging: <b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:		
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection		
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:		
Habitat Rating:				
Habitat Stream Condition:				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		<b>8</b>	<b>None</b>	<b>Yes</b>	Geomorphic Rating	<b>0.55</b>
7.2 Channel Aggradation		<b>11</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>12</b>		<b>No</b>	Channel Evolution Stage	<b>III</b>
7.4 Change in Planform		<b>13</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>44</b>			Stream Sensitivity	<b>Very High</b>



Phase 2 Segment Summary Report **West Branch Little River**

Stream:	<b>Big Spruce Brook</b>	SGAT Version:	<b>4.56</b>
Reach:	<b>M08.S1.02-A</b>	Organization:	<b>Bear Creek Environmental</b>
Segment Length(ft):	<b>1,255</b>	Observers:	<b>MN, GA</b>
Rain:	<b>No</b>	Completion Date:	<b>6/20/2008</b>
		Quality Control Status - Consultant:	<b>Provisional</b>
		Quality Control Status - Staff:	<b>Provisional</b>

Step 0 - Location: **Segment begins just downstream of tributary M08S1.02S1 just upstream of a bedrock grade control and continues for about 1255 feet.**

Step 5 - Notes: **Bankfull width is approximately two times the reference channel width from the VT hydraulic geometry curves. The channel dimensions are most likely due to precipitation patterns. Mount Mansfield annual precipitation averages over 78 inches. Precipitation increases with elevation at about 1 inch over 1,000 feet of elevation. Mount Mounsfeld receives more precipitation than most areas of the state. An orthographic effect often occurs on Mount Mansfield. Phase 2 channel width was used to determine phase 2 confinement type because of the uncertainty associated with reference channel width. Segment A is less entrenched than the upper segment "B".**

Step 7 - Narrative: **major historic degradation, minor aggradation, planform adjustment & minor widening.**

**Step 1. Valley and Floodplain**

1.1 Segmentation: <b>Valley Width</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Very Steep</b>	<b>Steep</b>	Valley Width (ft): <b>202</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Sometimes</b>	<b>Never</b>	Width Determination: <b>Measured</b>
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Sometimes</b>	<b>Never</b>	Confinement Type: <b>BD</b>
Berm: <b>0</b> <b>0</b>	Texture:	<b>N.E.</b>	<b>N.E.</b>	In Rock Gorge: <b>No</b>
Road: <b>0</b> <b>0</b>				Human Caused Change in Valley Width?: <b>No</b>
Railroad: <b>0</b> <b>0</b>				
Imp. Path: <b>0</b> <b>0</b>				
Dev.: <b>0</b> <b>0</b>				

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
<b>Waterfall</b>	<b>Mid-segment</b>	<b>8.0</b>	<b>6.0</b>	<b>Yes</b>	



### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **Big Spruce Brook**      Reach: **M08.S1.02-A**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>26.00</b>	2.11 Riffle/Step Spacing:	<b>100 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>2.20</b>	2.12 Substrate Composition		Bed:	<b>13 inches</b>
2.3 Mean Depth (ft):	<b>1.39</b>	Bedrock:	<b>0.0 %</b>	Bar:	<b>11 inches</b>
2.4 Floodprone Width (ft.):	<b>115.00</b>	Boulder:	<b>13.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>3.70</b>	Cobble:	<b>30.0 %</b>	Stream Type:	<b>C</b>
Human Elev FloodPIn (ft.):		Coarse Gravel:	<b>34.0 %</b>	Bed Material:	<b>Gravel</b>
2.6 Width/Depth Ratio:	<b>18.71</b>	Fine Gravel:	<b>21.0 %</b>	Subclass Slope:	<b>b</b>
2.7 Entrenchment Ratio:	<b>4.42</b>	Sand:	<b>2.0 %</b>	Bed Form:	<b>Step-Pool</b>
2.8 Incision Ratio:	<b>1.68</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	<b>No</b>	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Low</b>	Detritus:	<b>%</b>	Reference Stream Type:	
2.10 Riffles Type:	<b>Complete</b>	# Large Woody Debris:	<b>35</b>	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

#### Step 3. Riparian Features

3.1 Stream Banks				Typical Bank Slope:	<b>Steep</b>	
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>0.0</b>	<b>43.1</b>	
Material Type:	<b>Sand</b>	<b>Sand</b>	Erosion Height (ft.):	<b>0.0</b>	<b>4.0</b>	
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>	Revetment Type:	<b>None</b>	<b>None</b>	
Lower			Revetment Length:	<b>0.0</b>	<b>0.0</b>	
Material Type:	<b>Boulder/Cobbles</b>	<b>Boulder/Cobbles</b>				
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>				
				Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
				Dominant:	<b>Deciduous</b>	<b>Deciduous</b>
				Sub-dominant:	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>
				Bank Canopy		
				Canopy %:	<b>76-100</b>	<b>76-100</b>
				Mid-Channel Canopy:	<b>Closed</b>	

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>	Corridor Land
Dominant	<b>&gt;100</b>	<b>&gt;100</b>	Dominant
Sub-Dominant	<b>None</b>	<b>None</b>	Sub-dominant
W less than 25	<b>0</b>	<b>38</b>	(Legacy)
Buffer Vegetation Type			Failures
Dominant	<b>Deciduous</b>	<b>Deciduous</b>	Gullies
Sub-Dominant	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>	

#### 3.3 Riparian Corridor

	<u>Left</u>	<u>Right</u>		<u>Left</u>	<u>Right</u>
Dominant	<b>Forest</b>	<b>Forest</b>	Mass Failures		
Sub-Dominant	<b>None</b>	<b>Commercial</b>	Height		
W less than 25	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	<b>0</b>	
Buffer Vegetation Type			Gullies Length	<b>0</b>	
Dominant	<b>None</b>				
Sub-Dominant	<b>None</b>				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **Big Spruce Brook**

Reach: **M08.S1.02-A**

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Abundant</b>	4.5 Flow Regulation Type <b>None</b>	4.7 Stormwater Inputs <b>None</b>
4.2 Adjacent Wetlands: <b>Minimal</b>	Flow Reg. Use:	Field Ditch: Road Ditch:
4.3 Flow Status: <b>Moderate</b>	Impoundments:	Other: Tile Drain:
4.4 # of Debris Jams: <b>1</b>	Impoundment Loc.:	Overland Flow: Urb Strm Wtr Pipe:
	4.6 Up/Down Strm flow reg.: <b>None</b>	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.:	Affected Length (ft): <b>0</b>

#### 4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Bridge		Yes	No	No	No	Deposition Above, Scour Below
Bridge		Yes	Yes	No	No	None
Bedrock Outcrops	8	Yes	No	Yes	No	Scour Below

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types Diagonal: <b>0</b>	5.2 Other Features Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: <b>3</b> Delta: <b>0</b>	Flood chutes: <b>1</b> Avulsion: <b>0</b>	5.5 Straightening: <b>None</b>
Point: <b>0</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts Head Cuts: <b>0</b>	Straightening Length (ft.): <b>0</b>
Side: <b>10</b> Braiding: <b>0</b>	Steep Riffles: <b>0</b> Trib Rejuv.: <b>No</b>	5.5 Dredging: <b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:		
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection		
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:		
Habitat Rating:				
Habitat Stream Condition:				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		<b>10</b>	<b>None</b>	<b>Yes</b>	Geomorphic Rating	<b>0.61</b>
7.2 Channel Aggradation		<b>13</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>12</b>		<b>No</b>	Channel Evolution Stage	<b>III</b>
7.4 Change in Planform		<b>14</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>49</b>			Stream Sensitivity	<b>Very High</b>



Phase 2 Segment Summary Report **West Branch Little River**

Stream:	<b>Big Spruce Brook</b>	SGAT Version:	<b>4.56</b>
Reach:	<b>M08.S1.02-B</b>	Organization:	<b>Bear Creek Environmental</b>
Segment Length(ft):	<b>580</b>	Observers:	<b>MN, GA</b>
Rain:	<b>Yes</b>	Completion Date:	<b>6/24/2008</b>
		Quality Control Status - Consultant:	<b>Provisional</b>
		Quality Control Status - Staff:	<b>Provisional</b>

Step 0 - Location: **Segment begins 580 feet downstream of end of reach.**

Step 5 - Notes: **The RAF was not readily apparent in the field. We used our knowledge of the RAF from the lower segment to determine RAF in Segment B. We speculated that this segment had also incised historically. We originally thought this segment was in Stage F-IV in the field because the channel width was wider than reference (ie. channel had already narrowed). There was very little erosion. Given our uncertainty about the reference channel width, we are unsure of the channel has already widened. The RGA resulted in a score of 0.66, which on the cusp between "good" and "fair". Phase 2 channel width was used to determine phase 2 confinement type.**

Step 7 - Narrative: **Minor aggradation, planform adjustment, and widening and historic minor degradation. Speculation that has incised historically (given historic land use and incision noted below - likely has). Stream channel is wide and will narrow as it approaches stage V.**

**Step 1. Valley and Floodplain**

1.1 Segmentation: <b>Valley Width</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Very Steep</b>	<b>Very Steep</b>	Valley Width (ft): <b>98</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Always</b>	<b>Sometimes</b>	Width Determination: <b>Measured</b>
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Always</b>	<b>Sometimes</b>	Confinement Type: <b>NW</b>
Berm: <b>0</b> <b>0</b>	Texture:	<b>Gravel</b>	<b>Gravel</b>	In Rock Gorge: <b>No</b>
Road: <b>0</b> <b>0</b>				Human Caused Change in Valley Width?: <b>No</b>
Railroad: <b>0</b> <b>0</b>				
Imp. Path: <b>0</b> <b>0</b>				
Dev.: <b>0</b> <b>0</b>				
1.6 Grade Controls: <b>None</b>				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **Big Spruce Brook**      Reach: **M08.S1.02-B**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>24.50</b>	2.11 Riffle/Step Spacing:	<b>64 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>3.10</b>	2.12 Substrate Composition		Bed:	<b>10 inches</b>
2.3 Mean Depth (ft.):	<b>1.90</b>	Bedrock:	<b>1.0 %</b>	Bar:	<b>7 inches</b>
2.4 Floodprone Width (ft.):	<b>37.70</b>	Boulder:	<b>22.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>4.25</b>	Cobble:	<b>32.0 %</b>	Stream Type:	<b>B</b>
Human Elev FloodPIn (ft.):		Coarse Gravel:	<b>16.0 %</b>	Bed Material:	<b>Cobble</b>
2.6 Width/Depth Ratio:	<b>12.89</b>	Fine Gravel:	<b>14.0 %</b>	Subclass Slope:	<b>a</b>
2.7 Entrenchment Ratio:	<b>1.54</b>	Sand:	<b>15.0 %</b>	Bed Form:	<b>Step-Pool</b>
2.8 Incision Ratio:	<b>1.37</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	<b>No</b>	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Low</b>	Detritus:	<b>0.0 %</b>	Reference Stream Type:	<b>B</b>
2.10 Riffles Type:	<b>Complete</b>	# Large Woody Debris:	<b>22</b>	Reference Bed Material:	<b>Cobble</b>
				Reference Subclass Slope:	<b>a</b>
				Reference Bedform:	<b>Step-Pool</b>

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope:	<b>Steep</b>	
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>0.0</b>	<b>44.6</b>
Material Type:	<b>Gravel</b>	<b>Gravel</b>	Erosion Height (ft.):	<b>0.0</b>	<b>5.0</b>
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>	Revetment Type:	<b>None</b>	<b>None</b>
Lower			Revetment Length:	<b>0.0</b>	<b>0.0</b>
Material Type:	<b>Boulder/Cobbles</b>	<b>Boulder/Cobbles</b>			
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>			
			Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
			Dominant:	<b>Deciduous</b>	<b>Deciduous</b>
			Sub-dominant:	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>
			Bank Canopy		
			Canopy %:	<b>76-100</b>	<b>76-100</b>
			Mid-Channel Canopy:	<b>Closed</b>	

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>	Corridor Land
Dominant	<b>&gt;100</b>	<b>&gt;100</b>	Dominant
Sub-Dominant	<b>None</b>	<b>None</b>	Sub-dominant
W less than 25	<b>0</b>	<b>0</b>	(Legacy)
Buffer Vegetation Type			Failures
Dominant	<b>Deciduous</b>	<b>Deciduous</b>	Gullies
Sub-Dominant	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>	

