West Branch Passumpsic River & Sutton River Corridor Plan Addendum

Caledonia County, Vermont

February 12, 2014

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Funding for this project was provided by:
State of Vermont Ecosystem Restoration Program

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West Branch Passumpsic River & Sutton River Corridor Plan Addendum Caledonia County, Vermont

1.0 EXECUTIVE SUMMARY

A stream geomorphic assessment (study of stream dynamics and impacts to habitat and structure of streams and land adjacent to them) of the West Branch Passumpsic River and the Sutton River was conducted by Bear Creek Environmental, LLC (BCE) in summer 2013. The study was funded by the State of Vermont Ecosystem Restoration Program and prepared under contract to the Caledonia County Natural Resources Conservation District (CCNRCD). This report is an addendum to the *West Branch Passumpsic River & Calendar Brook Corridor Plan* (FEA, 2010). These studies are part of many efforts to understand the dynamics of the Passumpsic River watershed and to implement restoration projects at the site level following a major flood in 2002 in Lyndon and St. Johnsbury (FEA, 2010) and periodic problem flooding since.

A planning strategy based on *fluvial geomorphology* (flowing water and sediments in relation to land forms) 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 community watershed groups, municipalities and others to identify how changes to land-use alter the physical processes and habitat of rivers. The stream geomorphic assessment data will be used to help focus stream restoration activities within the watershed and assist with town planning and conservation district efforts.

Three reaches in the West Branch Passumpsic River watershed were included in the 2013 assessment; two on the main stem and one on the Sutton River, a tributary to the West Branch Passumpsic River. The study encompassed approximately two miles of stream channel. This assessment was helpful in identifying major stressors to geomorphic stability in this part of the West Branch watershed. One primary problem relating to geomorphic stability and habitat condition is channel straightening and corridor encroachment associated with the existence of major roads (Route 5A) and development, particularly near the confluence of the two streams. In some cases, this encroachment has limited floodplain access and has caused moderate to extreme channel degradation (lowering of the bed). This restricted floodplain access along the Sutton River has mostly occurred in the developed area of downtown West Burke just upstream of the confluence with the West Branch. Limited floodplain access along the West Branch has occurred where Route 5A comes very close to the stream. Channel straightening has resulted

in a reduction in habitat quality and diversity in the downtown West Burke area and along Route 5A. A lack of high quality streamside buffers is exacerbating bank instability in some locations.
Fluvial erosion hazards (FEH) are present within the project area due to the infrastructure within the river corridor and the associated alteration of the natural floodplain, which has caused instability in the stream channels. The Vermont Agency of Natural Resources defines fluvial erosion as erosion caused by rivers and streams that "can range from gradual bank erosion to catastrophic changes in river channel location and dimension during flood events" (Vermont Agency of Natural Resources, 2010b). A fluvial erosion hazard zone represents the land adjacent to the stream or river that is vulnerable to erosion and damage from flood waters based on the channel's need to migrate in its floodplain to achieve a balanced condition. The Town of Burke could avoid future damage and high costs through incorporating fluvial erosion hazard overlay areas in town planning and zoning strategies.

A list of 16 potential restoration and conservation projects was developed during project identification. Types of projects include: river corridor protection through easements, improving riparian buffers, improved stormwater management, a dam removal, bridge replacements, and alternatives analyses for the removal of an old berm and an old mill abutment. Phase 3 surveys for active restoration projects may be required at some point in the near future for project design and permitting.

2.0 PROJECT BACKGROUND

There are many scientific terms used in this river corridor plan, and the reader is encouraged to refer to the glossary at the end of the document. Important terms that are in the glossary are shown in italics the first time they are used in the text.

This study was a follow up to the Phase 1 and 2 Geomorphic Assessments completed by the CCNRCD in 2008 and the associated river corridor plan written in 2010 by Fitzgerald Environmental Associates (FEA), which included reaches on the main stem of the West Branch and Calendar Brook (Figure 2.1). In summer 2013, Bear Creek Environmental, LLC (BCE) focused on the West Branch Passumpsic River watershed in West Burke and Sutton, Vermont. One *tributary* (Sutton River) and the main stem of West Branch were assessed using the Vermont Agency of Natural Resources Phase 1 and Phase 2 Stream Geomorphic Assessment protocols during summer 2013. For background information regarding other previous studies and the geology, hydrology and land use of this watershed, please refer to the *West Branch Passumpsic River & Calendar Brook Corridor Plan* (FEA, 2010).

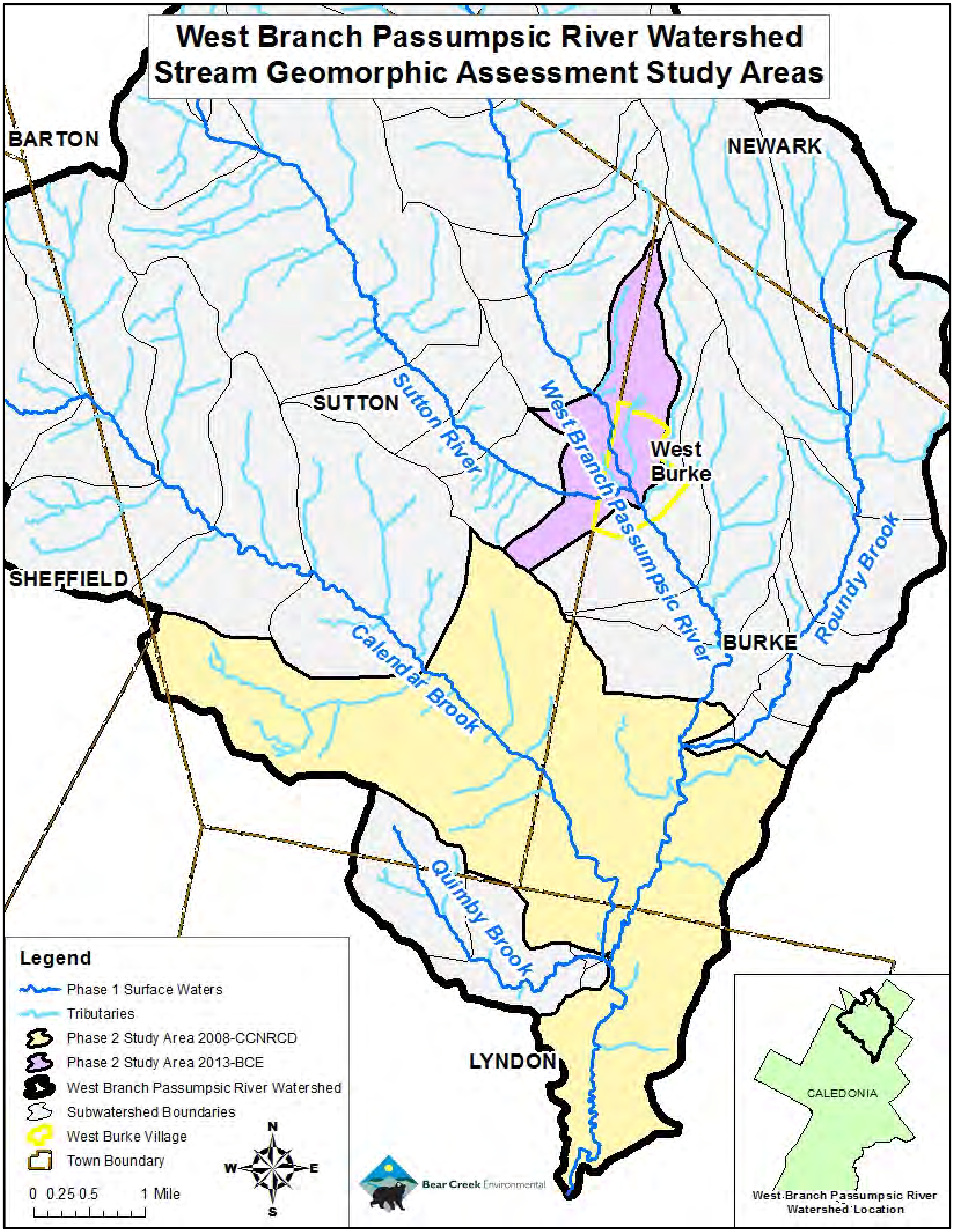


Figure 2.1. West Branch Passumpsic River Watershed Stream Geomorphic Assessment Study Areas

The Vermont River Management program has developed state-of-the-art Stream Geomorphic Assessment (SGA) protocols that utilize the science of *fluvial geomorphology* (fluvial = water, geo = earth, and morphology = the study of structure or form). Fluvial geomorphology focuses on the processes and pressures operating on river systems. The Vermont protocol includes three phases:

1. Phase 1 – Remote sensing and cursory field assessment;
2. Phase 2 – Rapid habitat and rapid geomorphic assessments 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.

3.0 METHODS

A summary of the Phase 1, Phase 2, and Bridge and *Culvert* methodologies is provided in the following sections.

3.1 Phase 1 Methodology

The Phase 1 assessment followed procedures specified in the Vermont Stream Geomorphic Assessment Phase 1 Handbook (Vermont Agency of Natural Resources, 2007). Phase 1, the remote sensing phase, involves the collection of data from topographic maps and aerial photographs, from existing studies, and from limited field studies, called "windshield surveys". The Phase 1 assessment provides an overview of the general physical nature of the watershed. As part of the Phase 1 study, stream reaches are determined based on geomorphic characteristics such as: valley confinement, valley slope, geologic materials, and tributary influence. The CCNRCD conducted most of the Phase 1 study including generation of watershed and reach level data from the Stream Geomorphic Assessment Tool (SGAT) used in ArcGIS. BCE was retained to complete the Phase 1 Assessment for the same three Phase 2 reaches on the West Branch Passumpsic River and the Sutton River (T3.11, T3.12, and T3.S3.01).

3.2 Phase 2 Methodology

The Phase 2 assessment of the West Branch Passumpsic River watershed followed procedures specified in the Vermont Stream Geomorphic Assessment (SGA) Phase 2 Handbook (Vermont Agency of Natural Resources, 2009b), and used version 10.0 of the SGAT Geographic Information System (GIS) extension to index impacts within each reach. The geomorphic condition for each Phase 2 reach is determined using the Rapid Geomorphic Assessment (RGA) protocol, and is based on the degree of departure of the channel from its reference stream type (Vermont Agency of Natural Resources, 2009b). The study used the 2008 Rapid Habitat Assessment (RHA) protocol (Vermont Agency of Natural Resources, 2008a; Milone and MacBroom, Inc., 2008).

Phase 1 reaches were divided further into *segment*s during the Phase 2 investigation based on changes in channel conditions. A segment is distinct in one or more of the following parameters: degree of floodplain encroachment or channel alteration, *grade control* occurrence (e.g. ledge), channel dimensions, channel sinuosity and slope, *riparian buffer* and corridor conditions, and degree of flow regulation. The three Phase 2 reaches studied in 2013 were broken further into eight segments based on field observations (Figure 3.1). Segments are labeled using letter notation (i.e. T12-A is the most downstream segment on Reach T12). The most downstream segment within a reach is labeled "A", the second from the reach point is "B, etc.

To assure a high level of confidence in the Phase 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, which took place during September 2013. The Project Team conducted the assessment according to the approved Quality Assurance procedures specified in the Phase 2 handbook. Staci Pomeroy of the State of Vermont Watershed Management Division conducted a QA/QC review of the data collected by Bear Creek Environmental (BCE) for the West Branch Passumpsic River and Sutton River in October 2013.

3.3 Bridge and Culvert Methodology

Bridge assessments were conducted by BCE on all public and private crossings within the selected Phase 2 reaches. The Agency of Natural Resources Bridge and Culvert protocols (Vermont Agency of Natural Resources, 2009a) were followed. Latitude and Longitude at each of the structures was determined using a MobileMapper 100 GPS unit. The assessment included photo documentation of the inlet, outlet, upstream, and downstream of each of the structures.

The Vermont Culvert Geomorphic Compatibility Screening Tool (Milone and MacBroom, Inc. 2008) was used to determine geomorphic compatibility for each bridge. Bridges are not typically screened for geomorphic compatibility in the VTANR protocol because they are usually more robust and have less impact on stream channel function than culverts. Bridges also do not have potential to become perched above the water surface, because the bottom of the structure is natural substrate. Bridges in this study were screened using the geomorphic compatibility tool that was modified by BCE to exclude the slope parameter. Tables 1 and 2 in Appendix A explain how each bridge was scored using the Screening Tool. The compatibility rating is based on four criteria: structure width in relation to bankfull channel width, sediment continuity, river approach angle, and erosion & armoring and the ratings span the following range: Fully Compatible, Mostly Compatible, Partially Compatible, Mostly incompatible, Fully Incompatible.