#### 3.3 Riparian Corridor

	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Forest</b>	<b>Forest</b>	Mass Failures	<b>42.44</b>
Sub-Dominant	<b>None</b>	<b>None</b>	Height	<b>35.0</b>
W less than 25	<b>0</b>	<b>0</b>	Gullies Number	<b>0</b>
Buffer Vegetation Type			Gullies Length	<b>0</b>
Dominant	<b>Deciduous</b>	<b>Deciduous</b>		
Sub-Dominant	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>		



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **Big Spruce Brook**

Reach: **M08.S1.02-B**

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps:	<b>Abundant</b>	4.5 Flow Regulation Type	<b>None</b>	4.7 Stormwater Inputs	<b>None</b>
4.2 Adjacent Wetlands:	<b>None</b>	Flow Reg. Use:		Field Ditch:	Road Ditch:
4.3 Flow Status:	<b>Moderate</b>	Impoundments:		Other:	Tile Drain:
4.4 # of Debris Jams:	<b>1</b>	Impoundment Loc.:		Overland Flow:	Urb Strm Wtr Pipe:
4.8 Channel Constrictions:	<b>None</b>	4.6 Up/Down Strm flow reg.:	<b>None</b>	4.9 # of Beaver Dams:	<b>0</b>
		(old) Upstrm Flow Reg.:		Affected Length (ft):	<b>0</b>

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>0</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing:	<b>No</b>
Mid:	<b>2</b>	Flood chutes:	<b>1</b>	5.5 Straightening:	<b>None</b>
Point:	<b>0</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>0</b>	Straightening Length (ft.):	<b>0</b>
Side:	<b>4</b>	Steep Riffles:	<b>0</b>	5.5 Dredging:	<b>None</b>
Braiding:	<b>0</b>	Trib Rejuv.:	<b>No</b>		

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:		
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection		
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:		
Habitat Rating:				
Habitat Stream Condition:				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	<b>Unconfined</b>	<u>Score</u>	<u>STD</u>	<u>Historic</u>		
7.1 Channel Degradation		<b>13</b>	<b>None</b>	<b>Yes</b>	Geomorphic Rating	<b>0.66</b>
7.2 Channel Aggradation		<b>13</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>13</b>		<b>No</b>	Channel Evolution Stage	<b>IV</b>
7.4 Change in Planform		<b>14</b>		<b>No</b>	Geomorphic Condition	<b>Good</b>
Total Score		<b>53</b>			Stream Sensitivity	<b>Moderate</b>



Phase 2 Segment Summary Report West Branch Little River

Stream:	Big Spruce Brook	SGAT Version:	4.56
Reach:	M08.S1.03-A	Organization:	Bear Creek Environmental
Segment Length(ft):	1,564	Observers:	MN, PD
Rain:	Yes	Completion Date:	9/29/2008
		Quality Control Status - Consultant:	Provisional
		Quality Control Status - Staff:	Provisional

Step 0 - Location: Segment begins about 430 feet downstream of wide span bridge and continues until just upstream of culvert crossing where valley broadens.

Step 5 - Notes: Substrate is covered by iron oxide precipitate. Good vegetation is holding the banks. Not much bank erosion. Bankfull channel width is 2.5 times the reference channel width. The cross sectional area is high relative to the other Big Spruce segments. Width to depth ratio is low. The bankfull elevation may have been identified as too high in the field; however, a review of the cross section indicates bankfull is at an appropriate change in slope within the cross section. Even is the bankfull is lowered one foot, the width to depth ratio is still low.

There is a wide span bridge in this segment that is not a floodprone or channel constriction.

Circa 2005, a free fall culvert was replaced with a large span bridge. As part of this project, the banks were rebuilt and a step-pool channel was constructed after the the culvert was removed and the bridge was installed. Rocks were placed along the bank; however, the amount of rock on the bank is not much different than the natural channel. This upstream and downstream channel is naturally straight, and this section was not indexed as straightened.

Phase 2 channel width was used to determine phase 2 confinement type because of the uncertainty associated with reference channel width (see phase 1 step 7).

Step 7 - Narrative: Major historic degradation; major aggradation & minor planform adjustment. Good vegetation is holding the banks - not much bank erosion.

Step 1. Valley and Floodplain

1.1 Segmentation: Channel Dimensions	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: None	Hillside Slope:	Extr.Steep	Extr.Steep	Valley Width (ft): 65
1.3 Corridor Encroachments:	Continuous w/ Bank:	Sometimes	Sometimes	Width Determination: Measured
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	Sometimes	Sometimes	Confinement Type: SC
Berm: 0 0	Texture:	Sand	Sand	In Rock Gorge: No
Road: 559 0 87 0				Human Caused Change in Valley Width?: No
Railroad: 0 0				
Imp. Path: 0 0				
Dev.: 0 0				

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
Dam	Mid-segment	2.0	2.0	Yes	





### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **Big Spruce Brook**

Reach: **M08.S1.03-A**

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps:	<b>Abundant</b>	4.5 Flow Regulation Type	<b>None</b>	4.7 Stormwater Inputs	
4.2 Adjacent Wetlands:	<b>None</b>	Flow Reg. Use:		Field Ditch:	<b>0</b> Road Ditch: <b>0</b>
4.3 Flow Status:	<b>Moderate</b>	Impoundments:		Other:	<b>1</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams:	<b>0</b>	Impoundment Loc.:		Overland Flow:	<b>0</b> Urb Strm Wtr Pipe: <b>0</b>
		4.6 Up/Down Strm flow reg.:	<b>None</b>	4.9 # of Beaver Dams:	<b>0</b>
		(old) Upstrm Flow Reg.:		Affected Length (ft):	<b>0</b>

#### 4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
<b>Bridge</b>				<b>No</b>	<b>No</b>	

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>0</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing:	<b>No</b>
Mid:	<b>2</b> Delta: <b>0</b>	Flood chutes: <b>2</b>	Avulsion: <b>0</b>	5.5 Straightening:	<b>None</b>
Point:	<b>0</b> Island: <b>2</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>0</b>	Straightening Length (ft.):	<b>0</b>
Side:	<b>6</b> Braiding: <b>0</b>	Steep Riffles: <b>0</b>	Trib Rejuv.: <b>No</b>	5.5 Dredging:	<b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	<b>0</b>	6.4 Sediment Deposition:	<b>0</b>	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	<b>0</b>	6.5 Channel Flow Status:	<b>0</b>	6.8 Bank Stability:	<b>0</b>	<b>0</b>
6.3 Pool Variability:	<b>0</b>	6.6 Channel Alteration:	<b>0</b>	6.9 Bank Vegetation Protection	<b>0</b>	<b>0</b>
Total Score:	<b>0</b>	6.7 Channel Sinuosity:	<b>0</b>	6.10 Riparian Veg. Zone Width:	<b>0</b>	<b>0</b>
Habitat Rating:	<b>0.00</b>					
Habitat Stream Condition:	<b>Fair</b>					

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Confined	Score	STD	Historic		
7.1 Channel Degradation		<b>9</b>	<b>None</b>	<b>Yes</b>	Geomorphic Rating	<b>0.59</b>
7.2 Channel Aggradation		<b>10</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>16</b>		<b>No</b>	Channel Evolution Stage	<b>III</b>
7.4 Change in Planform		<b>12</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>47</b>			Stream Sensitivity	<b>High</b>



**Phase 2 Segment Summary Report West Branch Little River**

Stream:	<b>Big Spruce Brook</b>	SGAT Version:	<b>4.56</b>
Reach:	<b>M08.S1.03-B</b>	Organization:	<b>Bear Creek Environmental</b>
Segment Length(ft):	<b>1,170</b>	Observers:	<b>MN, GA, PD</b>
Rain:	<b>Yes</b>	Completion Date:	<b>9/29/2008</b>
		Quality Control Status - Consultant:	<b>Provisional</b>
		Quality Control Status - Staff:	<b>Provisional</b>

Step 0 - Location: **Segment begins just upstream of in-stream culvert and continues until about 420 feet upstream of trib (M08S1.03S1) confluence.**

Step 5 - Notes: **Reach has experienced a stream type departure C-F. Major incision and active headcuts in reach.**

**Phase 2 channel width was used to determine phase 2 confinement type because of the uncertainty associated with reference channel width (see phase 1 step 7).**

Step 7 - Narrative: **Historic and active incision (2 active headcuts). Major widening (considerable erosion) & major planform adjustment (multiple islands & MCBs, some flood chutes). "F" stream type.**

**Step 1. Valley and Floodplain**

1.1 Segmentation: <b>Valley Width</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Steep</b>	<b>Very Steep</b>	Valley Width (ft): <b>179</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Sometimes</b>	<b>Never</b>	Width Determination: <b>Measured</b>
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Sometimes</b>	<b>Never</b>	Confinement Type: <b>BD</b>
Berm: <b>0</b> <b>0</b>	Texture:	<b>N.E.</b>	<b>N.E.</b>	In Rock Gorge: <b>No</b>
Road: <b>0</b> <b>5</b> <b>0</b>				Human Caused Change in Valley Width?: <b>No</b>
Railroad: <b>0</b> <b>0</b>				
Imp. Path: <b>0</b> <b>0</b>				
Dev.: <b>0</b> <b>0</b>				

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
Ledge	Mid-segment	4.0	3.0	Yes	
Ledge	Mid-segment	4.0	3.0	Yes	
Ledge	Mid-segment	4.0	3.0	Yes	
Ledge	Mid-segment	4.0	3.0	Yes	
Ledge	Mid-segment	13.0	10.0	Yes	



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **Big Spruce Brook**      Reach: **M08.S1.03-B**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>27.50</b>	2.11 Riffle/Step Spacing:	<b>98 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>2.10</b>	2.12 Substrate Composition		Bed:	<b>12.8 inches</b>
2.3 Mean Depth (ft.):	<b>1.65</b>	Bedrock:	<b>7.0 %</b>	Bar:	<b>3 inches</b>
2.4 Floodprone Width (ft.):	<b>35.60</b>	Boulder:	<b>13.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>9.40</b>	Cobble:	<b>23.0 %</b>	Stream Type:	<b>F</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	<b>35.0 %</b>	Bed Material:	<b>Gravel</b>
2.6 Width/Depth Ratio:	<b>16.67</b>	Fine Gravel:	<b>18.0 %</b>	Subclass Slope:	<b>a</b>
2.7 Entrenchment Ratio:	<b>1.29</b>	Sand:	<b>4.0 %</b>	Bed Form:	<b>Step-Pool</b>
2.8 Incision Ratio:	<b>4.48</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	<b>No</b>	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Low</b>	Detritus:	<b>0.0 %</b>	Reference Stream Type:	
2.10 Riffles Type:	<b>Eroded</b>	# Large Woody Debris:	<b>195</b>	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope:	<b>Steep</b>				
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>275.6</b>	<b>667.6</b>	Dominant:	<b>Deciduous</b>	<b>Deciduous</b>
Material Type:	<b>Sand</b>	<b>Sand</b>	Erosion Height (ft.):	<b>4.2</b>	<b>5.9</b>	Sub-dominant:	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>	Revetment Type:	<b>None</b>	<b>Rip-Rap</b>	Bank Canopy		
Lower			Revetment Length:	<b>0.0</b>	<b>62.1</b>	Canopy %:	<b>76-100</b>	<b>76-100</b>
Material Type:	<b>Gravel</b>	<b>Gravel</b>				Mid-Channel Canopy:	<b>Closed</b>	
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>						

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>	Corridor Land
Dominant	<b>&gt;100</b>	<b>0-25</b>	Dominant
Sub-Dominant	<b>None</b>	<b>&gt;100</b>	Sub-dominant
W less than 25	<b>0</b>	<b>803</b>	(Legacy)
Buffer Vegetation Type			Failures
Dominant	<b>Deciduous</b>	<b>Herbaceous</b>	Gullies
Sub-Dominant	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>	