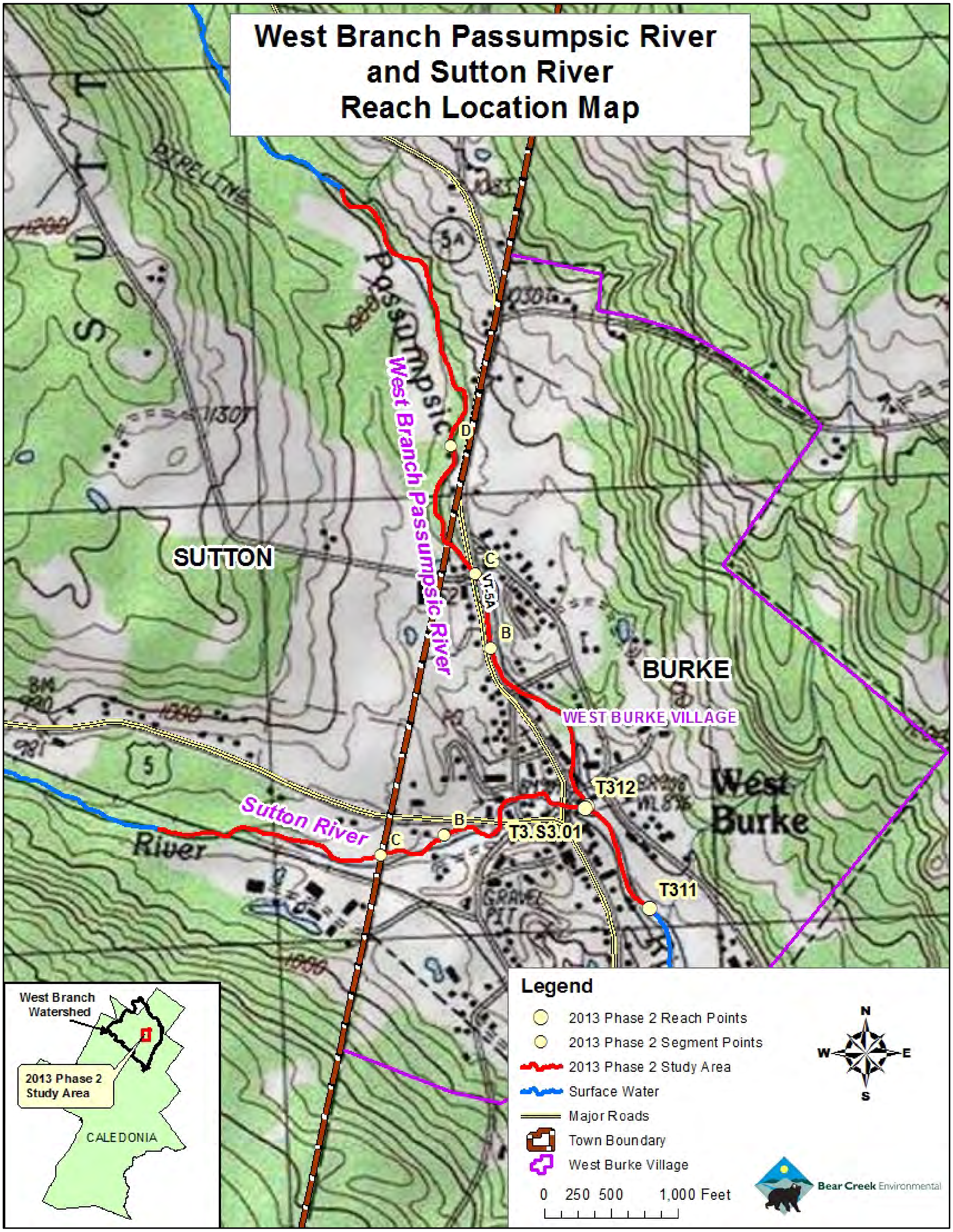


Figure 3.1. Reach Location Map for West Branch Passumpsic River and Sutton River

4.0 RESULTS

4.1 Phase 2 SGA Results

The stream condition is determined using the scores on the rapid assessment 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

The scores for the Rapid Habitat Assessment (RHA) and the Rapid Geomorphic Assessment (RGA) along with the exiting geomorphic and habitat conditions for each segment are shown in Table 1. Geomorphic condition is determined based on the degree (if any) of channel degradation, aggradation, widening and planform adjustment. 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 is a result of channel degradation or sediment build-up in the channel. In both situations the stream's energy is concentrated into both banks.

Two segments on the West Branch and one on the Sutton River (T3.12-A, T312-C, and T3.S3.01-C) are in "good" geomorphic condition. These segments are all located in areas where there are minimal to no corridor encroachments and buffer conditions are good for most of their length. The two most downstream reaches/segments assessed on both streams (T3.11 and T3.S3.01-A) are in "fair" geomorphic condition. On the downstream end of the Sutton River, there is extensive floodplain encroachment including roads and development. Stream crossings and lack of riparian buffer in segment T3.S3.01-A have also contributed to its "fair" condition. Reach T3.11 on the West Branch is in "fair" condition due to several factors including a lack of adequate buffer on the eastern side of the stream. Two segments on the West Branch, both in T3.12, and one segment on the Sutton River did not receive a full geomorphic assessment. T3.12-B was not fully assessed because it is extensively controlled by bedrock ledges. T3.12-D and T3.S3.01-B were not assessed due to lack of landowner permission along the stream banks. When a segment is not assessed, administrative judgment of the geomorphic condition is given. T3.12-D appears to be in "fair" geomorphic condition. T3.12-B and T3.S3.01-B were judged to be in "good" geomorphic condition.

Table 1. RHA and RGA Scores for Phase 2 Assessed Reaches/Segments

Stream	Phase 2 Segment ID	RHA Score (percent)	RHA Condition	RGA Score (percent)	RGA Condition	Stream Sensitivity
West Branch Passumpsic River	T3.11	57	Fair	55	Fair	Very High
	T3.12-A	58	Fair	65	Good	Moderate
	T3.12-B	Not Assessed – Bedrock Control Segment			Good	Not Evaluated
	T3.12-C	61	Fair	73	Good	Moderate
	T3.12-D	Not Assessed – No landowner permission			Fair	Not Evaluated
Sutton River	T3.S3.01-A	43	Fair	50	Fair	Very High
	T3.S3.01-B	Not Assessed – No landowner permission			Good	Not Evaluated
	T3.S3.01-C	73	Good	79	Good	Moderate

The habitat condition for each segment within the West Branch Passumpsic River 2013 study area is presented in Table 1. Only one assessed segment, T3.S3.01-C on the Sutton River, is in "good" habitat condition. Despite the railroad encroaching on the corridor, the banks and buffers for the most part are well vegetated. There is abundant large woody debris in the channel, many *pools*, and good canopy cover, all of which provide habitat for aquatic life. The rest of the segments are in "fair" habitat condition. Corridor encroachments, poor bank and buffer vegetation, invasive plants, thick algae cover, erosion and revetments, and channel straightening have all contributed to the "fair" habitat condition.

The reach condition ratings of the West Branch Passumpsic River watershed indicate that most 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 Passumpsic River 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. The channel evolution model is described below, and the evolution stage for each segment is provided in Section 4.2.

The "D" and "F" stage channel evolution models (Vermont Agency of Natural Resources, 2009b; Vermont Agency of Natural Resources, 2004) are helpful for explaining the channel adjustment processes underway in the West Branch Passumpsic 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 4.1 include:

- Stable (F-1) - a pre-disturbance period
- Incision (F-II) – channel degradation (head cutting)
- Widening (F-III) – bank failure
- Stabilizing (F-IV) – channel narrows through sediment build up and moves laterally building juvenile floodplain
- Stable (F-V) - 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.

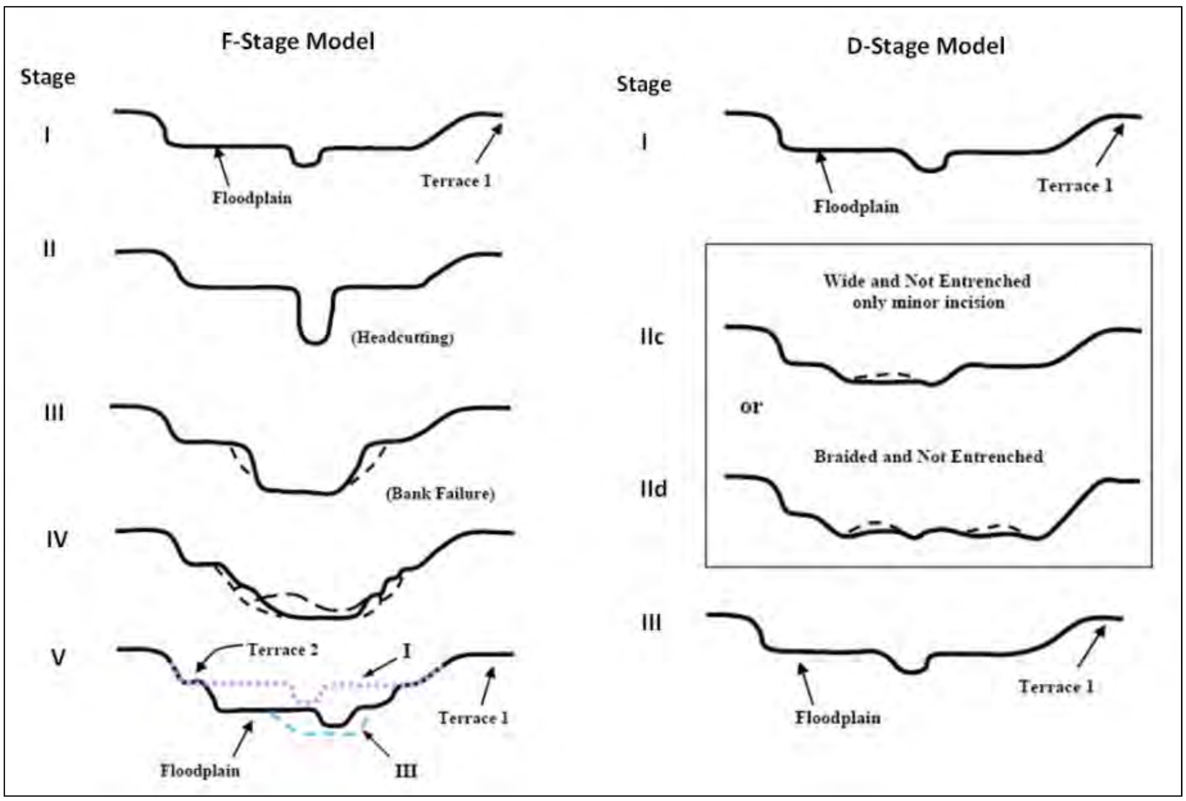


Figure 4.1 Typical channel evolution models for F-Stage and D-Stage
(Vermont Agency of Natural Resources, 2009b)

4.1.1 Departure Analysis

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, 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 Passumpsic River watershed include:

- Channelization and bank armoring
- Removal of woody riparian vegetation
- Floodplain encroachments

These anthropogenic practices have altered the balance between water and sediment discharges within the West Branch Passumpsic River watershed. 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 characteristics of the region, and the valley, floodplain, and stream morphology (ANR, 2010a). Sediment can be supplied to the river through bank erosion, large flooding events, and stormwater inputs. A sediment regime map depicting the reference and existing sediment regimes can be found in Figure 4.2. Reference and existing sediment regimes were derived from the Agency of Natural Resources Data Management System according to the sediment regime criteria established by the Vermont Agency of Natural Resources (2010a).

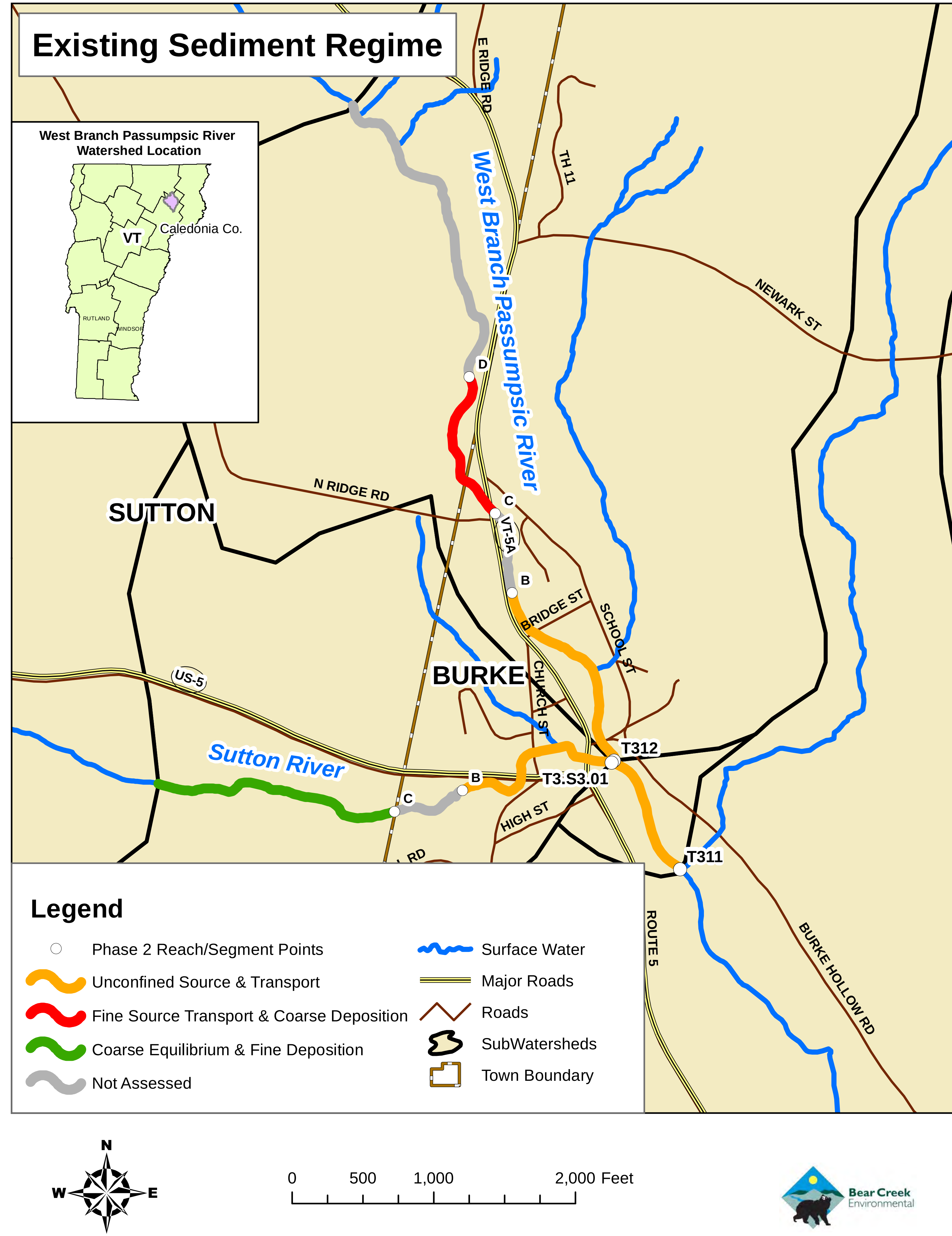
All of the assessed segments have a reference sediment regime of Coarse Equilibrium & Fine Deposition (*Equilibrium*). *Equilibrium* channels are unconfined on at least one side, and they transport and deposit sediment in equilibrium, wherein the stream power is balanced by the sediment load, sediment size, and boundary resistance (Vermont Agency of Natural Resources, 2010a).

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 a few of the assessed segments. Four of the segments have undergone a transformation from a reference sediment regime of Coarse Equilibrium & Fine Deposition to a departure sediment regime (Figure 4.2). Reaches/segments T3.11, T3.12-A, and T3.S3.01 departed to a sediment regime of *Unconfined Source and Transport* due to channel management practices such as straightening and floodplain encroachment. This regime type describes incised channels that have been extensively straightened and armored and are no longer a significant sediment supply due to the boundary resistance of the armoring (Vermont Agency of Natural Resources, 2010a). Segment T3.12-C was converted from an *Equilibirum* channel to a sediment regime of *Fine Source and Transport and Coarse Deposition*. This departure 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 analysis of sediment regimes at the watershed level is useful for summarizing the stressors affecting geomorphic condition of river channels. Sediment regime mapping provides a context for understanding the sediment transport and channel evolution processes.

Channel morphologic responses to these anthropogenic practices and changes in sediment regimes contribute to channel adjustment that may further create unstable channels. In some areas in reach T3.12, the placement of Route 5A has significantly changed the river's valley width, floodplain access, and its ability to meander. The same occurred on the Sutton River as a result of the encroachment of Route 5, Depot Street, and Church Street resulting in extreme degradation of the channel and disconnection to its floodplain.

4.1.2 Sensitivity Analysis

A stream sensitivity rating was determined based on existing stream type, dominant sediment size, and geomorphic condition. Stream sensitivity ratings help identify the likelihood that a segment will undergo vertical and lateral adjustments driven by natural or human-induced fluvial processes (ANR, 2010a). The sensitivity ratings are as follows: Very Low, Low, Moderate, High, Very High, and Extreme. The two most downstream segments assessed on the West Branch Passumpsic River main stem and the Sutton River had a sensitivity of Very High due to their impacts from human activity and the major channel adjustments occurring. The rest of the segments are assigned a rating of Moderate. A map showing stream sensitivities can be found in Figure 4.3.



West Branch Passumpsic River & Sutton River
Sediment Regimes - Sutton and Burke, Vermont

Bear Creek Environmental

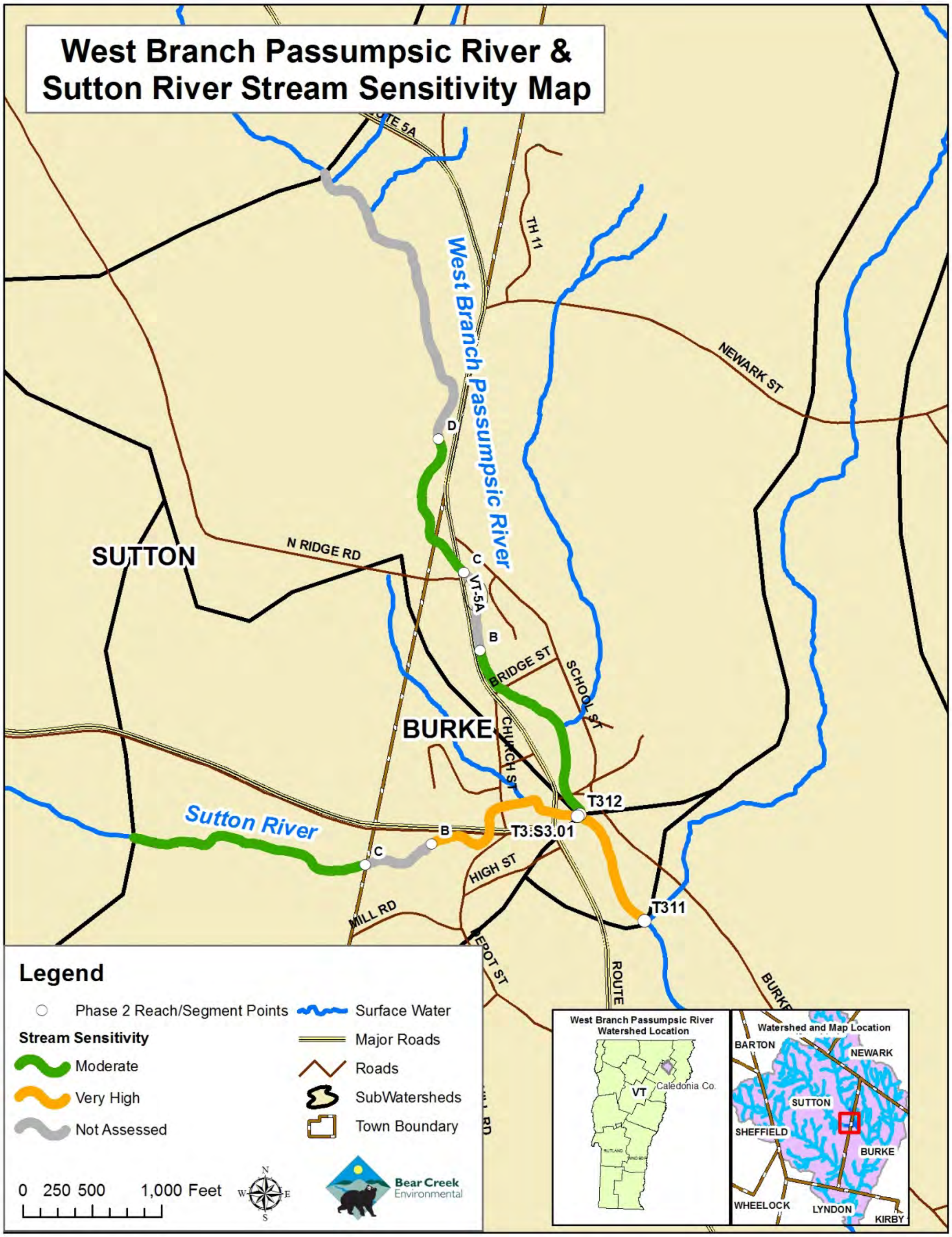


Figure 4.3. Stream Sensitivity in the West Branch Passumpsic River and Sutton River

4.2 Reach/Segment Descriptions and Project Identification

A description of each reach/segment is provided in this section along with a list of recommendations for restoration and protection strategies. The reaches/segments are listed from downstream to upstream. The reaches are broken into sections based on the stream they are located in: West Branch Passumpsic River main stem and Sutton River. For all of the assessed segments in the West Branch Passumpsic River and the Sutton River, the Phase 2 cross section measurements indicated that the bankfull width was narrower than the reference bankfull width determined in Phase 1. There are two possible explanations to the discrepancy: 1. Sandy soils with higher infiltration rates result in lower runoff volumes and therefore lower streamflows than predicted (FEA, 2010) and 2. Abundant wetlands in the watershed are providing more storage than typically found for this size watershed.

Site specific projects were identified using the criteria outlined by the VANR in Chapter 6 – Preliminary Identification and Prioritization (Vermont Agency of Natural Resources, 2010a). This planning guide is intended to aid in the development of projects that protect and restore river equilibrium. Project maps and tables (Appendix B) have been developed for the West Branch Passumpsic River watershed. These maps were created using indexed data from the Phase 2 Stream Geomorphic Assessments along with existing data available from the Vermont Center for Geographic Information.

A total of 16 projects were identified by BCE to promote the restoration or protection of channel stability and aquatic habitat in the West Branch Passumpsic River watershed. The projects are broken down by category as follows: 7 passive restoration (streamside plantings, natural buffer regeneration, and corridor easements); 2 stormwater improvement projects; 1 river corridor clean-up; and 7 active restoration (one alternatives analysis for old mill abutment removal, one dam removal, one old sewage pipe removal, one berm alternatives analysis, and three bridge retrofit/replacements). Information from the Phase 2 stream geomorphic assessment and bridge and culvert assessments could be used to inform the Towns of Sutton and Burke of which stream crossings are contributing to localized instability.

Phase 2 Segment Summary Reports from the Agency of Natural Resources' Data Management System, which contain all the data for the Phase 2 steps, as well as associated QA documents are included in Appendix C. The Phase 2 stream geomorphic assessment provides a picture of the condition of the channel and the adjustment process occurring; however, it is not a comprehensive study for determining site specific actions. The Phase 2 study provides a foundation for project development, and additional work is recommended to further develop these projects.

West Branch Passumpsic River Main Stem

T3.11

The lowest Phase 2 reach of the West Branch Passumpsic River main stem begins approximately 940 feet downstream of the confluence with the Sutton River and continues to the confluence. This reach has a reference confinement of Broad and the placement of Route 5A has not altered the valley confinement. The channel in reach T3.11 flows through a residential and commercial area with lack of buffer and berm along one side, eroding banks, and minimal riffle-pool habitat due to aggradation.

T3.11 is in **fair** geomorphic condition. This reach differs from the upstream segments in that it is rather unstable due to loss of floodplain access through berming (Figure 4.4). The major process presently occurring here is **widening**, which has followed minor downcutting of the channel bed (incision). Stormwater input from overland flow around an old sewage pipe on the western bank is causing significant erosion and sediment input (Figure 4.5). This pipe is located at the downstream end of a mass failure along the western bank contributing to sediment in the channel.

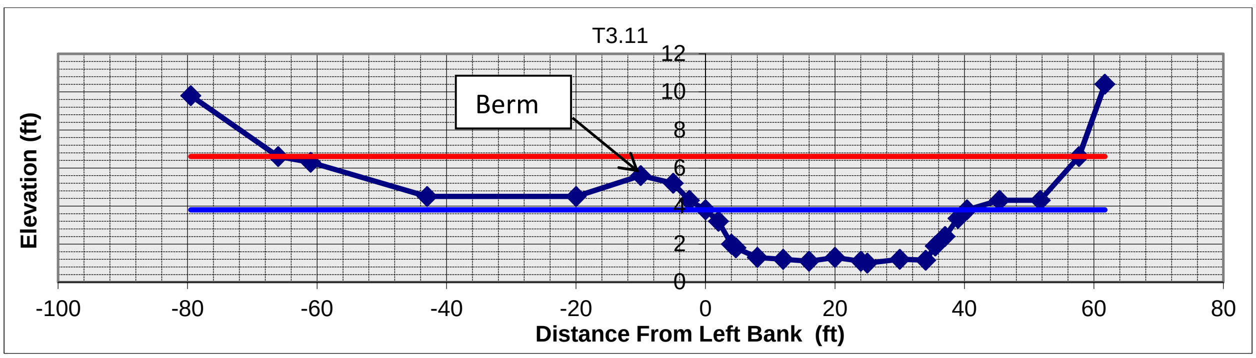


Figure 4.4. Cross section of T3.11 showing berm preventing floodplain access.

T3.11 is in **fair** habitat condition. This reach has limited pools; however, it does contain abundant large woody debris. The majority of the eastern bank has a buffer less than 25 feet and poor vegetative cover on this bank (Figure 4.6).

T3.11 Data Summary		**Reference**	**Existing**
Length: 939 ft Evolution Stage: F-III Sensitivity: Very High	Confinement	Broad	Broad
	Stream Type	C	C
	Dominant Bed Material	Gravel	Gravel
	Dominant Bedform	Riffle-Pool	Riffle-Pool
	Entrenchment Ratio	>2.2	3.1
	Incision Ratio	< 1.2	1.2
Major Stressors:	**Poor Bank Vegetation, Poor Buffers, Encroachments, Channel Straightening, Stormwater Input, Erosion, Mass Failure**		

Figure 4.5. Overland flow causing erosion around old sewage pipe in T3.11.

Figure 4.6. Widening channel and sparse buffer in T3.11.

T3.11 Project Identification:

- **Passive Restoration** by planting trees within the riparian corridor in areas where buffers are less than 25 feet wide to reduce property loss from further bank erosion and enhance bank and buffer conditions. (Map 1: Project #1)
- **Passive Restoration** by allowing natural regeneration of buffer to improve buffer habitat and stream channel protection. (Map 1: Project #2)
- **Active Restoration** by conducting alternatives analysis for berm removal to open up more floodplain access for overbank streamflows and sediment storage. (Map 1: Project #3)
- **Stormwater Management** by evaluating stormwater input around old sewage pipe no longer in use and stabilizing stream bank around the pipe.(Map 1:Project #4)

T3.12

This reach was split into four segments to account for changes in floodplain access resulting in a change in stream type as well as landowner permission. The reference confinement in this reach is variable and is changed by human impacts in the downstream end of the reach.