#### 3.3 Riparian Corridor

	<u>Left</u>	<u>Right</u>		<u>Left</u>	<u>Right</u>
Dominant	<b>Forest</b>	<b>Commercial</b>	Mass Failures		
Sub-Dominant	<b>None</b>	<b>Forest</b>	Height		
W less than 25	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	<b>0</b>	
Buffer Vegetation Type			Gullies Length	<b>0</b>	
Dominant	<b>None</b>				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **Big Spruce Brook**

Reach: **M08.S1.03-B**

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Abundant</b>	4.5 Flow Regulation Type <b>None</b>	4.7 Stormwater Inputs
4.2 Adjacent Wetlands: <b>None</b>	Flow Reg. Use:	Field Ditch: <b>0</b> Road Ditch: <b>1</b>
4.3 Flow Status: <b>Moderate</b>	Impoundments:	Other: <b>0</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams: <b>2</b>	Impoundment Loc.:	Overland Flow: <b>0</b> Urb Strm Wtr Pipe: <b>0</b>
	4.6 Up/Down Strm flow reg.: <b>None</b>	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.:	Affected Length (ft): <b>0</b>

#### 4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Culvert	8	Yes	Yes	Yes	Yes	Deposition Above, Deposition Below, Scour Below
Bedrock Outcrops	7	Yes	Yes	Yes	Yes	Deposition Above, Deposition Below, Scour Below

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>0</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: <b>6</b>	Delta: <b>0</b>	Flood chutes: <b>3</b>	Avulsion: <b>0</b>	5.5 Straightening: <b>None</b>
Point: <b>0</b>	Island: <b>3</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>2</b>	Straightening Length (ft.): <b>0</b>
Side: <b>7</b>	Braiding: <b>0</b>	Steep Riffles: <b>1</b>	Trib Rejuv.: <b>Yes</b>	5.5 Dredging: <b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:		
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection		
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:		
Habitat Rating:				
Habitat Stream Condition:				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		<b>2</b>	<b>C to F</b>	<b>No</b>	Geomorphic Rating	<b>0.35</b>
7.2 Channel Aggradation		<b>12</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>7</b>		<b>No</b>	Channel Evolution Stage	<b>III</b>
7.4 Change in Planform		<b>7</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>28</b>			Stream Sensitivity	<b>Extreme</b>



Phase 2 Segment Summary Report West Branch Little River

Stream:	West Branch	SGAT Version:	4.56
Reach:	M09-A	Organization:	Bear Creek Environmental
Segment Length(ft):	2,200	Observers:	CS, PD
Rain:	Yes	Completion Date:	6/24/2008
		Quality Control Status - Consultant:	Provisional
		Quality Control Status - Staff:	Provisional

- Step 0 - Location: **Segment begins just upstream of Rt 108 bridge near the confluence with Big Spruce Brook and continues until just downstream of next bridge.**
- Step 5 - Notes: **Entrenchment seemed to vary as did floodplain access along segment. In general was entrenched due to Rt 108 running along left bank. Cross section is representative of overall dominant segment type. Areas w/floodplain access were short and not continuous, and were too localized to be further segmented. Segment silted up quickly during a downpour. STD due to road encroachment. Human caused incision, but road is now new valley wall, therefore it is not human elevated floodplain.**
- Step 7 - Narrative: **Major historic degradation due to road encroachment, minor aggradation, widening and planform.**

Step 1. Valley and Floodplain

1.1 Segmentation: <b>Channel Dimensions</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Extr.Steep</b>	<b>Extr.Steep</b>	Valley Width (ft): <b>130</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Never</b>	<b>Sometimes</b>	Width Determination: <b>Estimated</b>
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Sometimes</b>	<b>Sometimes</b>	Confinement Type: <b>NW</b>
Berm: <b>243</b> <b>0</b> <b>0</b>	Texture:	<b>N.E.</b>	<b>N.E.</b>	In Rock Gorge: <b>No</b>
Road: <b>1,106</b> <b>0</b> <b>0</b>				Human Caused Change in Valley Width?: <b>Yes</b>
Railroad: <b>0</b> <b>0</b>				
Imp. Path: <b>0</b> <b>0</b>				
Dev.: <b>0</b> <b>0</b>				
1.6 Grade Controls: <b>None</b>				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **West Branch**

Reach: **M09-A**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>32.00</b>	2.11 Riffle/Step Spacing:	<b>209 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>3.70</b>	2.12 Substrate Composition		Bed:	<b>17 inches</b>
2.3 Mean Depth (ft):	<b>2.50</b>	Bedrock:	<b>0.0 %</b>	Bar:	<b>15.5 inches</b>
2.4 Floodprone Width (ft.):	<b>47.10</b>	Boulder:	<b>13.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>7.60</b>	Cobble:	<b>37.0 %</b>	Stream Type:	<b>B</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	<b>32.0 %</b>	Bed Material:	<b>Cobble</b>
2.6 Width/Depth Ratio:	<b>12.80</b>	Fine Gravel:	<b>13.0 %</b>	Subclass Slope:	<b>None</b>
2.7 Entrenchment Ratio:	<b>1.47</b>	Sand:	<b>4.0 %</b>	Bed Form:	<b>Riffle-Pool</b>
2.8 Incision Ratio:	<b>2.05</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	<b>Yes</b>	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Low</b>	Detritus:	<b>0.0 %</b>	Reference Stream Type:	
2.10 Riffles Type:	<b>Eroded</b>	# Large Woody Debris:	<b>47</b>	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

#### Step 3. Riparian Features

3.1 Stream Banks				Typical Bank Slope:	<b>Steep</b>	
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>26.5</b>	<b>52.9</b>	
Material Type:	<b>Sand</b>	<b>Sand</b>	Erosion Height (ft.):	<b>4.0</b>	<b>5.0</b>	
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>	Revetment Type:	<b>Rip-Rap</b>	<b>None</b>	
Lower			Revetment Length:	<b>426.3</b>	<b>0.0</b>	
Material Type:	<b>Boulder/Cobbl</b>	<b>Boulder/Cobbl</b>				
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>				
				Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
				Dominant:	<b>Herbaceous</b>	<b>Deciduous</b>
				Sub-dominant:	<b>Deciduous</b>	<b>Herbaceous</b>
				Bank Canopy		
				Canopy %:	<b>51-75</b>	<b>76-100</b>
				Mid-Channel Canopy:	<b>Closed</b>	

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	<b>51-100</b>	<b>&gt;100</b>
Sub-Dominant	<b>0-25</b>	<b>None</b>
W less than 25	<b>722</b>	<b>0</b>
Buffer Vegetation Type		
Dominant	<b>Deciduous</b>	<b>Deciduous</b>
Sub-Dominant	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>

#### 3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	Mass Failures	<u>Left</u>	<u>Right</u>
Dominant	<b>Residential</b>	<b>Forest</b>	Height		<b>27.68</b>
Sub-dominant	<b>Forest</b>	<b>None</b>	Gullies Number	<b>0</b>	
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Length	<b>0</b>	
Failures	<b>One</b>	<b>66.0</b>			
Gullies	<b>None</b>				



# Stream Geomorphic Assessment

## Agency of Natural Resources

VT DEC

Vermont.gov

July, 10 2010

Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M09-A

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps:	<b>Abundant</b>	4.5 Flow Regulation Type	<b>None</b>	4.7 Stormwater Inputs	
4.2 Adjacent Wetlands:	<b>None</b>	Flow Reg. Use:		Field Ditch:	<b>0</b> Road Ditch: <b>1</b>
4.3 Flow Status:	<b>Moderate</b>	Impoundments:		Other:	<b>0</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams:	<b>0</b>	Impoundment Loc.:		Overland Flow:	<b>0</b> Urb Strm Wtr Pipe: <b>0</b>
		4.6 Up/Down Strm flow reg.:	<b>None</b>	4.9 # of Beaver Dams:	<b>0</b>
		(old) Upstrm Flow Reg.:		Affected Length (ft):	<b>0</b>
4.8 Channel Constrictions:	<b>None</b>				

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>0</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing:	<b>No</b>
Mid:	<b>0</b> Delta: <b>0</b>	Flood chutes:	<b>1</b> Avulsion: <b>0</b>	5.5 Straightening:	<b>Straightening</b>
Point:	<b>1</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>0</b>	Straightening Length (ft.):	<b>2,167</b>
Side:	<b>7</b> Braiding: <b>0</b>	Steep Riffles:	<b>0</b> Trib Rejuv.: <b>Yes</b>	5.5 Dredging:	<b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:		6.4 Sediment Deposition:		Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:		6.5 Channel Flow Status:		6.8 Bank Stability:		
6.3 Pool Variability:		6.6 Channel Alteration:		6.9 Bank Vegetation Protection		
Total Score:		6.7 Channel Sinuosity:		6.10 Riparian Veg. Zone Width:		
Habitat Rating:						
Habitat Stream Condition:						

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		<b>5</b>	<b>C to B</b>	<b>Yes</b>	Geomorphic Rating	<b>0.56</b>
7.2 Channel Aggradation		<b>13</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>13</b>		<b>No</b>	Channel Evolution Stage	<b>III</b>
7.4 Change in Planform		<b>14</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>45</b>			Stream Sensitivity	<b>High</b>



Phase 2 Segment Summary Report West Branch Little River

Stream:	West Branch	SGAT Version:	4.56
Reach:	M09-B	Organization:	Bear Creek Environmental
Segment Length(ft):	1,225	Observers:	CS, PD, MA
Rain:	Yes	Completion Date:	6/27/2008
		Quality Control Status - Consultant:	Provisional
		Quality Control Status - Staff:	Provisional

Step 0 - Location:

Step 5 - Notes: **Segment break at upstream end is where trib enters on RB. Confinement is more open than both upstream and downstream segments (phase 2 channel width was used to estimate phase 2 confinement type because of uncertainty associated with reference channel width) and stream is riffle pool in this segment. Mansfield parking area runs along right side of stream and has caused a change in channel confinement. The construction of the parking lot resulted in a human caused change in confinement. Stream may have been moved to its current location when the parking area was built and changed the lateral constraints of the channel.**

**Stream has good floodplain access for most of the segment on at least 1 bank. Sediment retention ponds discharge to West Branch in this segment in at least 2 locations, adds a lot of suspended sediment during storm events. We noticed the stream silt up immediately following a heavy downpour while we were in conducting the assessment in segment A (downstream of sediment ponds). We did not see the same situation while assessing segment C (upstream of sediment ponds) during a similar rain shower.**

Step 7 - Narrative: **Minor aggradation, widening and planform adjustment. Sediment retention ponds in segment (along Mansfield parking lot) input silt and fines to segment during storm events.**

Step 1. Valley and Floodplain

1.1 Segmentation: <b>Channel Dimensions</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Extr.Steep</b>	<b>Extr.Steep</b>	Valley Width (ft): <b>161</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Sometimes</b>	<b>Sometimes</b>	Width Determination: <b>Measured</b>
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Sometimes</b>	<b>Sometimes</b>	Confinement Type: <b>NW</b>
Berm: <b>0</b> <b>0</b> <b>0</b>	Texture:	<b>N.E.</b>	<b>N.E.</b>	In Rock Gorge: <b>No</b>
Road: <b>405</b> <b>0</b> <b>0</b>				Human Caused Change in Valley Width?: <b>Yes</b>
Railroad: <b>0</b> <b>0</b>				
Imp. Path: <b>0</b> <b>0</b>				
Dev.: <b>0</b> <b>0</b>				
1.6 Grade Controls: <b>None</b>				





# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 12 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **West Branch**

Reach: **M09-B**

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Minimal</b>	4.5 Flow Regulation Type <b>None</b>	4.7 Stormwater Inputs
4.2 Adjacent Wetlands: <b>None</b>	Flow Reg. Use:	Field Ditch: <b>0</b> Road Ditch: <b>1</b>
4.3 Flow Status: <b>Moderate</b>	Impoundments:	Other: <b>2</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams: <b>1</b>	Impoundment Loc.:	Overland Flow: <b>0</b> Urb Strm Wtr Pipe: <b>0</b>
	4.6 Up/Down Strm flow reg.: <b>None</b>	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.:	Affected Length (ft): <b>0</b>

4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
<b>Bridge</b>	<b>18.5</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Yes</b>	<b>Deposition Above,Alignment</b>