T3.12-A

This segment begins where the Sutton River enters the West Branch Passumpsic River and continues 1,400 feet upstream through a developed section to where the river becomes more confined and there is a stream type change from “C” to a “B”. Route 5A has impacted the segment by encroaching on the river corridor and causing a change in valley type from Broad to Narrow. Stormwater from Route 5A is also entering the West Branch and altering its natural channel flow conditions. The corridor is rather developed in this segment and there are two bridge crossings that are constricting the flow through the channel. A portion of the eastern bank of T3.12-A lacks an adequate riparian buffer (Figure 4.7). At the downstream end of the segment, there are numerous old cars abandoned within the river corridor in an old junkyard along Burke Hollow Road.

Figure 4.7. Poor riparian buffer in T3.12-A.

T3.12-A is in **good** geomorphic condition with no major process occurring. The segment has experienced minor **historic incision** and is more **aggradational** than the upstream segments, but it remains in stage F-I. Due to the presence of grade controls it is not continuing to incise into the bed. Material that is transported from bedrock controlled segments upstream is working its way through segment T3.12-A. The valley width is variable throughout the segment with an average confinement of "Narrow". The cross section was measured in an area with a "Broad" valley. This segment is in **fair** habitat condition mainly due to its minimal large woody debris and larger pools, bank erosion and inadequate vegetation on the western bank and riparian area. Invasive species (Japanese knotweed and honeysuckle) are present along both banks.

T3.12-A Data Summary		Reference	Existing
Length: 1,400 ft Evolution Stage: F-I Sensitivity: Very High	Confinement	Broad	Narrow
	Stream Type	C	C
	Entrenchment Ratio	> 2.2	7.9
	Incision Ratio	< 1.2	1.3
	Dominant Bed Material	Cobble	Cobble
	Dominant Bedform	Riffle-Pool	Riffle-Pool
Major Stressors:	**Poor Bank Vegetation, Poor Buffers, Invasive Plants, Revetments, Channel Straightening, Encroachments, Development, Stormwater Inputs**		

T3.12-A Project Identification:

- **Active Restoration** by removing cars from abandoned junkyard area in river corridor. (Map 2: Project #1)
- **Active Restoration and Stormwater Management** by replacing deteriorated bridge (and evaluating causes for deterioration) at Burke Hollow Road crossing to improve geomorphic stability and habitat connectivity of the stream channel; also reduce the risk of debris jams, which may increase flooding risk. (Map 2: Project #2)
- **Passive Restoration** by planting trees within the riparian corridor in areas where buffers are less than 25 feet wide to reduce further bank erosion and enhance streambank conditions. (Map 2: Project #3)
- **Active Restoration** by replacing bridge at Bridge Street crossing to reduce the risk of debris jams, which may cause increased flooding risks. (Map 2: Project #4)

T3.12-B

This segment begins where the confinement becomes semi-confined and the stream type is a “B” and continues upstream to the Route 5A Bridge. There is extensive bedrock throughout this segment and it has a natural plane bed channel (Figure 4.8). Due to the extensive bedrock control, a full Phase 2 assessment was not conducted. Route 5A encroaches along the western bank for the entire length of the segment and has caused a stream type departure from a “C” to a “B”. Segment T3.12-B and was assigned an administrative judgment of **good** geomorphic condition due to its stability and lack of recent channel adjustment. A modified reference stream type of “B” was also assigned. The evolution of the channel back to the natural reference stream type of “C” is prohibitive due to the present infrastructure, valley conditions and stable bedrock channel.

Figure 4.8. Bedrock grade control segment T3.12-B.

T3.12-B Data Summary		Reference	Existing
Length: 600 ft Evolution Stage: NE Sensitivity: NE NE = Not Evaluated	Confinement	Broad	Semi-confined
	Stream Type	C	B
	Entrenchment Ratio	> 2.2	NE
	Incision Ratio	< 1.2	NE
	Dominant Bed Material	Bedrock	Bedrock
	Dominant Bedform	Plane Bed	Plane Bed
Major Stressors:	**Poor Bank Vegetation, Poor Buffers, Invasive Plants, Revetments, Channel Straightening, Encroachments, Development**		

T3.12-B Project Identification:

- None

T3.12-C

This segment begins at the Route 5A Bridge and continues upstream until an old mill abutment where the land use on the western bank becomes agricultural. T3.12-C has perhaps been impacted by the presence of the old mill dam that has since been removed. The old abutment is causing some localized geomorphic instability as floodwaters are diverted around it, thereby creating a flood chute (Figures 4.9 and 4.10). Removal of the abutment would provide for greater channel capacity, create a better connection to the floodplain, and improve the streambanks. Removal of the abutment would also limit the potential for debris jams during flood events. There is a dam present in the downstream section of the segment causing a potential fish passage issue (Figure 4.11). Removal of the dam would provide connectivity for fish species to upstream areas and restore natural conditions of streamflow and sediment deposition and transport.

T3.12-C is in **good** geomorphic condition with major **historic incision** as the main process that has occurred most likely due to influence from the old mill dam. Abundant bedrock in the bed is preventing further incision and bedrock along the western bank and trees are preventing widening leading to its stable condition. T12-C is in **fair** habitat condition primarily due to channel morphology impacted by bed degradation, lack of connectivity from the dam, and pockets of areas with no buffer.

Figure 4.9. Old mill dam location with abutments in segment T3.12-C.

Figure 4.10. Old bypass around channel through abutment in segment T3.12-C.

Figure 4.11. Dam in segment T3.12-C.

T3.12-C Data Summary		Reference	Existing
Length: 1,020 ft Evolution Stage: F-II Sensitivity: Moderate	Confinement	Narrow	Narrow
	Stream Type	C	C
	Entrenchment Ratio	> 2.2	2.5
	Incision Ratio	< 1.2	1.6
	Dominant Bed Material	Cobble	Cobble
	Dominant Bedform	Riffle-Pool	Riffle-Pool
Major Stressors:	**Poor Buffers, Revetments, Dam, Old abutment**		

T3.12-C Project Identification:

- **Active restoration** by alternatives analysis for dam removal to improve habitat connectivity and restore natural sediment transport and streamflow conditions. (Map 2: Project #5)
- **Passive restoration** by planting trees within the riparian corridor in areas where buffers are less than 25 feet wide to reduce further bank erosion and enhance streambank conditions. (Map 2: Project #6)
- **Active restoration** by alternatives analysis for old abutment removal to improve geomorphic stability and connection to the floodplain. (Map 2: Project #7)

T3.12-D

The most upstream segment (T3.12-D) did not receive a full Phase 2 assessment due to lack of landowner permission. This segment begins just above an old mill dam where the land use becomes agricultural and continues upstream for about ½ mile where land use on both sides turns to forested. A stream geomorphic condition of **fair** was assigned based on administrative judgment due to the lack of buffer from agricultural activities.

T3.12-D Data Summary		Reference	Existing
Length: 2,640 ft Evolution Stage: NE Sensitivity: NE	Confinement	Very Broad	Very Broad
	Stream Type	C	C
	Entrenchment Ratio	> 2.2	NE
	Incision Ratio	< 1.2	NE
	Dominant Bed Material	Gravel	Gravel
	Dominant Bedform	Riffle-Pool	Riffle-Pool
Major Stressors:	**Poor Buffers, Poor Bank Vegetation**		

T3.12-D Project Identification:

- None

Sutton River

T3.S3.01

This reach was divided up into three segments based on channel conditions and the lack of landowner permission through the middle of the reach.

T3.S3.01-A

This segment begins at the confluence with the West Branch Passumpsic River and continues upstream for 1,320 feet until the river corridor goes away from Route 5. Development, road encroachment, and channel alteration in downtown West Burke have impacted the segment considerably. Numerous stormwater inputs (overland flow, tile drains, road ditches, and urban stormwater pipes) are increasing the natural flow conditions in the channel. The stream channel flows through three bridge crossings, two of which are causing channel and floodprone constrictions.

This segment is in **fair** geomorphic condition. The human caused impact to the stream has led to extreme **historic incision.** The bed has degraded so much that the channel has lost connection to its floodplain and has departed from its reference "C" stream type and is now a "B" stream (See Figures 4.12 and 4.13). Abundant rip rap along the banks is limiting widening. **Planform adjustment** is major due to the extensive channel straightening. This segment is in **fair** habitat condition because of a lack of adequate bank and buffer vegetation, extensive revetments, algal growth on the substrate, fines and embedded larger substrate, and poor channel morphology. Increased algal growth in streams is commonly associated with stormwater carrying pollutants to receiving streams. Numerous stormwater inputs were observed in this segment, which most likely have contributed to the algal growth. Some areas of the channel bed have departed from riffle-pool to plane bed from the excessive bed degradation.

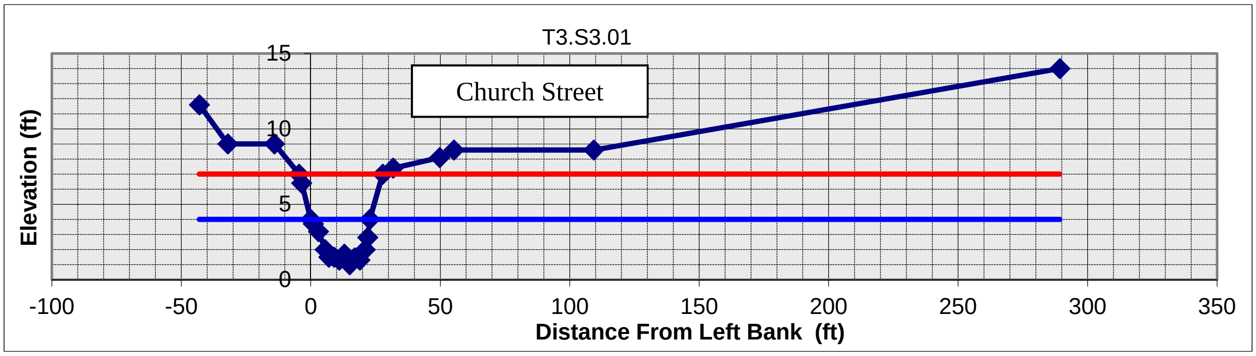


Figure 4.12. Cross section in T3.S3.01-A shows the degree of incision which has caused a disconnection to the floodplain.

Figure 4.13. View of eastern (right) bank of cross section in T3.S3.01-A shows the degree of incision and lack of buffer.

T3.S3.01-A Data Summary		**Reference**	**Existing**
Length: 1,320 ft Evolution Stage: F-II Sensitivity: Very High	Confinement	Very Broad	Very Broad
	Stream Type	C	B
	Entrenchment Ratio	> 2.2	1.4
	Incision Ratio	< 1.2	2.0
	Dominant Bed Material	Gravel	Gravel
	Dominant Bedform	Riffle-Pool	Riffle-Pool
Major Stressors:	**Poor Buffers, Poor Bank Vegetation, Revetments, Encroachments, Development, Channel Straightening, Stormwater Input**		

T3.S3.01-A Project Identification:

- **Stormwater Management** by providing improved treatment of stormwater runoff and attenuation of stormflows entering the stream. (Map 3: Project #1)
- **Passive Restoration** by planting trees within the riparian corridor in areas where buffers are less than 25 feet wide to reduce further bank erosion and enhance streambank conditions. (Map 3: Projects #2 & #3)

T3.S3.01-B

The middle segment (T3.S3.01-B) of the Sutton River did not receive a full Phase 2 assessment due to lack of landowner permission. This segment begins where the river corridor is no longer encroached upon by Route 5 and continues for 540 feet just upstream of a home on the northern bank. An administrative judgment of **good** geomorphic condition was assigned for T3.S3.01-B based on its similarity to the upstream segment, which was in good condition.

T3.S3.01-B Data Summary		**Reference**	**Existing**
Length: 540 ft Evolution Stage: NE Sensitivity: NE	Confinement	Very Broad	Very Broad
	Stream Type	C	C
	Entrenchment Ratio	> 2.2	NE
	Incision Ratio	< 1.2	NE
	Dominant Bed Material	Cobble	Cobble
	Dominant Bedform	Riffle-Pool	Riffle-Pool
Major Stressors:	**Development**		

T3.S3.01-B Project Identification:

- None

T3.S3.01-C

The upper segment begins just above where housing and road development in the corridor ends and the railroad within the river corridor begins. The segment is 1,756 feet long and is in in **good** geomorphic condition despite the presence of the railroad, which has caused a minor change in valley width. Aside from a few short lived locations (including the area around the railroad bridge), banks and buffers are well vegetated. The channel has good floodplain access and is in stable condition. T3.S3.01-C is also in **good** habitat condition thanks to the well forested banks and buffers, abundant large woody debris and pools. Fine sediment was present on the channel bed, which increased the embeddedness of the larger substrate, but this appeared to be a natural condition of the channel in this part of the watershed.

T3.S3.01-C Data Summary		**Reference**	**Existing**
Length: 1,756 ft Evolution Stage: F-I Sensitivity: Moderate	Confinement	Broad	Broad
	Stream Type	C	C
	Entrenchment Ratio	> 2.2	2.9
	Incision Ratio	< 1.2	1.0
	Dominant Bed Material	Cobble	Cobble
	Dominant Bedform	Riffle-Pool	Riffle-Pool
Major Stressors:	**Encroachments**		

T3.S3.01-C Project Identification:

- **Passive Restoration** by protecting the river corridor through easements to maintain excellent floodplain access and sediment attenuation. (Map 3: Project #4)

- **Active Restoration** by investigating the removal of sheet metal, which is causing drop in bed elevation. This project would enhance connectivity for fish species. (Map 3: Project #5)

4.3 Stream Crossings

Table 3 on page 2 of Appendix A summarizes the data collected and compatibility for the assessed structures within the Phase 2 study area. Of the eight bridges assessed, six were "partially compatible" with the natural stream channel form and process and two were "mostly compatible." The term "partially compatible" means that there is a moderate risk of structure failure and replacement may be needed in future, while "mostly compatible" suggests that there is a low risk of failure for the structure (Milone & MacBroom, 2008). This information can be used by municipalities and the Vermont Agency of Transportation to prioritize bridge replacements.

Stream crossings that have been recommended for replacement are in segments T3.12-A on the main stem of the West Branch and T3.S3.01-C on the Sutton River. Figures 4.14 and 4.15 show the crossing on Burke Hollow Road in segment T3.12-A where the bridge decking has deteriorated from overland runoff. There is also a metal bar in the channel causing a potential problem for fish migration. At the Bridge Street crossing there is a substantial channel constriction (50 percent bankfull width), which has resulted in scouring of the structure (Figure 4.16). The third stream crossing recommended for retrofitting/replacement is the railroad crossing in segment T3.S3.01-C due to its constrictive nature, poor alignment, and piers and sheet metal in the channel. The sheet metal in the channel is causing a potential issue for fish passage due to the drop it has created. More details of recommendations on retrofitting or replacing the bridges are included in the tables and maps in Appendix B under site level opportunities.

Figure 4.14. Deteriorating decking of Burke hollow Road Bridge in segment T3.12-A.

Figure 4.15 Steel bar in channel at Burke Hollow Road stream crossing potentially preventing fish passage.

Figure 4.16. Channel constriction at Bridge Street crossing in segment T3.12-A.

4.4 Next Steps

There are many opportunities available to work towards restoring the West Branch Passumpsic River and the Sutton River to stable conditions. Preliminary reach level and site level projects have been identified and will form the basis for future project development. These preliminary projects include: protection of the river corridor through easements, streamside plantings, berm removal, investigation of old abutment removal, dam removal, bridge replacement, and improving stormwater runoff. 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 Towns of Sutton and Burke could pursue the opportunity to work with the Caledonia County Natural Resources Conservation District and the Vermont Agency of Natural Resources to develop Fluvial Erosion Hazard Zones for the land surrounding the West Branch main stem and tributaries. The following are recommendations for next steps.

1. Project partners to provide outreach to private landowners and the public about the plan and potential projects.
2. CCNRCD in collaboration with the Vermont Agency of Natural Resources will develop Fluvial Erosion Hazard Zones for the existing Phase 2 data on the main stem of the West Branch Passumpsic River and Sutton River.
3. Work with regulatory agencies on project design and permitting.

4. Acquire funding and hire contractors (river scientists and engineers) to prepare project design and implementation strategies for selected high priority projects (refer to Appendix B).
5. Obtain funding and perform Phase 2 assessment of more tributaries to the West Branch Passumpsic River.

For additional information about river restoration and protection opportunities within the West Branch Passumpsic River watershed please contact:

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Caledonia County NRCD
481 Summer Street
St. Johnsbury, VT 05819

5.0 LIST OF ACRONYMS AND GLOSSARY OF TERMS

List of Acronyms

BCE – Bear Creek Environmental, LLC
CCNRCD – Caledonia County Natural Resources Conservation District
CREP – Conservation Reserve Enchancement Program
CRWC – Connecticut River Watershed Council
EQIP – Environmental Quality Incentives Program
ERP – Ecosystem Restoration Program
FEH – Fluvial Erosion Hazard Zone
GIS – Geographic Information System
NWI – National Wetlands Inventory
QA/QC – quality assurance/quality control
RCE – ANR River Corridor Easement Program
RHA- Rapid Habitat Assessment
RGA-Rapid Geomorphic Assessment
SGA – Stream Geomorphic Assessment
SGAT – Stream Geomorphic Assessment Tool
TFS – Trees for Streams
USGS – United States Geological Survey
VANR – Vermont Agency of Natural Resources
VTDEC – Vermont Department of Environmental Conservation
WHIP – Wildlife Habitat Incentives Program
WRP – Wetland Reserve Program

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, 2009, VT Agency of Natural Resources, Waterbury, VT.
http://www.vtwaterquality.org/rivers/docs/assessmenthandbooks/rv_apxqglossary.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 rising 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 stream bank 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.

Bifurcated Channel – a river channel that has split into two branches as a result of planform adjustment (i.e. split flow due to island).

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 main stem 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).

Diagonal Bar – Type of depositional feature perpendicular to the bank that is formed from excess sedimentation and within the channel and from the development of steep riffles.

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 – The 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.

Floodprone Width – the wetted width of the channel when the water level is twice the maximum bankfull depth. For most channels this is associated with less than a 50 year return period (Rosgen, 1996).

Fluvial Geomorphology – the physics of flowing water, sediments, and other products of watersheds in relation to various land forms.

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.

Steep Riffle – Associated with aggradation where sediment has dropped out to form a steep face of sediment on the downstream side.

Surficial Sediment/Geology – Sediment that lies on top of bedrock.

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

Tributary Rejuvenation – As the bed of the main stem is lowered, head cuts (incision) begin at the mouth of the tributary and move upstream.

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.

6.0 REFERENCES

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APPENDIX A

Bridge & Culvert Assessment Data

Table 1. Scoring Table (Vermont Culvert Geomorphic Compatibility Screen Tool, adapted by BCE for bridges)				
Score	**% Bankfull Width**	**Sediment Continuity**	**Approach Angle**	**Erosion and Armoring**
5	%BFW ≥ 120	No upstream deposition or downstream bed scour	Naturally Straight	No erosion **or** armoring
4	100 ≤ %BFW < 120	**Either** upstream deposition **or** downstream bed scour, **without** upstream deposits taller than 0.5 bankfull height **or** high downstream banks	n/a	No erosion **and** intact armoring, **or** low upstream **or** downstream erosion **without** armoring
3	75 ≤ %BFW < 100	**Either** upstream deposition **or** downstream bed scour, **with** either upstream deposits taller than 0.5 bankfull height **or** high downstream banks	Mild bend	Low upstream **or** downstream erosion **with** armoring
2	50 ≤ %BFW < 75	**Both** upstream deposition **and** downstream bed scour, **without** upstream deposits taller than 0.5 bankfull height **or** high downstream banks	Channelized Straight	Low upstream **and** downstream erosion
1	30 ≤ %BFW < 50	**Both** upstream deposition **and** downstream bed scour, **with** upstream deposits taller than 0.5 bankfull height **or** high downstream banks	n/a	Severe upstream **or** downstream erosion
0	%BFW < 30	**Both** upstream deposition **and** downstream bed scour, **with** upstream deposits taller than 0.5 bankfull height **and** high downstream banks	Sharp Bend	Severe upstream **and** downstream erosion, **or** failing armoring upstream **or** downstream

Table 2. Compatibility Rating Results (Vermont Culvert Geomorphic Compatibility Screen Tool, adapted by BCE for bridges)			
Category Name	**Screen Score**	**Threshold Conditions**	**Description of Structure-channel Geomorphic Compatibility**
Fully Compatible	16<GC≤20	n/a	Structure fully compatible with natural channel form and process. There is a low risk of failure. No replacement anticipated over the lifetime of the structure. A similar structure is recommended when replacement is needed.
Mostly Compatible	12<GC≤16	n/a	Structure mostly compatible with current channel form and process. There is a low risk of failure. No replacement anticipated over the lifetime of the structure. Minor design adjustments recommended when replacement is needed to make fully compatible.
Partially Compatible	8<GC≤12	n/a	Structure compatible with either current form or process, but not both. Compatibility likely short term. There is a moderate risk of structure failure and replacement may be needed. Re-design suggested to improve geomorphic compatibility.
Mostly Incompatible	4<GC≤8	% Bankfull Width + Approach Angle scores ≤ 2	Structure mostly incompatible with current form and process, with a moderate to high risk of structure failure. Re-design and replacement planning should be initiated to improve geomorphic compatibility.
Fully Incompatible	0≤GC≤4	% Bankfull Width + Approach Angle scores ≤ 2 **AND** Sediment Continuity + Erosion and Armoring scores ≤ 2	Structure fully incompatible with channel and high risk of failure. Re-design and replacement should be performed as soon as possible to improve geomorphic compatibility.

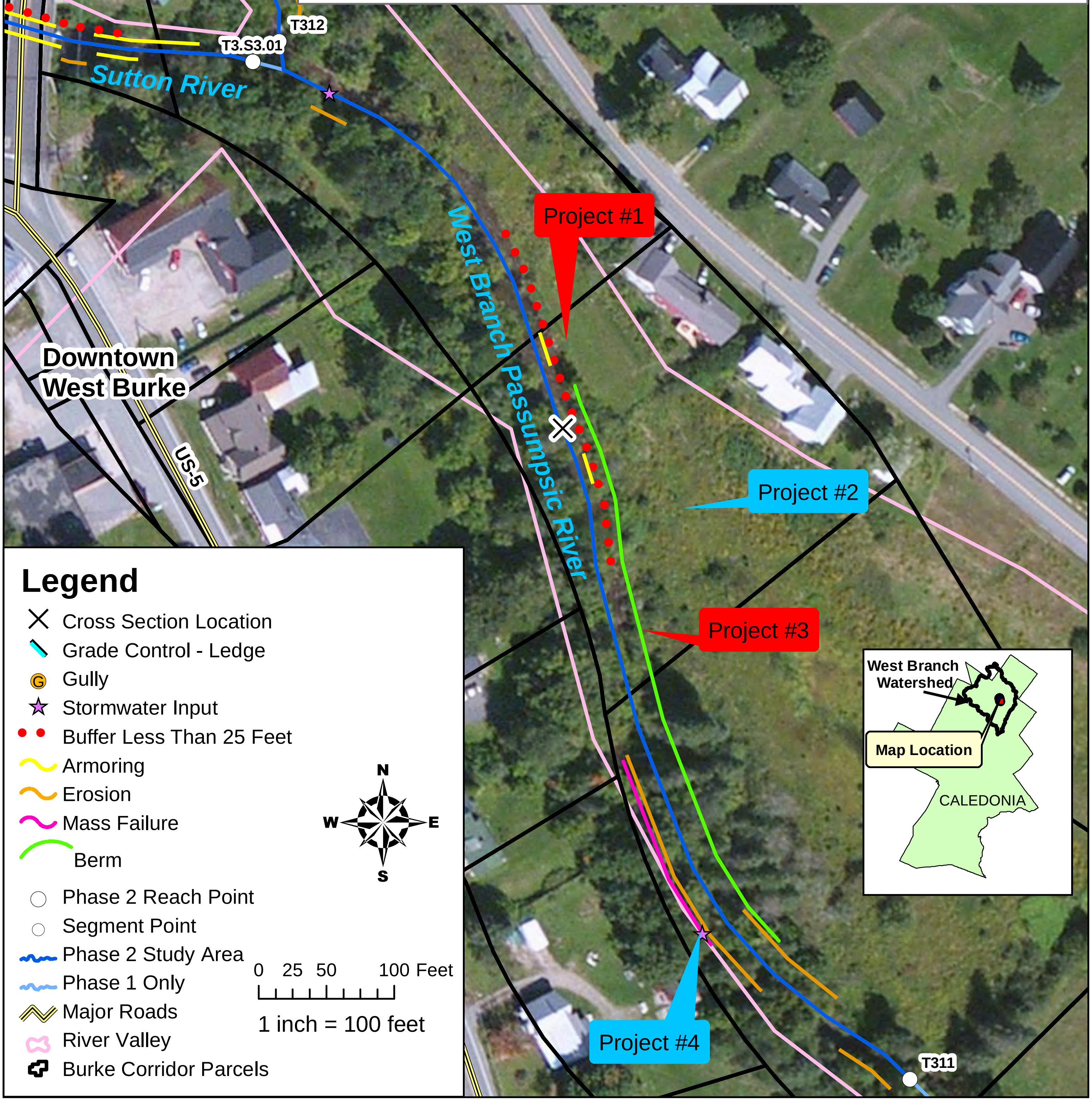
Table 3. West Branch Passumpsic River & Sutton River Bridge Assessment (2013)											
Reach/ Segment Number	Town	Road Name	Structure ID[1]	Percent Bankfull Channel Width[2]	Phase 2 Notes	Scoring					
						% Bankfull Width	Sediment Continuity	Approach Angle	Erosion & Armoring	Total Score	Category
T3.12-A	Burke	Burke Hollow Road	990002000603021	60	Scour below. Deteriorating decking caused by stormwater runoff. Metal bar at bridge outlet is a grade control with a drop of 2 feet.	2	4	2 Channelized Straight	0	**8**	Partially Compatible
T3.12-A	Burke	Bridge Street	990033000903021	50	Deteriorated wing walls and abutments at upstream end.	2	5	5 Naturally Straight	0	**12**	Partially Compatible
T3.12-C	Burke	Route 5A	200287000303022	71	In good condition but still constricting. Bedrock underneath structure providing stability. Poorly aligned. Scour below is most likely due to bedrock.	2	4	5 Naturally Straight	4	**15**	Mostly Compatible
T3.12-C	Sutton	Private Driveway	n/a	114	Not a channel constriction. Wooden foot bridge.	4	5	3 Mild Bend	0	**12**	Partially Compatible
T3.S3.01-A	Burke	Route 5A	200287000103022	237	Not a channel constriction. Abundant fine sediment in structure but does not seem to be deposited. Sediment may have been filled in when bridge was built. Old dam remnants causing scour, not structure.	5	5	3 Mild Bend	0	**13**	Mostly Compatible
T3.S3.01-A	Burke	Church Street	700034033403023	88	Deteriorating footers. Overland runoff from road.	3	5	3 Mild Bend	0	**11**	Partially Compatible
T3.S3.01-A	Burke	Route 5	300113014903021	78	Deposition above. Deteriorating wing walls. Stormwater runoff from road scouring wingwall on downstream side. Very low clearance.	4	4	3 Mild Bend	0	**11**	Partially Compatible
T3.S3.01-C	Sutton	Railroad	n/a	68	Poorly aligned. Boulders and corrugated sheet metal just upstream of structure is maybe causing a fish passage issue. Five old piers in channel.	2	5	3 Mild Bend	0	**10**	Partially Compatible

[1]The structure ID is the identification number provided by the 2010 "TransStructures_TRANSTRUC" shapefile from the Vermont Center for Geographic Information, unless no number was available.
[2]Percent Bankfull Channel Width percentages are calculated based on the observed channel width for each segment's cross section. The constriction percentage is calculated by dividing the present constriction width by the observed channel width. The span percentage is calculated by dividing the bridge span by the observed channel width.