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>0</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: <b>0</b>	Delta: <b>0</b>	Flood chutes: <b>1</b>	Avulsion: <b>0</b>	5.5 Straightening: <b>Straightening</b>
Point: <b>2</b>	Island: <b>0</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>0</b>	Straightening Length (ft.): <b>1,080</b>
Side: <b>8</b>	Braiding: <b>0</b>	Steep Riffles: <b>0</b>	Trib Rejuv.: <b>No</b>	5.5 Dredging: <b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:		
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection		
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:		
Habitat Rating:				
Habitat Stream Condition:				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		<b>8</b>	<b>None</b>	<b>Yes</b>	Geomorphic Rating	<b>0.55</b>
7.2 Channel Aggradation		<b>11</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>12</b>		<b>No</b>	Channel Evolution Stage	<b>IV</b>
7.4 Change in Planforml		<b>13</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>44</b>			Stream Sensitivity	<b>Very High</b>



Phase 2 Segment Summary Report **West Branch Little River**

Stream:	<b>West Branch</b>	SGAT Version:	<b>4.56</b>
Reach:	<b>M09-C</b>	Organization:	<b>Bear Creek Environmental</b>
Segment Length(ft):	<b>800</b>	Observers:	<b>CS, MA</b>
Rain:	<b>Yes</b>	Completion Date:	<b>6/27/2008</b>
		Quality Control Status - Consultant:	<b>Provisional</b>
		Quality Control Status - Staff:	<b>Provisional</b>

Step 0 - Location: **Segment begins where reach begins to have more grade controls and continues for another 800 feet to just upstream from the Long Trail tributary confluence.**

Step 5 - Notes: **Segmented due to abundant grade controls in reach and more step-pool like conditions. VHD shows 2 tributaries entering the West Branch in segment. Only one trib enters. The other one has been re-routed to enter trib perhaps. Good floodplain access, little erosion. Bridge 108 in segment has significant scouring of wingwalls on upstream and downstream end.**

Step 7 - Narrative: **Minor aggradation, widening and planform.**

**Step 1. Valley and Floodplain**

1.1 Segmentation:	<b>Grade Controls</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan:	<b>None</b>	Hillside Slope:	<b>Extr.Steep</b>	<b>Steep</b>	Valley Width (ft): <b>130</b>
1.3 Corridor Encroachments:		Continuous w/ Bank:	<b>Sometimes</b>	<b>Never</b>	Width Determination: <b>Measured</b>
<u>Length (ft)</u>	<u>One</u>	<u>Height</u>	<u>Both</u>	<u>Height</u>	Within 1 Bankfull W: <b>Sometimes</b>
Berm:	<b>0</b>		<b>0</b>		Texture: <b>N.E.</b>
Road:	<b>326</b>		<b>0</b>		<b>N.E.</b>
Railroad:	<b>0</b>		<b>0</b>		In Rock Gorge: <b>No</b>
Imp. Path:	<b>0</b>		<b>0</b>		Human Caused Change in Valley Width?: <b>Yes</b>
Dev.:	<b>0</b>		<b>0</b>		

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
Ledge	Mid-segment	4.0	2.0	Yes	
Ledge	Mid-segment	4.0	2.0	Yes	
Ledge	Mid-segment	4.0	2.0	Yes	
Ledge	Mid-segment	3.0	2.0	Yes	
Ledge	Mid-segment	3.0	2.0	Yes	
Ledge	Mid-segment	5.0	3.0	Yes	
Ledge	Mid-segment	0.0	0.0	Yes	





# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: West Branch

Reach: M09-C

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Abundant</b>	4.5 Flow Regulation Type <b>None</b>	4.7 Stormwater Inputs <b>None</b>
4.2 Adjacent Wetlands: <b>None</b>	Flow Reg. Use:	Field Ditch: Road Ditch:
4.3 Flow Status: <b>Moderate</b>	Impoundments:	Other: Tile Drain:
4.4 # of Debris Jams: <b>1</b>	Impoundment Loc.:	Overland Flow: Urb Strm Wtr Pipe:
	4.6 Up/Down Strm flow reg.: <b>None</b>	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.:	Affected Length (ft): <b>0</b>

4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Bridge	11	Yes	Yes	Yes	Yes	Scour Below, Alignment

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types Diagonal: <b>0</b>	5.2 Other Features Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: <b>4</b> Delta: <b>0</b>	Flood chutes: <b>0</b>	Avulsion: <b>0</b>
Point: <b>0</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts Head Cuts: <b>0</b>	5.5 Straightening: <b>Straightening</b>
Side: <b>13</b> Braiding: <b>0</b>	Steep Riffles: <b>0</b>	Trib Rejuv.: <b>No</b>
		5.5 Straightening Length (ft.): <b>380</b>
		5.5 Dredging: <b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type: <u>Left</u> <u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:
Habitat Rating:		
Habitat Stream Condition:		

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		16	None	No	Geomorphic Rating	0.68
7.2 Channel Aggradation		12	None	No	Channel Evolution Model	D
7.3 Widening Channel		13		No	Channel Evolution Stage	IIc
7.4 Change in Planforml		13		No	Geomorphic Condition	Good
Total Score		54			Stream Sensitivity	Moderate



Phase 2 Segment Summary Report West Branch Little River

Stream:	NoName17	SGAT Version:	4.56
Reach:	M09.S4.01-0	Organization:	Bear Creek Environmental
Segment Length(ft):	1,623	Observers:	CS, MA
Rain:	Yes	Completion Date:	7/3/2008
		Quality Control Status - Consultant:	Provisional
		Quality Control Status - Staff:	Provisional

Step 0 - Location: Segment begins at confluence with another tributary that flows into the West Branch and continues 1623 feet.

Step 5 - Notes: Lower section of reach does not follow VHD layer. The stream has been re-routed to enter another tributary, which then flows into the West Branch. The lower culvert has wooden planks in place within culvert to trap sediment for habitat and reduce high velocities. Upper end of reach becomes more step-pool like and bedrock dominated. It is only a short amount of reach. Therefore, did not segment.  
6/25/10 - Mary Nealon revisited Longtrail tributary. The dominant bedform appears to be step-pool, although the lower part of the reach has some riffle-pool characteristics. The reach has good floodplain access up above and becomes more incised near straightened section. The section below the culvert (access road to Mansfield parking lot) has likely been relocated. There is a perched tributary in the location when the main channel likely was located at one point. A second cross section was assessed. This cross section was similar in terms of cross sectional area to the first cross section. The RAF was revised on the first cross section, and results in an incision ratio of 1.4. It appeared to be more incised than 1.4 below the culvert and less incised in the upper reach (good floodplain access). Phase 2 channel width was used to determine phase 2 confinement type because of the uncertainty associated with reference channel width (see phase 1 step 7).

Step 7 - Narrative: Channel evolution stage varied. Good floodplain access at upstream end or reach; middle portion of reach may be in stage F-IV. Lower portion when channel has been altered was incised and was likely in stage F-III. Major historic incision, major aggradation, minor widening (little bank erosion mapped, yet appeared incised) and minor planform adjustment.

**Step 1. Valley and Floodplain**

1.1 Segmentation:	None	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan:	None	Hillside Slope:	Steep	Steep	Valley Width (ft): 176
1.3 Corridor Encroachments:		Continuous w/ Bank:	Never	Sometimes	Width Determination: Estimated
<u>Length (ft)</u>	<u>One</u>	<u>Height</u>	<u>Both</u>	<u>Height</u>	Within 1 Bankfull W: Sometimes Sometimes
Berm:	0		0		Texture: N.E. N.E.
Road:	578	0	0		In Rock Gorge: No
Railroad:	0		0		Human Caused Change in Valley Width?: Yes
Imp. Path:	0		0		
Dev.:	594		0		

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
Weir	Mid-segment	1.0	1.0	Yes	
Ledge	Mid-segment	3.0	1.0	Yes	



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **NoName17** Reach: **M09.S4.01-0**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>24.00</b>	2.11 Riffle/Step Spacing:	<b>98 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>2.80</b>	2.12 Substrate Composition		Bed:	<b>13 inches</b>
2.3 Mean Depth (ft):	<b>1.94</b>	Bedrock:	<b>0.0 %</b>	Bar:	<b>11 inches</b>
2.4 Floodprone Width (ft.):	<b>115.70</b>	Boulder:	<b>17.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>3.80</b>	Cobble:	<b>44.0 %</b>	Stream Type:	<b>C</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	<b>31.0 %</b>	Bed Material:	<b>Cobble</b>
2.6 Width/Depth Ratio:	<b>12.37</b>	Fine Gravel:	<b>8.0 %</b>	Subclass Slope:	<b>b</b>
2.7 Entrenchment Ratio:	<b>4.82</b>	Sand:	<b>0.0 %</b>	Bed Form:	<b>Step-Pool</b>
2.8 Incision Ratio:	<b>1.36</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	<b>Yes</b>	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Low</b>	Detritus:	<b>0.0 %</b>	Reference Stream Type:	
2.10 Riffles Type:	<b>Complete</b>	# Large Woody Debris:	<b>42</b>	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope:	<b>Steep</b>				
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>52.0</b>	<b>67.7</b>	Dominant:	<b>Deciduous</b>	<b>Deciduous</b>
Material Type:	<b>Sand</b>	<b>Sand</b>	Erosion Height (ft.):	<b>3.4</b>	<b>5.3</b>	Sub-dominant:	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>	Revetment Type:	<b>Rip-Rap</b>	<b>Rip-Rap</b>	Bank Canopy		
Lower			Revetment Length:	<b>110.8</b>	<b>70.8</b>	Canopy %:	<b>76-100</b>	<b>76-100</b>
Material Type:	<b>Boulder/Cobbles</b>	<b>Boulder/Cobbles</b>				Mid-Channel Canopy:	<b>Closed</b>	
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>						

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>	Corridor Land
Dominant	<b>&gt;100</b>	<b>51-100</b>	Dominant
Sub-Dominant	<b>0-25</b>	<b>0-25</b>	Sub-dominant
W less than 25	<b>171</b>	<b>412</b>	(Legacy)
Buffer Vegetation Type			Failures
Dominant	<b>Deciduous</b>	<b>Deciduous</b>	Gullies
Sub-Dominant	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>	

#### 3.3 Riparian Corridor

	<u>Left</u>	<u>Right</u>		<u>Left</u>	<u>Right</u>
Dominant	<b>Forest</b>	<b>Commercial</b>	Mass Failures		
Sub-Dominant	<b>Commercial</b>	<b>Forest</b>	Height		
W less than 25	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	<b>0</b>	
Failures	<b>None</b>		Gullies Length	<b>0</b>	
Gullies	<b>None</b>				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: NoName17

Reach: M09.S4.01-0

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Abundant</b>	4.5 Flow Regulation Type <b>None</b>	4.7 Stormwater Inputs <b>None</b>
4.2 Adjacent Wetlands: <b>None</b>	Flow Reg. Use:	Field Ditch: Road Ditch:
4.3 Flow Status: <b>Moderate</b>	Impoundments:	Other: Tile Drain:
4.4 # of Debris Jams: <b>2</b>	Impoundment Loc.:	Overland Flow: Urb Strm Wtr Pipe:
	4.6 Up/Down Strm flow reg.: <b>None</b>	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.:	Affected Length (ft): <b>0</b>

4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Culvert	12	Yes	Yes	Yes	Yes	Deposition Above
Bridge	25	Yes	Yes	No	Yes	Deposition Below

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types Diagonal: <b>1</b>	5.2 Other Features Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: <b>3</b> Delta: <b>0</b>	Flood chutes: <b>0</b>	Avulsion: <b>0</b>
Point: <b>1</b> Island: <b>0</b>	5.3 Steep Riffles and Head Cuts Head Cuts: <b>0</b>	Straightening Length (ft.): <b>517</b>
Side: <b>6</b> Braiding: <b>0</b>	Steep Riffles: <b>1</b>	Trib Rejuv.: <b>No</b>
		5.5 Dredging: <b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:		
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection		
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:		
Habitat Rating:				
Habitat Stream Condition:				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		<b>8</b>	<b>None</b>	<b>Yes</b>	Geomorphic Rating	<b>0.55</b>
7.2 Channel Aggradation		<b>9</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>14</b>		<b>No</b>	Channel Evolution Stage	<b>IV</b>
7.4 Change in Planform		<b>13</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>44</b>			Stream Sensitivity	<b>High</b>