APPENDIX B

Potential Project Locations and Descriptions

Map 1: Impacts and Potential Projects
Reach T3.11
West Branch Passumpsic River Watershed



Background is Bing Imagery

Projects:

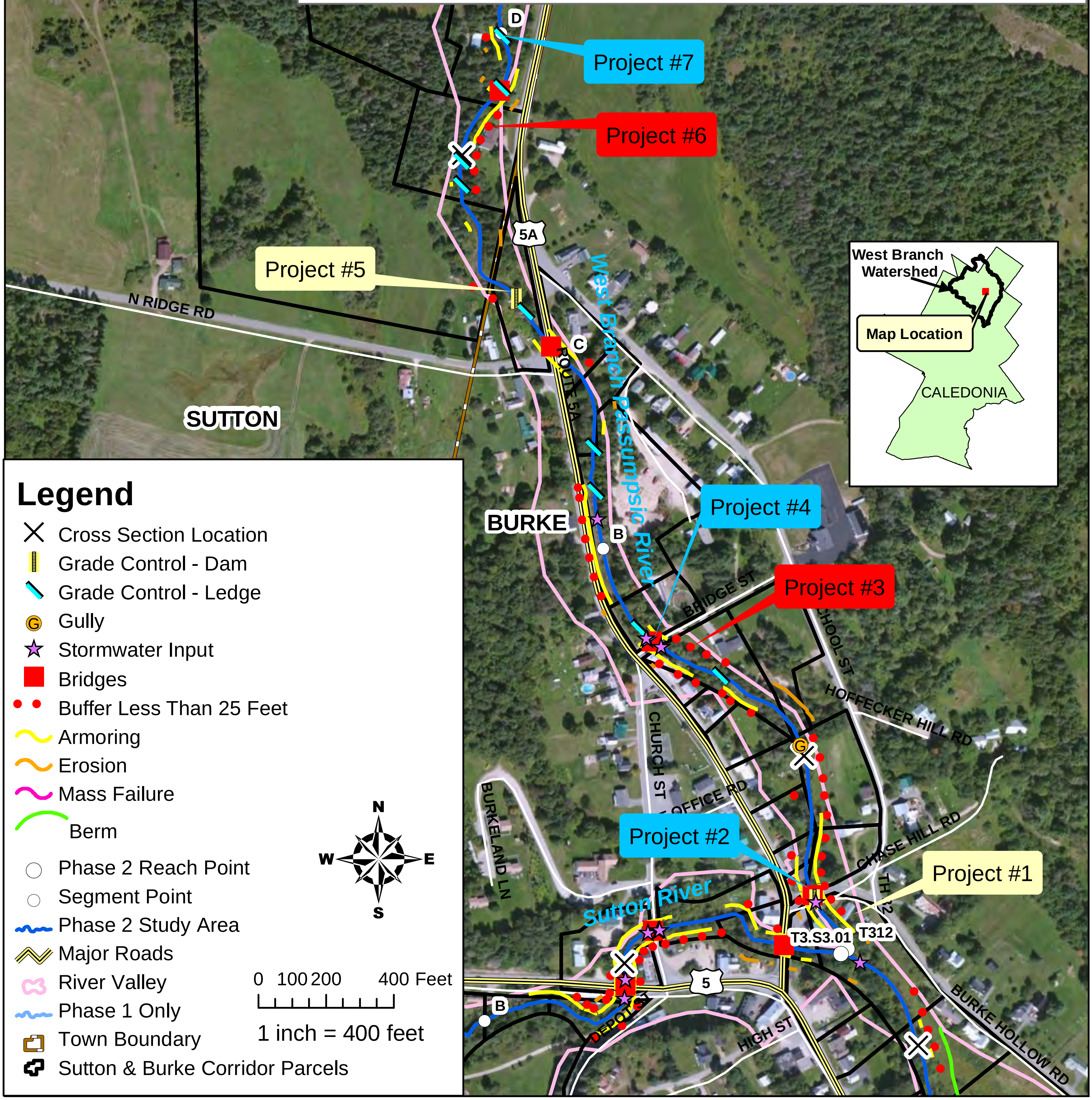
1. Streamside Plantings
2. Allow Natural Regeneration of Buffer
3. Alternatives Analysis for Berm Removal
4. Stormwater Management and Bank Stabilization

Project Priority:

- Low
- Moderate
- High

Bear Creek Environmental

Map 2: Impacts and Potential Projects
Reach T3.12
West Branch Passumpsic River Watershed



Background is Bing Imagery

Projects:

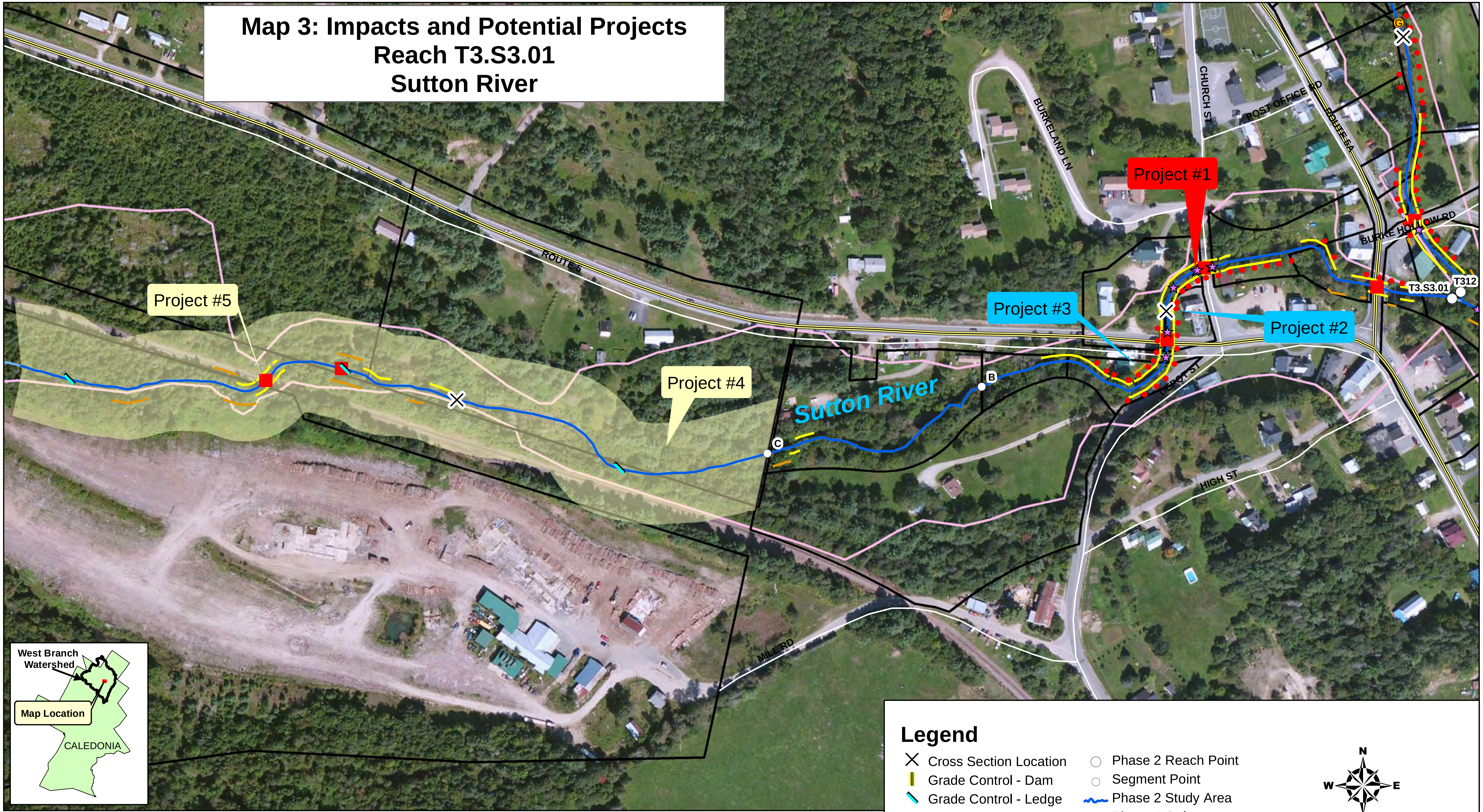
1. River Corridor Clean-up
2. Bridge Replacement
& Evaluate Stormwater Management
3. Streamside Plantings
4. Bridge Replacement
5. Dam Removal
6. Streamside Plantings
7. Old Abutment Removal

Project Priority:

- Low
- Moderate
- High

Bear Creek Environmental

Map 3: Impacts and Potential Projects
Reach T3.S3.01
Sutton River



Background is Bing Imagery

Legend

- Cross Section Location
- Grade Control - Dam
- Grade Control - Ledge
- Gully
- Stormwater Input
- Bridges
- Buffer Less Than 25 Feet
- Armoring
- Erosion
- Mass Failure
- Phase 2 Reach Point
- Segment Point
- Phase 2 Study Area
- Phase 1 Only
- Major Roads
- River Valley
- River Corridor Easement

N W E S

0 50 100 200 Feet

1 inch = 200 feet

Projects:

1. Stormwater Management
2. Streamside Plantings
3. Streamside Plantings
4. River Corridor Easement
5. Investigation of removal of piers and sheet metal

Project Priority:

- Low
- Moderate
- High

Bear Creek Environmental

Table 1. West Branch Passumpsic River Maps 1 and 2: T3.11 and T3.12 Site Level Opportunities for Restoration and Protection Burke & Sutton, Vermont							
Project # Segment	**Type of Project**	**Site Description Including Stressors and Constraints**	**Project or Strategy Description**	**Technical Feasibility and Priority**	**Benefits**	**Costs**	**Potential Partners/Programs**
*Project #1 T3.11	Passive Restoration	Residential lawn along river corridor lacks adequate buffer on eastern bank	Streamside plantings	High Priority	Improved habitat and water quality	Cost of plantings	Landowners, CCNRCD, VANR, Town of Burke TFS, WHIP, CRWC
Project #2 T3.11	Passive Restoration	Old agricultural fields along river corridor does not have adequate buffer on eastern bank	Allow vegetation to naturally regenerate over time	Moderate Priority	Improved habitat and water quality	None	Landowners, CCNRCD
Project #3 T3.11	Active Restoration	A 450-foot berm on eastern side is limiting floodplain access at lower flows	Alternatives analysis for the removal of the berm	High Priority	Improved geomorphic stability	Cost of analysis and potential berm removal	Landowners, CCNRCD, VANR, Town of Burke ERP, CRWC
Project #4 T3.11	Active Restoration	Stormwater runoff around abandoned sewage pipe along western bank is causing bank instability	Evaluate stormwater inputs and stabilize streambank	Moderate Priority	Improved habitat and water quality	Cost of stabilization and evaluation	Landowners, CCNRCD, VANR, Town of Burke/Village of West Burke ERP, CRWC
Project #1 T3.12-A	River corridor clean-up	Old cars in river corridor	Clean up old cars in river corridor	Low Priority	Improved habitat	Cost of car removal	Landowners, CCNRCD
Project #2 T3.12-A	Active Restoration/ Stormwater Management	Stormwater runoff has deteriorated Burke Hollow Road bridge decking; steel bar may be causing fish passage issue	Replace bridge, Evaluate stormwater inputs	Moderate Priority	Improved habitat and water quality; Decreased risk of flooding from debris jams	Cost of bridge replacement and evaluation	Landowners, CCNRCD, VANR, VTrans, Town of Burke VTrans, ERP, CRWC

Table 1. West Branch Passumpsic River
Maps 1 and 2: T3.11 and T3.12
Site Level Opportunities for Restoration and Protection
Sutton & Burke, Vermont

Project # Segment	Type of Project	Site Description Including Stressors and Constraints	Project or Strategy Description	Technical Feasibility and Priority	Benefits	Costs	Potential Partners/Programs
Project #3 T3.12-A	Passive Restoration	Residential area where buffer is not adequate	Streamside plantings	High Priority	Improved habitat and water quality	Cost of plantings	Landowners, CCNRCD, VANR, Town of Burke TFS, WHIP, CRWC
Project #4 T3.12-A	Active Restoration	Bridge Street crossing is causing channel constriction	Replace bridge	Moderate Priority	Improved habitat and water quality; Decreased risk of flooding from debris jams	Cost of bridge replacement	Landowners, CCNRCD, VTrans, Town of Burke VTrans, CRWC
Project #5 T3.12-C	Active Restoration	Dam creating potential fish passage issue	Alternatives analysis for dam removal	Low Priority	Improved habitat	Cost of dam removal	Landowners, CCNRCD, VANR, Town of Burke ERP, CRWC
*Project #6 T3.12-C	Passive Restoration	Residential area where buffer is not adequate	Streamside plantings	High Priority	Improved habitat and water quality	Cost of plantings	Landowners, CCNRCD, VANR, Town of Sutton TFS, WHIP, CRWC
Project #7 T3.12-C	Active Restoration	Old abutment from old mill causing redirection of channel flow around old mill dam	Alternatives analysis for removal of old abutment	Moderate Priority	Improved geomorphic stability	Cost of abutment removal	Landowners, CCNRCD, VANR, Town of Sutton ERP, CRWC

* Indicates that there is landowner interest for this project. TFS=Trees for Streams, WHIP=Wildlife Habitat Incentives Program, CRWC=Connecticut River Watershed Council, ERP=Ecosystem Restoration Program, VTrans = Vermont Agency of Transportation

Table 2. Sutton River Map 3: T3.S3.01 Site Level Opportunities for Restoration and Protection Burke & Sutton, Vermont							
Project # Segment	**Type of Project**	**Site Description Including Stressors and Constraints**	**Project or Strategy Description**	**Technical Feasibility and Priority**	**Benefits**	**Costs**	**Potential Partners/Programs**
Project #1 T3.S3.01	Stormwater Management	Runoff from Church Street, Building Tile Drain, and Urban Stormwater Pipe is causing excess stormwater in stream channel.	Evaluate stormwater inputs	High Priority	Improved water quality	Unknown	Landowner, TRORC, VANR, Town of Burke ERP
Project #2 T3.S3.01-A	Passive Restoration	Residential area where buffer is not adequate	Streamside plantings	Moderate Priority	Improved habitat and water quality	Cost of plantings	Landowners, CCNRCD, VANR, Town of Sutton TFS, WHIP, CRWC
Project #3 T3.S3.01-A	Passive Restoration	Residential area where buffer is not adequate	Streamside plantings	Moderate Priority	Improved habitat and water quality	Cost of plantings	Landowners, CCNRCD, VANR, Town of Sutton TFS, WHIP, CRWC
Project #4 T3.S3.01-C	Passive Restoration	Mostly forested river corridor with good floodplain access	Protect river corridor through easement	Low Priority	Improved habitat and water quality	Cost of easement	Landowners, CCNRCD, VANR, Town of Sutton RCE
Project #5 T3.S3.01-C	Active Restoration	Railroad bridge crossing is poorly aligned; piers and sheet metal in channel; sheet metal is maybe causing a fish passage issue	Investigate removal of sheet metal	Low Priority	Improved habitat and geomorphic stability	Cost of removal of sheet metal	Landowners, CCNRCD, VTFW, VTrans, Railroad Company, Town of Sutton VTFW, CRWC

* Indicates that there is landowner interest for this project. TFS=Trees for Streams, WHIP=Wildlife Habitat Incentives Program, CRWC=Connecticut River Watershed Council, ERP=Ecosystem Restoration Program, RCE=River Corridor Easement, VTrans = Vermont Agency of Transportation , VTFW = Vermont Fish and Wildlife Department

APPENDIX C

Phase 2 Geomorphic Assessment Data

Phase 2 Segment Summary Report West Branch Passumpsic

Stream:	West Branch Passumpsic River	SGAT Version:	4.56
Reach:	T3.11-0	Organization:	Bear Creek Environmental
Segment Length(ft):	939	Observers:	PD, EE
Rain:	Yes	Completion Date:	8/27/2013
		Qualtiy Control Status - Consultant:	Provisional
		Qualtiy Control Status - Staff:	Provisional

Step 0 - Location:

Step 5 - Notes:

Step 7 - Narrative: **Berm along left bank for most of segment but there is a lower RAF on the opposite side of stream, so IR =1.2. Removal of berm would provide better floodplain access. channel has widened somewhat, landowner said he noticed about 10 feet off bank lost in 15 years. Planform is major due to straightening. Minor aggradation, but steep riffles are present.**

Step 1. Valley and Floodplain

1.1 Segmentation: **None**

1.2 Alluvial Fan: **None**

1.3 Corridor Encroachments:

Length (ft)	One	Height	Both	Height
Berm:	450	2	0	
Road:	423	0	0	
Railroad:	0		0	
Imp. Path:	0		0	
Dev.:	371		231	

1.4 Adjacent Side	Left	Right
Hillside Slope:	Steep	Very Steep
Continuous w/ Bank:	Never	Sometimes
Within 1 Bankfull W:	Never	Sometimes
Texture:	N.E.	N.E.

1.5 Valley Features	
Valley Width (ft):	210
Width Determination:	Measured
Confinement Type:	BD
In Rock Gorge:	No
Human Caused Change in Valley Width?:	No

1.6 Grade Controls: **None**

Stream: **West Branch Passumpsic River** Reach: **T3.11-0**

Step 2. Stream Channel

2.1Bankfull Width (ft.):	**40.40**	2.11 Riffle/Step Spacing:	**146 ft.**	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	**2.80**	2.12 Substrate Composition		Bed:	**11.3 inches**
2.3 Mean Depth (tf):	**2.18**	Bedrock:	**0.0 %**	Bar:	**6.1 inches**
2.4 Floodprone Width (ft.):	**123.70**	Boulder:	**3.0 %**	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	**3.30**	Cobble:	**45.0 %**	Stream Type:	**C**
Human Elev FloodPln (ft.):	**4.60**	Coarse Gravel:	**32.0 %**	Bed Material:	**Gravel**
2.6 Width/Depth Ratio:	**18.53**	Fine Gravel:	**11.0 %**	Subclass Slope:	**b**
2.7 Entrenchment Ratio:	**3.06**	Sand:	**9.0 %**	Bed Form:	**Riffle-Pool**
2.8 Incision Ratio:	**1.18**	Silt and Smaller:	**0.0 %**	Field Measured Slope:	
Human Elevated Inc. Rat.:	**1.64**	Silt/Clay Present:	**No**	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	**Low**	Detritus:	**0.0 %**	Reference Stream Type:	
2.10 Riffles Type:	**Sedimented**	# Large Woody Debris:	**16**	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope: **Steep**

Bank Texture	Left	Right
Upper		
Material Type:	**Sand**	**Mix**
Consistency:	**Non-cohesive**	**Non-cohesive**
Lower		
Material Type:	**Boulder/Cobble**	**Mix**
Consistency:	**Non-cohesive**	**Non-cohesive**

Bank Erosion	Left	Right
Erosion Length (ft.):	**98.0**	**275.9**
Erosion Height (ft.):	**2.0**	**3.9**
Revetment Type:	**Rip-Rap**	**None**
Revetment Length:	**48.7**	**0.0**

Near Bank Vegetation Type	Left	Right
Dominant:	**Herbaceous**	**Deciduous**
Sub-dominant:	**Shrubs/Sapling**	**Shrubs/Sapling**
Bank Canopy		
Canopy %:	**1-25**	**26-50**
Mid-Channel Canopy:	**Open**	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	**>100**	**51-100**
Sub-Dominant	**0-25**	**26-50**
W less than 25	**256**	**0**
Buffer Vegitation Type		
Dominant	**Herbaceous**	**Mixed Trees**
Sub-Dominant	**Shrubs/Sapling**	**Herbaceous**

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	**Pasture**	**Residential**
Sub-dominant	**Residential**	**Forest**
(Legacy)	Amount	Mean Hieght
Failures	**One**	**20.0**
Gullies	**None**	

	Left	Right
Mass Failures		**145.5857**
Height		**20.0**
Gullies Number	**0**	
Gullies Length	**0**	

Stream: **West Branch Passumpsic River** Reach: **T3.11-0**

Step 4. Flow & Flow Modifiers

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

4.8 Channel Constrictions: **None**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types		Diagonal:	**0**	5.2 Other Features		Neck Cutoff:	**0**	5.4 Stream Ford or Animal Crossing:	**No**
Mid:	**0**	Delta:	**1**	Flood chutes:	**0**	Avulsion:	**0**	5.5 Straightening:	**With Windrowing**
Point:	**0**	Island:	**0**	5.3 Steep Riffles and Head Cuts		Head Cuts:	**0**	Straightening Length (ft.):	**613**
Side:	**2**	Braiding:	**0**	Steep Riffles:	**1**	Trib Rejuv.:	**No**	5.5 Dredging:	**None**

Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:		6.4 Sediment Deposition:	Stream Gradiant Type	Left	Right
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:	**0**	6.7 Channel Sinuosity:	6.10 Riparian Veg. Zone Width:		
Habitat Rating:	**0.00**				
Habitat Stream Condition:					

Step 7. Rapid Geomorphic Assessment Data

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

Phase 2 Segment Summary Report West Branch Passumpsic

Stream: **West Branch Passumpsic River**
Reach: **T3.12-A**
Segment Length(ft): **1,400**
Rain: **No**

SGAT Version: **4.56**
Organization: **Bear Creek Environmental**
Observers: **Pam DeAndrea, Mary Nealon**
Completion Date: **8/17/2013**
Qualtiy Control Status - Consultant: **Provisional**
Qualtiy Control Status - Staff: **Provisional**

Step 0 - Location: **Segment begins at confluence with Sutton River and continues for 1400 feet.**

Step 5 - Notes: **The subdominant bedform of plane bed is natural. There is bedrock on the bed creating runs as opposed to riffles in some areas. Segment has only slightly incised and remains in stage F-I.**

Step 7 - Narrative: **Minor historic incision. More aggradational than upstream segment, but no large mid-channel bars. Some erosion but very low w/d ratio. Channel is therefore not widening much. Planform change is due to historic channel straightening. Material transported by upstream segments with numerous grade controls is working its way through channel but still in stage F-I because it has not incised significantly.**

Step 1. Valley and Floodplain

1.1 Segmentation: **Channel Dimensions**

1.2 Alluvial Fan: **None**

1.3 Corridor Encroachments:

Length (ft)	One	Height	Both	Height
Berm:	0		0	
Road:	865	0	0	
Railroad:	0		0	
Imp. Path:	0		0	
Dev.:	363		670	

1.4 Adjacent Side	Left	Right
Hillside Slope:	Steep	Hilly
Continuous w/ Bank:	Never	Sometimes
Within 1 Bankfull W:	Sometimes	Sometimes
Texture:	N.E.	N.E.

1.5 Valley Features

Valley Width (ft):	145
Width Determination:	Measured
Confinement Type:	NW
In Rock Gorge:	No
Human Caused Change in Valley Width?:	Yes

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
Ledge	Mid-segment	6.0	5.0	Yes	
Ledge	Mid-segment	2.9	1.0	Yes	
Dam	Mid-segment	2.5	2.0	Yes	

Stream: **West Branch Passumpsic River** Reach: **T3.12-A**

Step 2. Stream Channel

2.1Bankfull Width (ft.):	**26.20**	2.11 Riffle/Step Spacing:	**195 ft.**	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	**3.30**	2.12 Substrate Composition		Bed:	**7.7 inches**
2.3 Mean Depth (tf):	**2.06**	Bedrock:	**2.0 %**	Bar:	**4.8 inches**
2.4 Floodprone Width (ft.):	**206.00**	Boulder:	**1.0 %**	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	**4.30**	Cobble:	**52.0 %**	Stream Type:	**C**
Human Elev FloodPln (ft.):		Coarse Gravel:	**25.0 %**	Bed Material:	**Cobble**
2.6 Width/Depth Ratio:	**12.72**	Fine Gravel:	**7.0 %**	Subclass Slope:	**None**
2.7 Entrenchment Ratio:	**7.86**	Sand:	**13.0 %**	Bed Form:	**Riffle-Pool**
2.8 Incision Ratio:	**1.30**	Silt and Smaller:	**0.0 %**	Field Measured Slope:	
Human Elevated Inc. Rat.:	**0.00**	Silt/Clay Present:	**No**	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	**Low**	Detritus:	**0.0 %**	Reference Stream Type:	
2.10 Riffles Type:	**Complete**	# Large Woody Debris:	**10**	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope: **Steep**

Bank Texture	Left	Right
Upper		
Material Type:	**Sand**	**Sand**
Consistency:	**Non-cohesive**	**Non-cohesive**
Lower		
Material Type:	**Gravel**	**Gravel**
Consistency:	**Non-cohesive**	**Non-cohesive**

Bank Erosion	Left	Right
Erosion Length (ft.):	**159.0**	**52.6**
Erosion Height (ft.):	**2.9**	**3.2**
Revetment Type:	**Multiple**	**Multiple**
Revetment Length:	**480.7**	**692.9**