Phase 2 Segment Summary Report West Branch Little River

Stream:	NoName13	SGAT Version:	4.56
Reach:	M07.T5.01.S1.01-A	Organization:	Bear Creek Environmental
Segment Length(ft):	1,100	Observers:	PD, MA
Rain:	Yes	Completion Date:	7/30/2008
		Quality Control Status - Consultant:	Provisional
		Quality Control Status - Staff:	Provisional

Step 0 - Location: **Segment begins at a flood chute along Ranch Brook. The stream enters the flood chute and then flows into Ranch Brook. This segment continues upstream through a steep valley until the culvert at the cross country ski area along Rt 108.**

Step 5 - Notes: **At outlet, segment actually flows into flood chute of Ranch Brook and then enters Ranch Brook. Channel seems to have been very incised and widened (bankfull width is 2 times the reference width). Widening is continuing through bank erosion. Significant garbage within segment. Most of the segment has very steep slope, but towards the end, slope decreases and channel becomes slightly narrower. Segment break was made slightly further upstream at culvert because channel dimensions and valley width were most different upstream of culvert.**

**Bankfull indicators in this segment were difficult to discern given the excessive bank erosion and the entrenchment.**

Step 7 - Narrative: **Extreme historic degradation and major widening. Current widening through erosion of banks. Some aggradation and minor planform.**

Step 1. Valley and Floodplain

1.1 Segmentation: <b>Channel Dimensions</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Extr.Steep</b>	<b>Extr.Steep</b>	Valley Width (ft): <b>34</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Always</b>	<b>Sometimes</b>	Width Determination: <b>Measured</b>
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Always</b>	<b>Sometimes</b>	Confinement Type: <b>SC</b>
Berm: <b>0</b>	Texture:	<b>Sand</b>	<b>Sand</b>	In Rock Gorge: <b>No</b>
Road: <b>0</b>				Human Caused Change in Valley Width?: <b>No</b>
Railroad: <b>0</b>				
Imp. Path: <b>0</b>				
Dev.: <b>0</b>				
1.6 Grade Controls: <b>None</b>				





# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: NoName13

Reach: M07.T5.01.S1.01-A

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Minimal</b>	4.5 Flow Regulation Type <b>None</b>	4.7 Stormwater Inputs
4.2 Adjacent Wetlands: <b>None</b>	Flow Reg. Use:	Field Ditch: <b>0</b> Road Ditch: <b>1</b>
4.3 Flow Status: <b>Moderate</b>	Impoundments:	Other: <b>0</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams: <b>4</b>	Impoundment Loc.:	Overland Flow: <b>0</b> Urb Strm Wtr Pipe: <b>0</b>
	4.6 Up/Down Strm flow reg.: <b>None</b>	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.:	Affected Length (ft): <b>0</b>

#### 4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Culvert	5.3	Yes	Yes	Yes	Yes	Deposition Above, Deposition Below, Scour Below

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>0</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: <b>5</b>	Delta: <b>0</b>	Flood chutes: <b>2</b>	Avulsion: <b>0</b>	5.5 Straightening: <b>Straightening</b>
Point: <b>0</b>	Island: <b>0</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>0</b>	Straightening Length (ft.): <b>42</b>
Side: <b>5</b>	Braiding: <b>0</b>	Steep Riffles: <b>1</b>	Trib Rejuv.: <b>Yes</b>	5.5 Dredging: <b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:		
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection		
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:		
Habitat Rating:				
Habitat Stream Condition:				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Confined	Score	STD	Historic		
7.1 Channel Degradation		<b>6</b>	<b>B to F</b>	<b>Yes</b>	Geomorphic Rating	<b>0.51</b>
7.2 Channel Aggradation		<b>14</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>8</b>		<b>No</b>	Channel Evolution Stage	<b>III</b>
7.4 Change in Planform		<b>13</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>41</b>			Stream Sensitivity	<b>Extreme</b>



**Phase 2 Segment Summary Report West Branch Little River**

Stream:	NoName13	SGAT Version:	4.56
Reach:	M07.T5.01.S1.01-B	Organization:	Bear Creek Environmental
Segment Length(ft):	2,000	Observers:	PD, MA
Rain:	Yes	Completion Date:	7/30/2008
		Quality Control Status - Consultant:	Provisional
		Quality Control Status - Staff:	Provisional

Step 0 - Location: **Segment begins at culvert at the cross country ski center and continues for 2000 feet until the underground culvert at the Inn at the Mountain.**

Step 5 - Notes: **Entrenchment varies within segment. Segment begins where valley opens up and channel dimensions are clearly different than downstream of culvert. There is little buffer at beginning of segment and then it becomes mostly forested in corridor and difficult to determine valley walls. Very broad valley. Upstream portion of segment (just downstream of underground culvert system at the Inn at the Mountain) has iron bacteria covering substrate for about 300 feet of stream.**

Step 7 - Narrative: **Major historic incision, minor aggradation, widening and planform.**

**Step 1. Valley and Floodplain**

1.1 Segmentation: <b>Channel Dimensions</b>	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: <b>None</b>	Hillside Slope:	<b>Steep</b>	<b>Steep</b>	Valley Width (ft): <b>368</b>
1.3 Corridor Encroachments:	Continuous w/ Bank:	<b>Never</b>	<b>Never</b>	Width Determination: <b>Measured</b>
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	<b>Never</b>	<b>Never</b>	Confinement Type: <b>VB</b>
Berm: <b>0</b> <b>0</b>	Texture:	<b>N.E.</b>	<b>N.E.</b>	In Rock Gorge: <b>No</b>
Road: <b>0</b> <b>0</b>				Human Caused Change in Valley Width?: <b>No</b>
Railroad: <b>0</b> <b>0</b>				
Imp. Path: <b>0</b> <b>0</b>				
Dev.: <b>492</b> <b>0</b>				
1.6 Grade Controls: <b>None</b>				



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **NoName13** Reach: **M07.T5.01.S1.01-B**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>12.50</b>	2.11 Riffle/Step Spacing:	<b>177 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>1.80</b>	2.12 Substrate Composition		Bed:	<b>9.4 inches</b>
2.3 Mean Depth (ft):	<b>0.98</b>	Bedrock:	<b>0.0 %</b>	Bar:	<b>6 inches</b>
2.4 Floodprone Width (ft.):	<b>426.00</b>	Boulder:	<b>6.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>2.90</b>	Cobble:	<b>32.0 %</b>	Stream Type:	<b>C</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	<b>35.0 %</b>	Bed Material:	<b>Gravel</b>
2.6 Width/Depth Ratio:	<b>12.76</b>	Fine Gravel:	<b>17.0 %</b>	Subclass Slope:	<b>b</b>
2.7 Entrenchment Ratio:	<b>34.08</b>	Sand:	<b>10.0 %</b>	Bed Form:	<b>Riffle-Pool</b>
2.8 Incision Ratio:	<b>1.61</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	<b>No</b>	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Low</b>	Detritus:	<b>0.0 %</b>	Reference Stream Type:	
2.10 Riffles Type:	<b>Complete</b>	# Large Woody Debris:	<b>15</b>	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope:	<b>Steep</b>				
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>217.4</b>	<b>61.4</b>	Dominant:	<b>Herbaceous</b>	<b>Herbaceous</b>
Material Type:	<b>Sand</b>	<b>Sand</b>	Erosion Height (ft.):	<b>2.6</b>	<b>2.0</b>	Sub-dominant:	<b>Deciduous</b>	<b>Deciduous</b>
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>	Revetment Type:	<b>Rip-Rap</b>	<b>Rip-Rap</b>	Bank Canopy		
Lower			Revetment Length:	<b>99.9</b>	<b>63.1</b>	Canopy %:	<b>76-100</b>	<b>76-100</b>
Material Type:	<b>Boulder/Cobbles</b>	<b>Boulder/Cobbles</b>				Mid-Channel Canopy:	<b>Closed</b>	
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>						

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>	Corridor Land
Dominant	<b>&gt;100</b>	<b>&gt;100</b>	Dominant
Sub-Dominant	<b>26-50</b>	<b>26-50</b>	Sub-dominant
W less than 25	<b>283</b>	<b>236</b>	(Legacy)
Buffer Vegetation Type			Failures
Dominant	<b>Coniferous</b>	<b>Coniferous</b>	Gullies
Sub-Dominant	<b>Herbaceous</b>	<b>Herbaceous</b>	

#### 3.3 Riparian Corridor

	<u>Left</u>	<u>Right</u>		<u>Left</u>	<u>Right</u>		<u>Left</u>	<u>Right</u>
Dominant	<b>Forest</b>	<b>Forest</b>	Dominant	<b>Forest</b>	<b>Forest</b>	Mass Failures		
Sub-Dominant	<b>Residential</b>	<b>Residential</b>	Sub-dominant	<b>Residential</b>	<b>Residential</b>	Height		
W less than 25	<b>Amount</b>	<b>Mean Hieght</b>	(Legacy)	<b>Amount</b>	<b>Mean Hieght</b>	Gullies Number	<b>0</b>	
Buffer Vegetation Type	<b>None</b>	<b>None</b>	Failures	<b>None</b>	<b>None</b>	Gullies Length	<b>0</b>	
Dominant	<b>None</b>	<b>None</b>	Gullies	<b>None</b>	<b>None</b>			
Sub-Dominant								



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: NoName13

Reach: M07.T5.01.S1.01-B

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Abundant</b>	4.5 Flow Regulation Type: <b>None</b>	4.7 Stormwater Inputs
4.2 Adjacent Wetlands: <b>Minimal</b>	Flow Reg. Use:	Field Ditch: <b>0</b> Road Ditch: <b>0</b>
4.3 Flow Status: <b>Moderate</b>	Impoundments:	Other: <b>0</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams: <b>4</b>	Impoundment Loc.:	Overland Flow: <b>1</b> Urb Strm Wtr Pipe: <b>0</b>
	4.6 Up/Down Strm flow reg.: <b>None</b>	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.:	Affected Length (ft): <b>0</b>

#### 4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Culvert	3.5	Yes	Yes	Yes	Yes	Deposition Below, Scour Above
Culvert	3	Yes	Yes	Yes	Yes	Deposition Above, Deposition Below, Scour Below
Bridge	11	Yes	Yes	No	Yes	Deposition Above, Deposition Below
Bridge	10	Yes	Yes	No	Yes	Deposition Above
Bridge	11	Yes	Yes	No	Yes	Deposition Above, Deposition Below, Scour Below

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>1</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: <b>1</b>	Delta: <b>0</b>	Flood chutes: <b>2</b>	Avulsion: <b>0</b>	5.5 Straightening: <b>Straightening</b>
Point: <b>1</b>	Island: <b>0</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>0</b>	Straightening Length (ft.): <b>419</b>
Side: <b>6</b>	Braiding: <b>0</b>	Steep Riffles: <b>2</b>	Trib Rejuv.: <b>No</b>	5.5 Dredging: <b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:		
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection:		
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:		

Habitat Rating:

Habitat Stream Condition:

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		<b>8</b>	<b>None</b>	<b>Yes</b>	Geomorphic Rating	<b>0.60</b>
7.2 Channel Aggradation		<b>14</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>13</b>		<b>No</b>	Channel Evolution Stage	<b>III</b>
7.4 Change in Planform		<b>13</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>48</b>			Stream Sensitivity	<b>Very High</b>





# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page 2

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: **NoName13** Reach: **M07.T5.01.S1.01-C**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	<b>15.20</b>	2.11 Riffle/Step Spacing:	<b>66 ft.</b>	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	<b>2.00</b>	2.12 Substrate Composition		Bed:	<b>5.4 inches</b>
2.3 Mean Depth (ft.):	<b>0.90</b>	Bedrock:	<b>0.0 %</b>	Bar:	<b>2.5 inches</b>
2.4 Floodprone Width (ft.):	<b>81.20</b>	Boulder:	<b>0.0 %</b>	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	<b>3.30</b>	Cobble:	<b>24.0 %</b>	Stream Type:	<b>C</b>
Human Elev FloodPln (ft.):		Coarse Gravel:	<b>43.0 %</b>	Bed Material:	<b>Gravel</b>
2.6 Width/Depth Ratio:	<b>16.89</b>	Fine Gravel:	<b>12.0 %</b>	Subclass Slope:	<b>b</b>
2.7 Entrenchment Ratio:	<b>5.34</b>	Sand:	<b>21.0 %</b>	Bed Form:	<b>Riffle-Pool</b>
2.8 Incision Ratio:	<b>1.65</b>	Silt and Smaller:	<b>0.0 %</b>	Field Measured Slope:	
Human Elevated Inc. Rat.:	<b>0.00</b>	Silt/Clay Present:	<b>No</b>	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	<b>Low</b>	Detritus:	<b>0.0 %</b>	Reference Stream Type:	
2.10 Riffles Type:	<b>Complete</b>	# Large Woody Debris:	<b>18</b>	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope:	<b>Steep</b>				
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type	<u>Left</u>	<u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>259.2</b>	<b>133.3</b>	Dominant:	<b>Herbaceous</b>	<b>Herbaceous</b>
Material Type:	<b>Sand</b>	<b>Sand</b>	Erosion Height (ft.):	<b>3.0</b>	<b>3.2</b>	Sub-dominant:	<b>None</b>	<b>Deciduous</b>
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>	Revetment Type:	<b>Rip-Rap</b>	<b>Rip-Rap</b>	Bank Canopy		
Lower			Revetment Length:	<b>470.0</b>	<b>286.6</b>	Canopy %:	<b>1-25</b>	<b>51-75</b>
Material Type:	<b>Gravel</b>	<b>Gravel</b>				Mid-Channel Canopy:	<b>Open</b>	
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>						

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	<b>0-25</b>	<b>0-25</b>
Sub-Dominant	<b>51-100</b>	<b>&gt;100</b>
W less than 25	<b>1,179</b>	<b>547</b>
Buffer Vegetation Type		
Dominant	<b>Herbaceous</b>	<b>Deciduous</b>
Sub-Dominant	<b>None</b>	<b>Shrubs/Sapling</b>

#### 3.3 Riparian Corridor

Corridor Land	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Commercial</b>	<b>Commercial</b>	Mass Failures	
Sub-dominant	<b>Shrubs/Sapling</b>	<b>Forest</b>	Height	
(Legacy)	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	<b>0</b>
Failures	<b>None</b>		Gullies Length	<b>0</b>
Gullies	<b>None</b>			



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010

### Phase 2 Segment Summary Report

### West Branch Little River

Page3

Stream: NoName13

Reach: M07.T5.01.S1.01-C

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Minimal</b>	4.5 Flow Regulation Type <b>None</b>	4.7 Stormwater Inputs
4.2 Adjacent Wetlands: <b>None</b>	Flow Reg. Use:	Field Ditch: <b>1</b> Road Ditch: <b>0</b>
4.3 Flow Status: <b>Moderate</b>	Impoundments:	Other: <b>4</b> Tile Drain: <b>0</b>
4.4 # of Debris Jams: <b>1</b>	Impoundment Loc.:	Overland Flow: <b>1</b> Urb Strm Wtr Pipe: <b>0</b>
	4.6 Up/Down Strm flow reg.: <b>None</b>	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.:	Affected Length (ft): <b>0</b>

#### 4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Bridge	10	Yes	No	No	No	None
Bridge	7.8	Yes	Yes	No	Yes	Deposition Below, Scour Below, Alignment
Culvert	2	Yes	Yes	Yes	Yes	Scour Below, Alignment
Culvert	3	Yes	Yes	Yes	Yes	Scour Below, Alignment
Culvert	3.4	Yes	Yes	Yes	Yes	Deposition Above, Scour Below, Alignment

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types	Diagonal: <b>0</b>	5.2 Other Features	Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: <b>2</b>	Delta: <b>0</b>	Flood chutes: <b>1</b>	Avulsion: <b>0</b>	5.5 Straightening: <b>Straightening</b>
Point: <b>1</b>	Island: <b>0</b>	5.3 Steep Riffles and Head Cuts	Head Cuts: <b>0</b>	Straightening Length (ft.): <b>1,865</b>
Side: <b>5</b>	Braiding: <b>0</b>	Steep Riffles: <b>1</b>	Trib Rejuv.: <b>Yes</b>	5.5 Dredging: <b>None</b>

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:		
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection:		
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:		

Habitat Rating:

Habitat Stream Condition:

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic		
7.1 Channel Degradation		<b>6</b>	<b>None</b>	<b>Yes</b>	Geomorphic Rating	<b>0.54</b>
7.2 Channel Aggradation		<b>13</b>	<b>None</b>	<b>No</b>	Channel Evolution Model	<b>F</b>
7.3 Widening Channel		<b>12</b>		<b>No</b>	Channel Evolution Stage	<b>III</b>
7.4 Change in Planform		<b>12</b>		<b>No</b>	Geomorphic Condition	<b>Fair</b>
Total Score		<b>43</b>			Stream Sensitivity	<b>Very High</b>



Phase 2 Segment Summary Report West Branch Little River

Stream:	NoName13	SGAT Version:	4.56
Reach:	M07.T5.01.S1.01-D	Organization:	Bear Creek Environmental
Segment Length(ft):	1,816	Observers:	PD, CS
Rain:	Yes	Completion Date:	8/14/2008
		Quality Control Status - Consultant:	Provisional
		Quality Control Status - Staff:	Provisional
		Why Not Assessed:	wetland

Step 0 - Location: Segment begins about 200 feet upstream of culvert at the Lodge driveway and continues until stream ends. This segment is primarily a wetland and then the stream disappears where the topography gets steeper as part of a ski trail.

Step 5 - Notes: Segment contained a small channel flowing through a wetland and then the channel is lost among wetland habitat, which then disappears as the topography gets steeper on a ski trail. There is no administrative judgement since this segment is a wetland.

Step 7 - Narrative:

Step 1. Valley and Floodplain

1.1 Segmentation: Channel Dimensions	1.4 Adjacent Side	<u>Left</u>	<u>Right</u>	1.5 Valley Features
1.2 Alluvial Fan: None	Hillside Slope:	Very Steep	Very Steep	Valley Width (ft): 280
1.3 Corridor Encroachments:	Continuous w/ Bank:	Never	Never	Width Determination: Estimated
<u>Length (ft)</u> <u>One</u> <u>Height</u> <u>Both</u> <u>Height</u>	Within 1 Bankfull W:	Never	Never	Confinement Type: VB
Berm: 0 0	Texture:	N.E.	N.E.	In Rock Gorge: No
Road: 0 0				Human Caused Change in Valley Width?: Yes
Railroad: 0 0				
Imp. Path: 0 0				
Dev.: 74 0				
1.6 Grade Controls: None				



### Phase 2 Segment Summary Report

### West Branch Little River

### Page 2

Stream: **NoName13** Reach: **M07.T5.01.S1.01-D**

#### Step 2. Stream Channel

2.1 Bankfull Width (ft.):	2.11 Riffle/Step Spacing:	2.13 Average Largest Particle on
2.2 Max Depth (ft.):	2.12 Substrate Composition	Bed:
2.3 Mean Depth (ft):	Bedrock: %	Bar:
2.4 Floodprone Width (ft.):	Boulder: %	2.14 Stream Type
2.5 Aband. Floodpn (ft.):	Cobble: %	Stream Type:
Human Elev FloodPln (ft.):	Coarse Gravel: %	Bed Material:
2.6 Width/Depth Ratio: <b>0.00</b>	Fine Gravel: %	Subclass Slope:
2.7 Entrenchment Ratio: <b>0.00</b>	Sand: %	Bed Form:
2.8 Incision Ratio: <b>0.00</b>	Silt and Smaller: %	Field Measured Slope:
Human Elevated Inc. Rat.: <b>0.00</b>	Silt/Clay Present:	2.15 Sub-reach Stream Type
2.9 Sinuosity:	Detritus: %	Reference Stream Type:
2.10 Riffles Type:	# Large Woody Debris:	Reference Bed Material:
		Reference Subclass Slope:
		Reference Bedform:

#### Step 3. Riparian Features

3.1 Stream Banks			Typical Bank Slope: <b>Steep</b>			
Bank Texture			Bank Erosion	<u>Left</u>	<u>Right</u>	Near Bank Vegetation Type <u>Left</u> <u>Right</u>
Upper	<u>Left</u>	<u>Right</u>	Erosion Length (ft.):	<b>0.0</b>	<b>0.0</b>	Dominant: <b>Herbaceous</b> <b>Herbaceous</b>
Material Type:	<b>Sand</b>	<b>Sand</b>	Erosion Height (ft.):	<b>0.0</b>	<b>0.0</b>	Sub-dominant: <b>Shrubs/Sapling</b> <b>Shrubs/Sapling</b>
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>	Revetment Type:	<b>None</b>	<b>None</b>	Bank Canopy
Lower			Revetment Length:	<b>0.0</b>	<b>0.0</b>	Canopy %: <b>1-25</b> <b>1-25</b>
Material Type:	<b>Sand</b>	<b>Sand</b>				Mid-Channel Canopy: <b>Open</b>
Consistency:	<b>Non-cohesive</b>	<b>Non-cohesive</b>				

#### 3.2 Riparian Buffer

Buffer Width	<u>Left</u>	<u>Right</u>	Corridor Land
Dominant	<b>&gt;100</b>	<b>&gt;100</b>	Dominant
Sub-Dominant	<b>26-50</b>	<b>26-50</b>	Sub-dominant
W less than 25	<b>0</b>	<b>0</b>	(Legacy)
Buffer Vegetation Type			Failures
Dominant	<b>Herbaceous</b>	<b>Herbaceous</b>	Gullies
Sub-Dominant	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>	

#### 3.3 Riparian Corridor

	<u>Left</u>	<u>Right</u>	<u>Left</u>	<u>Right</u>
Dominant	<b>Shrubs/Sapling</b>	<b>Shrubs/Sapling</b>	Mass Failures	
Sub-Dominant	<b>Residential</b>	<b>Forest</b>	Height	
W less than 25	<u>Amount</u>	<u>Mean Hieght</u>	Gullies Number	<b>0</b>
Buffer Vegetation Type			Gullies Length	<b>0</b>
Dominant	<b>None</b>			
Sub-Dominant	<b>None</b>			



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010  
Page3

### Phase 2 Segment Summary Report

### West Branch Little River

Stream: NoName13

Reach: M07.T5.01.S1.01-D

#### Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: <b>Abundant</b>	4.5 Flow Regulation Type <b>None</b>	4.7 Stormwater Inputs <b>None</b>
4.2 Adjacent Wetlands: <b>Abundant</b>	Flow Reg. Use:	Field Ditch: Road Ditch:
4.3 Flow Status: <b>Moderate</b>	Impoundments:	Other: Tile Drain:
4.4 # of Debris Jams: <b>1</b>	Impoundment Loc.:	Overland Flow: Urb Strm Wtr Pipe:
	4.6 Up/Down Strm flow reg.: <b>None</b>	4.9 # of Beaver Dams: <b>0</b>
	(old) Upstrm Flow Reg.:	Affected Length (ft): <b>0</b>
4.8 Channel Constrictions: <b>None</b>		

#### Step 5. Channel Bed and Planform Changes

5.1 Bar Types Diagonal:	5.2 Other Features Neck Cutoff: <b>0</b>	5.4 Stream Ford or Animal Crossing: <b>No</b>
Mid: Delta:	Flood chutes: <b>2</b>	5.5 Straightening: <b>None</b>
Point: Island:	5.3 Steep Riffles and Head Cuts Head Cuts: <b>0</b>	Straightening Length (ft.): <b>0</b>
Side: Braiding: <b>0</b>	Steep Riffles: <b>0</b>	5.5 Dredging: <b>None</b>
	Trib Rejuv.:	

#### Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:	6.4 Sediment Deposition:	Stream Gradient Type	<u>Left</u>	<u>Right</u>
6.2 Pool Substrate:	6.5 Channel Flow Status:	6.8 Bank Stability:		
6.3 Pool Variability:	6.6 Channel Alteration:	6.9 Bank Vegetation Protection		
Total Score:	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:		
Habitat Rating:				
Habitat Stream Condition:				

#### Step 7. Rapid Geomorphic Assessment Data

Confinement Type	<u>Score</u>	<u>STD</u>	<u>Historic</u>	
7.1 Channel Degradation				Geomorphic Rating
7.2 Channel Aggradation				Channel Evolution Model
7.3 Widening Channel				Channel Evolution Stage
7.4 Change in Planform				Geomorphic Condition
Total Score				Stream Sensitivity



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
July, 10 2010

### Phase 2 - Stream Geometry Data

### West Branch Little River

Reach	Phase 2 Stream Type						Phase 1 Data			Phase 2 Channel Data												
	Seg-ment	Stream Type	Bed Material	Bedform	Subcl. Slope	Sub Rch?	Channel Slope	Channel Width	Bankfull Width	Max Depth	Mean Depth	Floodpr Width	Recnt Abandn Fldpin	Width Depth Ratio	Entrenchment Ratio	Incision Ratio	Channel Evolution Stage	Channel Evolution Model	Geo Assess Condition	Hab Assess Condition	QC Staff	QC Auto
M301	0	B	Gravel	Plane Bed	c	No	0.23		69.5	3	2.24	131	7	31.03	1.88	2.33	III	F	Poor	Poor	P	F
M302	0	C	Gravel	Riffle-Pool	None	No	0.55		57	4.25	2.85	225	8.15	20.00	3.95	1.92	IV	F	Fair	Fair	P	F
M303	A	F	Cobble	Plane Bed	None	No	0.86		62.5	4.2	2.63	76	10.4	23.76	1.22	2.48	II	F	Fair	Fair	P	F
M303	B	B	Gravel	Plane Bed	c	No	0.86		60	3.4	2.52	96	8.1	23.81	1.60	2.38	III	F	Fair	Fair	P	F
M304	A	B	Gravel	Plane Bed	c	No	0.89		77	2.95	1.8	118	8.45	42.78	1.53	2.86	IV	F	Poor	Poor	P	F
M304	B	F	Gravel	Plane Bed	None	No	0.89		60	3.3	2.34	84	11.8	25.64	1.40	3.58	II	F	Fair	Poor	P	F
M304	C	C	Gravel	Riffle-Pool	None	No	0.89		57	2.9	2.28	145	4.4	25.00	2.54	1.52	IV	F	Fair	Fair	P	F
M305	0	C	Cobble	Riffle-Pool	None	No	1.35		63	3.3	2.52	222.5	4.1	25.00	3.53	1.24	IV	F	Fair	Fair	P	F
M306	0	F	Cobble	Plane Bed	b	No	2.92		51	3.2	1.89	76	8.2	26.98	1.49	2.56	II	F	Fair	Fair	P	F
M01	0	B	Gravel	Plane Bed	c	No	0.49		70	3	2.2	131	7	31.82	1.87	2.33	III	F	Poor	Poor	F	F
M07	A	B	Cobble	Riffle-Pool	None	No	3.45		55.5	2.7	1.84	93.5	5.9	30.16	1.68	2.19	III	F	Fair		F	P
M07	B	B	Cobble	Step-Pool	None	No	3.45		49	5.3	3.42	69.5	5.3	14.33	1.42	1.00	I	F	Good		F	P
M07	C	F	Cobble	Step-Pool	None	Yes	3.45							0.00	0.00	0.00			Good		F	F
M07	D	B	Cobble	Step-Pool	None	No	3.45		43	4.05	2.88	61.7	6.15	14.93	1.43	1.52	III	F	Fair	Good	F	P
M07	E	A	Bedrock	Cascade	None	Yes	3.45							0.00	0.00	0.00			Reference		F	F
M07	F	B	Cobble	Riffle-Pool	None	No	3.45		65	3.9	2.63	93.5	5.7	24.71	1.44	1.46	III	F	Good	Good	F	P
M07.T6.01	A	C	Cobble	Riffle-Pool	b	Yes	7.13		39	2.7	1.53	101	2.7	25.49	2.59	1.00	IIc	D	Fair		F	P
M07.T6.01	B	A	Boulder	Cascade	None	No	7.13							0.00	0.00	0.00			Reference		F	F
M08	A	B	Cobble	Riffle-Pool	None	No	3.50		42	3	2.2	50.5	3.2	19.09	1.20	1.07	IIc	D	Good		F	P
M08	B	C	Gravel	Riffle-Pool	b	Yes	3.50		38	3.8	2.5	210.7	6.6	15.20	5.54	1.74	III	F	Fair		F	P
M08	C	B	Gravel	Riffle-Pool	None	Yes	3.50		44	4.1	2.6	86	5.1	16.92	1.95	1.24	III	F	Fair		F	P
M08.S1.01	A	F	Gravel	Plane Bed	b	No	3.52		28.5	1.8	1.32	38.2	6.1	21.59	1.34	3.39	III	F	Fair		F	P
M08.S1.01	B	C	Gravel	Step-Pool	b	No	3.52		22	2.2	1.63	105	3.7	13.50	4.77	1.68	III	F	Fair		F	P
M08.S1.02	A	C	Gravel	Step-Pool	b	No	8.01		26	2.2	1.39	115	3.7	18.71	4.42	1.68	III	F	Fair		F	P
M08.S1.02	B	B	Cobble	Step-Pool	a	Yes	8.01		24.5	3.1	1.9	37.7	4.25	12.89	1.54	1.37	IV	F	Good		F	P



# Stream Geomorphic Assessment

## Agency of Natural Resources

VT DEC  
Vermont.gov  
July, 10 2010

Reach	Segment	Stream Type	Bed Material	Bedform	Subcl. Slope	Sub Rch?	Channel Slope	Channel Width	Bankfull Width	Max Depth	Mean Depth	Floodpr Width	Recnt Abandn Fldpin	Width Depth Ratio	Entrenchment Ratio	Inclision Ratio	Channel Evolution Stage	Channel Evolution Model	Geo Assess Condition	Hab Assess Condition	QC Staff	QC Auto
M08.S1.03	A	B	Cobble	Step-Pool	a	No	10.94		24.5	3.3	2.2	40.5	5.2	11.14	1.65	1.58	III	F	Fair	Fair	F	P
M08.S1.03	B	F	Gravel	Step-Pool	a	No	10.94		27.5	2.1	1.65	35.6	9.4	16.67	1.29	4.48	III	F	Fair		F	P
M09	A	B	Cobble	Riffle-Pool	None	No	4.59		32	3.7	2.5	47.1	7.6	12.80	1.47	2.05	III	F	Fair		F	P
M09	B	C	Gravel	Riffle-Pool	b	No	4.59		37	2.7	2.16	120.5	4.9	17.13	3.26	1.81	IV	F	Fair		F	P
M09	C	C	Cobble	Step-Pool	b	No	4.59		29	3.2	2.12	73.4	3.2	13.68	2.53	1.00	IIc	D	Good		F	P
M09.S4.01	0	C	Cobble	Step-Pool	b	No	4.00		24	2.8	1.94	115.7	3.8	12.37	4.82	1.36	IV	F	Fair		F	P
M07.T5.01.S1.01	A	F	Cobble	Step-Pool	a	Yes	5.33		23.8	1.6	1.05	31	2.3	22.67	1.30	1.44	III	F	Fair		F	P
M07.T5.01.S1.01	B	C	Gravel	Riffle-Pool	b	No	5.33		12.5	1.8	0.98	426	2.9	12.76	34.08	1.61	III	F	Fair		F	P
M07.T5.01.S1.01	C	C	Gravel	Riffle-Pool	b	No	5.33		15.2	2	0.9	81.2	3.3	16.89	5.34	1.65	III	F	Fair		F	P
M07.T5.01.S1.01	D					No	5.33							0.00	0.00	0.00					F	F



# Stream Geomorphic Assessment

## Agency of Natural Resources



Vermont.gov  
Julv. 10 2010

### Phase 2 - Rapid Geomorphic Assessment

### West Branch Little River

Reach	Seg-ment	Sub Rch?	Degradation			Aggradation			Widening		Planform		Geo Score	Geo Condition	Evol. Stage	Confin. Type	Sensitivity	QC Staff	QC Auto
			Score	STD	Historic	Score	STD	Historic	Score	Historic	Score	Historic							
M01	0	No	4	C to B	Yes	7	None	No	8	No	8	No	0.34	Poor	III	VB	Very High	F	F
M07	A	No	7	None	Yes	13	None	No	12	No	13	No	0.56	Fair	III	NW	High	F	P
M07	B	No	16	None	No	11	None	No	14	No	18	No	0.74	Good	I	NW	Moderate	F	P
M07	C	Yes											0.00	Good		NC		F	F
M07	D	No	8	None	Yes	14	None	No	12	No	17	No	0.64	Fair	III	SC	High	F	P
M07	E	Yes											0.00	Reference		NC		F	F
M07	F	No	10	None	Yes	14	None	No	14	No	19	No	0.71	Good	III	NW	Moderate	F	P
M07.T5.01.S1.01	A	Yes	6	B to F	Yes	14	None	No	8	No	13	No	0.51	Fair	III	SC	Extreme	F	P
M07.T5.01.S1.01	B	No	8	None	Yes	14	None	No	13	No	13	No	0.60	Fair	III	VB	Very High	F	P
M07.T5.01.S1.01	C	No	6	None	Yes	13	None	No	12	No	12	No	0.54	Fair	III	VB	Very High	F	P
M07.T5.01.S1.01	D	No											0.00			VB		F	F
M07.T6.01	A	Yes	18	None	No	9	None	No	14	No	7	No	0.60	Fair	IIc	NW	High	F	P
M07.T6.01	B	No											0.00	Reference		NC		F	F
M08	A	No	17	None	No	9	None	No	12	No	14	No	0.65	Good	IIc	NC	Moderate	F	P
M08	B	Yes	8	None	Yes	10	None	No	13	No	15	No	0.58	Fair	III	BD	Very High	F	P
M08	C	Yes	13	C to B	Yes	11	None	No	13	Yes	14	No	0.64	Fair	III	BD	Very High	F	P
M08.S1.01	A	No	3	C to F	Yes	11	None	No	8	Yes	6	No	0.35	Fair	III	NW	Extreme	F	P
M08.S1.01	B	No	8	None	Yes	11	None	No	12	No	13	No	0.55	Fair	III	NW	Very High	F	P
M08.S1.02	A	No	10	None	Yes	13	None	No	12	No	14	No	0.61	Fair	III	BD	Very High	F	P
M08.S1.02	B	Yes	13	None	Yes	13	None	No	13	No	14	No	0.66	Good	IV	NW	Moderate	F	P
M08.S1.03	A	No	9	None	Yes	10	None	No	16	No	12	No	0.59	Fair	III	SC	High	F	P
M08.S1.03	B	No	2	C to F	No	12	None	No	7	No	7	No	0.35	Fair	III	BD	Extreme	F	P
M09	A	No	5	C to B	Yes	13	None	No	13	No	14	No	0.56	Fair	III	NW	High	F	P
M09	B	No	8	None	No	11	None	No	12	No	13	No	0.55	Fair	IV	NW	Very High	F	P
M09	C	No	16	None	No	12	None	No	13	No	13	No	0.68	Good	IIc	NW	Moderate	F	P
M09.S4.01	0	No	8	None	Yes	9	None	No	14	No	13	No	0.55	Fair	IV	BD	High	F	P
M301	0	No	4	C to B	Yes	7	None	No	8	No	8	No	0.34	Poor	III	VB	Very High	P	F



# Stream Geomorphic Assessment

VT DEC

## Agency of Natural Resources

Vermont.gov

July, 10 2010

Reach	Seg- ment	Sub Rch?	Score	STD	Historic	Score	STD	Historic	Score	Historic	Score	Historic	Geo Score	Geo Condition	Evol. Stage	Confin. Type	Sensitivity	QC Staff	QC Auto
M302	0	No	7	None	Yes	9	None	No	7	Yes	7	No	0.38	Fair	IV	VB	Very High	P	F
M303	A	No	3	C to F	Yes	9	None	No	12	No	14	No	0.48	Fair	II	VB	Extreme	P	F
M303	B	No	5	C to B	Yes	7	None	No	12	No	13	No	0.46	Fair	III	VB	Very High	P	F
M304	A	No	3	C to B	Yes	7	None	No	6	No	8	No	0.30	Poor	IV	VB	Very High	P	F
M304	B	No	3	C to F	Yes	8	None	No	8	No	13	No	0.40	Fair	II	VB	Extreme	P	F
M304	C	No	7	None	Yes	11	None	No	11	No	10	No	0.49	Fair	IV	VB	Very High	P	F
M305	0	No	11	None	Yes	13	None	No	12	No	8	No	0.55	Fair	IV	VB	High	P	F
M306	0	No	3	C to F	Yes	8	None	No	8	No	11	No	0.38	Fair	II	SC	Extreme	P	F

# APPENDIX B

## PROBLEM STRUCTURES

West Branch Watershed Stream Crossing Assessments  
Data collection by Bear Creek Environmental, LLC  
Stowe, Vermont  
July 8, 2010

---

**West Branch Little River  
Mountain Road  
Segment M08-C**

Arch Length: 73 feet  
Arch Height: 9.5 feet  
Arch Width: 16 feet



Outlet



Inlet

**Geomorphic Compatibility – Partially Compatible**

Percent Bankfull Width – Significantly undersized (36%)

Slope – Not applicable to arches

Approach Angle – Mild bend

Erosion and Armoring – No erosion; armoring intact upstream, failing downstream

Sediment Continuity – No sediment deposits greater than 1/2 bankfull channel width

Additional problems noted: scour above and below; deposition above and below; side bar in structure

**Aquatic Organism Passage – Full**

**Priority for Replacement - High**

West Branch Watershed Stream Crossing Assessments  
Data collection by Bear Creek Environmental, LLC  
Stowe, Vermont  
July 8, 2010

---

**West Branch Little River  
Mansfield Parking Area  
Segment M09-B**

Road Width: 27 feet

Bridge Clearance: 6.1 feet

Bridge Span: 18.5 feet



Outlet



Inlet

**Geomorphic Compatibility – Not Applicable**

Percent Bankfull Width – Undersized (50%)

Slope – Not applicable to bridges

Approach Angle – Channelized straight

Erosion and Armoring – Low erosion downstream; Upstream and downstream armoring intact

Sediment Continuity – No sediment deposits greater than 1/2 bankfull width

Notes: Deposition above and alignment; side bar in structure

**Aquatic Organism Passage – Not Applicable**

**Priority for Replacement - Moderate**

West Branch Watershed Stream Crossing Assessments  
Data collection by Bear Creek Environmental, LLC  
Stowe, Vermont  
July 8, 2010

---

**West Branch Little River  
Mountain Road  
Segment M09-C**

Road Width: 31 feet  
Bridge Clearance: 7 feet  
Bridge Span: 11 feet



Inlet



Outlet

**Geomorphic Compatibility – Not applicable**

Percent Bankfull Width – Significantly Undersized (38%)

Slope – Not applicable to bridges

Approach Angle – Channelized straight

Erosion and Armoring – Downstream hard bank armoring intact, upstream failing

Sediment Continuity – No sediment deposits greater than 1/2 bankfull width

Notes: Scour below structure; alignment; major scour causing undermining of wing walls both upstream and downstream; bedrock downstream and upstream of structure and in structure; grade control at downstream end of structure

**Aquatic Organism Passage – Not applicable**

**Priority for Replacement - High**

**Inn Brook**  
**Ranch Brook Road**  
**Segment M07.T5.01.SI.01-A**

Culvert Length: 20 feet  
Culvert Height: 4.7 feet  
Culvert Width: 5.3 feet



Inlet

**Geomorphic Compatibility – Partially Compatible**

Percent Bankfull Width – Significantly Undersized (46%)

Slope – Culvert slope is higher than channel slope

Approach Angle – Channelized straight

Erosion and Armoring – Low erosion downstream; upstream armoring intact

Sediment Continuity – No sediment deposits greater than 1/2 bankfull channel width

Notes: Deposition above and below; scour below; no material in structure; cascade at downstream end with 1.2 foot drop; pool 2.8 feet deep downstream of structure; steep riffle immediately upstream of structure; mid-channel bar downstream of structure; culvert has been squashed

**Aquatic Organism Passage – Reduced**

**Priority for Replacement - High**

West Branch Watershed Stream Crossing Assessments  
Data collection by Bear Creek Environmental, LLC  
Stowe, Vermont  
July 8, 2010

---

**Inn Brook**  
**Access Road to Cross Country Ski Center**  
**Segment M07.T5.01.SI.01-B**

Culvert Length: 20 feet  
Culvert Height: 3.5 feet  
Culvert Width: 3.5 feet



Outlet



Inlet

**Geomorphic Compatibility – Mostly Incompatible**

Percent Bankfull Width – Significantly Undersized (30%)

Slope – Culvert slope is higher than channel slope

Approach Angle – Channelized straight

Erosion and Armoring – No erosion; armoring intact upstream, failing downstream

Sediment Continuity – No sediment deposits greater than 1/2 bankfull channel width

Notes: Deposition below; scour above; cascade at outlet with 1 foot drop; downstream banks higher than upstream banks; One culvert is inside another culvert; no material in structure

**Aquatic Organism Passage – Reduced**

**Priority for Replacement – High**

West Branch Watershed Stream Crossing Assessments  
Data collection by Bear Creek Environmental, LLC  
Stowe, Vermont  
July 8, 2010

---

**Inn Brook  
Lintilhac Drive  
Segment M07.T5.01.SI.01-B**

Culvert Length: 35 feet  
Culvert Height: 3 feet  
Culvert Width: 3 feet



Outlet



Inlet

**Geomorphic Compatibility – Mostly Compatible**

Percent Bankfull Width – Significantly Undersized (26%)

Slope – Culvert slope is the same as channel slope

Approach Angle – Naturally straight

Erosion and Armoring – No erosion; armoring intact upstream and downstream

Sediment Continuity – No sediment deposits greater than 1/2 bankfull channel width

Notes: Deposition above and below; scour below; free fall at outlet with 2.5 foot drop; 2.7 foot pool just downstream of structure; steep riffle immediately upstream of structure

**Aquatic Organism Passage – No AOP**

**Priority for Replacement – High**

West Branch Watershed Stream Crossing Assessments  
Data collection by Bear Creek Environmental, LLC  
Stowe, Vermont  
July 8, 2010

---

**Inn Brook**  
**Toll Road**  
**Segment M07.T5.01.SI.01-C**

Culvert Length: 600 feet  
Culvert Height: 3 feet  
Culvert Width: 3 feet



Outlet



Location of underground culvert

**Geomorphic Compatibility – Mostly Incompatible**

Percent Bankfull Width – Significantly Undersized (26%)

Slope – Culvert slope is higher than channel slope

Approach Angle – Mild bend enters pond then culvert

Erosion and Armoring – Low erosion downstream; armoring intact upstream and failing downstream

Sediment Continuity – No sediment deposits greater than 1/2 bankfull channel width

Notes: Scour below; alignment; stream is piped through property in long underground culvert.

Streamflow goes into manmade pond, then into a penstock, over a grade control and then enters pipe.

Very altered channel.

**Aquatic Organism Passage – No AOP**

**Priority for Replacement – High**

West Branch Watershed Stream Crossing Assessments  
Data collection by Bear Creek Environmental, LLC  
Stowe, Vermont  
July 8, 2010

---

**Inn Brook  
Private Driveway  
Segment M07.T5.01.SI.01-C**

Road Width: 14.5 feet  
Bridge Clearance: 5 feet  
Bridge Span: 7.8 feet



Outlet



Inlet

**Geomorphic Compatibility – Not Applicable**

Percent Bankfull Width – Undersized (68%)

Slope – Not applicable to bridges

Approach Angle – Channelized straight

Erosion and Armoring – No erosion; upstream armoring failing and no downstream armoring

Sediment Continuity – No sediment deposits greater than 1/2 bankfull width

Notes: Deposition below, scour below and alignment; bridge located where upstream is completely channelized and armored with riprap; grade control and pond just upstream

**Aquatic Organism Passage – Not Applicable**

**Priority for Replacement - Moderate**

West Branch Watershed Stream Crossing Assessments  
Data collection by Bear Creek Environmental, LLC  
Stowe, Vermont  
July 8, 2010

---

**Inn Brook**  
**The Lodge Parking Lot**  
**Segment M07.T5.01.SI.01-C**

Culvert Length: 120 feet  
Culvert Height: 2 feet  
Culvert Width: 2 feet



Outlet



Inlet

**Geomorphic Compatibility – Partially Compatible**

Percent Bankfull Width – Significantly Undersized (17%)

Slope – Culvert slope is higher than channel slope

Approach Angle – Channelized straight

Erosion and Armoring – No erosion; No armoring upstream; intact downstream

Sediment Continuity – No sediment deposits greater than 1/2 bankfull channel width

Notes: Scour below; alignment; stream is piped through property in long underground culvert; storm drain in parking lot goes right into culvert; no material in culvert; very altered channel

**Aquatic Organism Passage – No AOP**

**Priority for Replacement – High**

**Inn Brook**  
**The Lodge Driveway**  
**Segment M07.T5.01.SI.01-C**

Culvert Length: 42 feet  
Culvert Height: 2.5 feet  
Culvert Width: 3.4 feet



Outlet



Inlet

**Geomorphic Compatibility – Partially Compatible**

Percent Bankfull Width – Significantly Undersized (30%)

Slope – Culvert slope is same as channel slope

Approach Angle – Mild bend

Erosion and Armoring – High erosion upstream; no erosion downstream; armoring failing upstream and downstream

Sediment Continuity – No sediment deposits greater than 1/2 bankfull channel width

Notes: Deposition above, scour below; alignment; no material throughout

**Aquatic Organism Passage – Reduced AOP**

**Priority for Replacement – High**

West Branch Watershed Stream Crossing Assessments  
Data collection by Bear Creek Environmental, LLC  
Stowe, Vermont  
July 8, 2010

---

**Long Trail Tributary  
Mansfield Parking Lot  
Reach M09.S4.01**

Culvert Length: 84 feet  
Culvert Height: 8 feet  
Culvert Width: 12 feet



Outlet



Inlet

**Geomorphic Compatibility – Mostly Compatible**

Percent Bankfull Width – Undersized (50%)

Slope – Culvert slope is same as channel slope

Approach Angle – Mild bend

Erosion and Armoring – No erosion upstream or downstream; armoring intact upstream and downstream

Sediment Continuity – No sediment deposits greater than 1/2 bankfull channel width

Notes: Deposition above; wooden planks in culvert; small cascade on downstream end; 0.4 foot drop

**Aquatic Organism Passage – Reduced AOP**

**Priority for Replacement – High**

West Branch Watershed Stream Crossing Assessments  
Data collection by Bear Creek Environmental, LLC  
Stowe, Vermont  
July 8, 2010

---

**Big Spruce Brook  
Ski Hostel Driveway  
Segment M08.S1.01-A**

Road Width: 17 feet  
Bridge Clearance: 5.7 feet  
Bridge Span: 15 feet



Outlet



Inlet

**Geomorphic Compatibility – Not applicable**

Percent Bankfull Width –Undersized (53%)

Slope – Not applicable to bridges

Approach Angle – Mild bend

Erosion and Armoring – Low erosion upstream, none downstream; Downstream and upstream hard bank armoring intact

Sediment Continuity – No sediment deposits greater than 1/2 bankfull width

Notes: Deposition above and below; scour below; some invasive plants, mostly grass downstream

**Aquatic Organism Passage – Not applicable**

**Priority for Replacement - Moderate**

West Branch Watershed Stream Crossing Assessments  
Data collection by Bear Creek Environmental, LLC  
Stowe, Vermont  
July 8, 2010

---

**Big Spruce Brook  
Spruce Peak Road  
Segment M08.S1.03-B**

Culvert Length: 60 feet  
Culvert Height: 8 feet  
Culvert Width: 8 feet



Inlet



Outlet

**Geomorphic Compatibility – Partially Compatible**

Percent Bankfull Width – Significantly Undersized (29%)

Slope – Culvert slope is lower than channel slope

Approach Angle – Channelized straight

Erosion and Armoring – High erosion upstream, low erosion downstream; armoring failing upstream and downstream

Sediment Continuity – No sediment deposits greater than ½ bankfull channel width

Notes: Deposition above and below; scour below; no material throughout; large free fall with 8.1 foot drop – fish passage issue; steep riffle upstream

**Aquatic Organism Passage – No AOP**

**Priority for Replacement – High**