Near Bank Vegetation Type	Left	Right
Dominant:	**Shrubs/Sapling**	**Deciduous**
Sub-dominant:	**Deciduous**	**Bare**
Bank Canopy		
Canopy %:	**51-75**	**1-25**
Mid-Channel Canopy:	**Open**	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	**51-100**	**0-25**
Sub-Dominant	**0-25**	**51-100**
W less than 25	**798**	**596**
Buffer Vegitation Type		
Dominant	**Herbaceous**	**Herbaceous**
Sub-Dominant	**Mixed Trees**	**Mixed Trees**

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	**Residential**	**Residential**
Sub-dominant	**Forest**	**Shrubs/Sapling**
(Legacy)	Amount	Mean Hieght
Failures	**None**	
Gullies	**One**	**1.0**

	Left	Right
Mass Failures		
Height		
Gullies Number	**1**	
Gullies Length	**2**	

Stream: **West Branch Passumpsic River** Reach: **T3.12-A**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: **Minimal**
4.2 Adjacent Wetlands: **Minimal**
4.3 Flow Status: **Low**
4.4 # of Debris Jams: **0**

4.5 Flow Regulation Type **None**
Flow Reg. Use:
Impoundments: **Unknown**
Impoundment Loc.:
4.6 Up/Down Strm flow reg.: **None**
(old) Upstrm Flow Reg.: **Unknown**

4.7 Stormwater Inputs
Field Ditch: **0** Road Ditch: **1**
Other: **0** Tile Drain: **0**
Overland Flow: **3** Urb Strm Wtr Pipe: **0**
4.9 # of Beaver Dams: **0**
Affected Length (ft): **0**

4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Bridge	13	Yes	Yes	Yes	Yes	None
Bridge	15.7	Yes	Yes	Yes	Yes	Scour Below

Step 5. Channel Bed and Planform Changes

5.1 Bar Types
Mid: **0** Point: **0** Side: **6**
Diagonal: **2** Delta: **1** Island: **0** Braiding: **0**

5.2 Other Features
Flood chutes: **3**
5.3 Steep Riffles and Head Cuts
Steep Riffles: **3**
Neck Cutoff: **0**
Avulsion: **0**
Head Cuts: **0**
Trib Rejuv.: **No**

5.4 Stream Ford or Animal Crossing: **No**
5.5 Straightening: **Straightening**
Straightening Length (ft.): **1,013**
5.5 Dredging: **None**

Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:
6.2 Pool Substrate:
6.3 Pool Variability:
Total Score: **0**
Habitat Rating: **0.00**
Habitat Stream Condition:

6.4 Sediment Deposition:
6.5 Channel Flow Status:
6.6 Channel Alteration:
6.7 Channel Sinuosity:

Stream Gradiant Type Left Right
6.8 Bank Stability:
6.9 Bank Vegetation Protection
6.10 Riparian Veg. Zone Width:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Unconfined**	Score	STD	Historic
7.1 Channel Degradation	14	None	Yes
7.2 Channel Aggradation	12	None	No
7.3 Widening Channel	15	None	No
7.4 Change in Planforml	11	None	Yes
Total Score	52		

Geomorphic Rating **0.65**
Channel Evolution Model **F**
Channel Evolution Stage **I**
Geomorphic Condition **Good**
Stream Sensitivity **Moderate**

Phase 2 Segment Summary Report **West Branch Passumpsic**

Stream: **West Branch Passumpsic River**
Reach: **T3.12-B**
Segment Length(ft): **600**
Rain: **No**

SGAT Version: **4.56**
Organization: **Bear Creek Environmental**
Observers: **PD, MN**
Completion Date: **8/17/2013**
Qualtiy Control Status - Consultant: **Provisional**
Qualtiy Control Status - Staff: **Provisional**
Why Not Assessed: **Other (to be explained in comments)**

Step 0 - Location: **extensive bedrock throughout segment and natural plane bed system. Not as steep as a gorge but no need for full Phase 2 assessment since channel is stable through continuous bedrock on the bed.**

Step 5 - Notes: **Stream type departure from "C" to "B" may have occurred due to change in confinement from "broad" to "semi-confined". Channel is stable due to extensive bedrock and will not migrate back to a "C". A modified reference stream type of "B" was therefore assigned.**

Segment assigned "good" condition due to its stability, lack of aggradation, widening, and recent planform change.

Step 7 - Narrative:

Step 1. Valley and Floodplain

1.1 Segmentation: **Subreach**

1.2 Alluvial Fan: **None**

1.3 Corridor Encroachments:

Length (ft)	One	Height	Both	Height
Berm:	0		0	
Road:	600	0	0	
Railroad:	0		0	
Imp. Path:	0		0	
Dev.:	322		248	

1.4 Adjacent Side	Left	Right
Hillside Slope:	Very Steep	Hilly
Continuous w/ Bank:	Sometimes	Never
Within 1 Bankfull W:	Sometimes	Never
Texture:	Sand	N.E.

1.5 Valley Features

Valley Width (ft): **75**
Width Determination: **Estimated**
Confinement Type: **SC**
In Rock Gorge: **No**
Human Caused Change in Valley Width?: **Yes**

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	3.0	2.5	Yes	

Stream: **West Branch Passumpsic River** Reach: **T3.12-B**

Step 2. Stream Channel

2.1Bankfull 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 (tf):		Bedrock:	%	Bar:	
2.4 Floodprone Width (ft.):		Boulder:	%	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):		Cobble:	%	Stream Type:	**B**
Human Elev FloodPln (ft.):		Coarse Gravel:	%	Bed Material:	**Bedrock**
2.6 Width/Depth Ratio:	**0.00**	Fine Gravel:	%	Subclass Slope:	**c**
2.7 Entrenchment Ratio:	**0.00**	Sand:	%	Bed Form:	**Plane Bed**
2.8 Incision Ratio:	**0.00**	Silt and Smaller:	%	Field Measured Slope:	
Human Elevated Inc. Rat.:	**0.00**	Silt/Clay Present:		2.15 Sub-reach Stream Type	
2.9 Sinuosity:		Detritus:	**0.0 %**	Reference Stream Type:	**B**
2.10 Riffles Type:		# Large Woody Debris:		Reference Bed Material:	**Bedrock**
				Reference Subclass Slope:	**c**
				Reference Bedform:	**Plane Bed**

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope: **Steep**

Bank Texture	Left	Right
Upper		
Material Type:	**Sand**	**Sand**
Consistency:	**Non-cohesive**	**Non-cohesive**
Lower		
Material Type:	**Bedrock**	**Boulder/Cobble**
Consistency:	**Cohesive**	**Cohesive**

Bank Erosion	Left	Right
Erosion Length (ft.):	**23.2**	**0.0**
Erosion Height (ft.):	**4.0**	**0.0**
Revetment Type:	**Multiple**	**Multiple**
Revetment Length:	**72.8**	**249.2**

Near Bank Vegetation Type	Left	Right
Dominant:	**Herbaceous**	**Herbaceous**
Sub-dominant:	**Coniferous**	**None**
Bank Canopy		
Canopy %:	**51-75**	**1-25**
Mid-Channel Canopy:	**Open**	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	**51-100**	**0-25**
Sub-Dominant	**26-50**	**26-50**
W less than 25	**25**	**207**
Buffer Vegitation Type		
Dominant	**Mixed Trees**	**Herbaceous**
Sub-Dominant	**Herbaceous**	**Mixed Trees**

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	**Forest**	**Residential**
Sub-dominant	**Residential**	**None**
(Legacy)	Amount	Mean Hieght
Failures	**None**	
Gullies	**None**	

	Left	Right
Mass Failures		
Height		
Gullies Number	**0**	
Gullies Length	**0**	

Stream: **West Branch Passumpsic River** Reach: **T3.12-B**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: **Minimal**
4.2 Adjacent Wetlands: **None**
4.3 Flow Status: **Low**
4.4 # of Debris Jams: **0**

4.5 Flow Regulation Type **None**
Flow Reg. Use:
Impoundments: **None**
Impoundment Loc.:
4.6 Up/Down Strm flow reg.: **None**
(old) Upstrm Flow Reg.: **None**

4.7 Stormwater Inputs
Field Ditch: **0** Road Ditch: **0**
Other: **0** Tile Drain: **0**
Overland Flow: **1** Urb Strm Wtr Pipe: **0**
4.9 # of Beaver Dams: **0**
Affected Length (ft): **0**

4.8 Channel Constrictions: **None**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types
Mid:
Point:
Side:

Diagonal:
Delta:
Island:
Braiding: **0**

5.2 Other Features
Flood chutes: **0**
5.3 Steep Riffles and Head Cuts
Steep Riffles: **0**

Neck Cutoff: **0**
Avulsion: **0**
Head Cuts: **0**
Trib Rejuv.:

5.4 Stream Ford or Animal Crossing: **No**
5.5 Straightening: **Straightening**
Straightening Length (ft.): **386**
5.5 Dredging: **None**

Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:
6.2 Pool Substrate:
6.3 Pool Variability:
Total Score:
Habitat Rating:
Habitat Stream Condition:

6.4 Sediment Deposition:
6.5 Channel Flow Status:
6.6 Channel Alteration:
6.7 Channel Sinuosity:

Stream Gradiant Type Left Right
6.8 Bank Stability:
6.9 Bank Vegetation Protection
6.10 Riparian Veg. Zone Width:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type Score STD Historic
7.1 Channel Degradation
7.2 Channel Aggradation
7.3 Widening Channel
7.4 Change in Planforml
Total Score

Geomorphic Rating
Channel Evolution Model
Channel Evolution Stage
Geomorphic Condition **Good**
Stream Sensitivity

Phase 2 Segment Summary Report **West Branch Passumpsic**

Stream:	**West Branch Passumpsic River**	SGAT Version:	**4.56**
Reach:	**T3.12-C**	Organization:	**Bear Creek Environmental**
Segment Length(ft):	**1,020**	Observers:	**MN, PD**
Rain:	**No**	Completion Date:	**8/17/2013**
		Qualtiy Control Status - Consultant:	**Provisional**
		Qualtiy Control Status - Staff:	**Provisional**

Step 0 - Location: **Downstream segment break is at intersection of North Ridge Road and Rt 5A**

Step 5 - Notes:

Step 7 - Narrative: **Old mill dams in the 1930s both upstream and downstream of segment may have caused historic channel incision. Abundant bedrock in bed is preventing further incision. Bedrock along right bank may be preventing widening (w/d ratio= 15) along with large trees on banks. Although incised, channel has not progressed along channel evolution model. Channel has incised to bedrock.**

Step 1. Valley and Floodplain

1.1 Segmentation: **Valley Width**

1.2 Alluvial Fan: **None**

1.3 Corridor Encroachments:

	Length (ft) One	Height	Both	Height
Berm:	0		0	
Road:	531	0	0	
Railroad:	0		0	
Imp. Path:	0		0	
Dev.:	274		265	

1.4 Adjacent Side	Left	Right
Hillside Slope:	Hilly	Very Steep
Continuous w/ Bank:	Never	Sometimes
Within 1 Bankfull W:	Never	Sometimes
Texture:	N.E.	Sand

1.5 Valley Features

Valley Width (ft):	**150**
Width Determination:	**Measured**
Confinement Type:	**NW**
In Rock Gorge:	**No**
Human Caused Change in Valley Width?:	**No**

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
Ledge	Mid-segment	1.5	0.7	Yes	
Ledge	Mid-segment	1.5	0.7	Yes	
Ledge	Mid-segment	1.5	0.8	Yes	
Ledge	Mid-segment	2.0	1.2	Yes	
Dam	Mid-segment	3.0	2.5	Yes	
Ledge	Mid-segment	6.5	4.0	Yes	

Stream: **West Branch Passumpsic River** Reach: **T3.12-C**

Step 2. Stream Channel

2.1Bankfull Width (ft.):	**32.30**	2.11 Riffle/Step Spacing:	**216 ft.**	2.13 Average Largest Particle on		
2.2 Max Depth (ft.):	**2.70**	2.12 Substrate Composition		Bed:	**14.6**	**inches**
2.3 Mean Depth (tf):	**2.16**	Bedrock:	**26.0 %**	Bar:	**N/A**	**inches**
2.4 Floodprone Width (ft.):	**79.80**	Boulder:	**15.0 %**	2.14 Stream Type		
2.5 Aband. Floodpn (ft.):	**4.40**	Cobble:	**30.0 %**	Stream Type:	**C**	
Human Elev FloodPln (ft.):		Coarse Gravel:	**12.0 %**	Bed Material:	**Cobble**	
2.6 Width/Depth Ratio:	**14.95**	Fine Gravel:	**10.0 %**	Subclass Slope:	**None**	
2.7 Entrenchment Ratio:	**2.47**	Sand:	**7.0 %**	Bed Form:	**Riffle-Pool**	
2.8 Incision Ratio:	**1.63**	Silt and Smaller:	**0.0 %**	Field Measured Slope:		
Human Elevated Inc. Rat.:	**0.00**	Silt/Clay Present:	**No**	2.15 Sub-reach Stream Type		
2.9 Sinuosity:	**Low**	Detritus:	**0.0 %**	Reference Stream Type:		
2.10 Riffles Type:	**Eroded**	# Large Woody Debris:	**10**	Reference Bed Material:		
				Reference Subclass Slope:		
				Reference Bedform:		

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope: **Steep**

Bank Texture	Left	Right	Bank Erosion	Left	Right	Near Bank Vegetation Type	Left	Right
Upper			Erosion Length (ft.):	**74.2**	**55.1**	Dominant:	**Coniferous**	**Coniferous**
Material Type:	**Sand**	**Sand**	Erosion Height (ft.):	**3.8**	**4.5**	Sub-dominant:	**Herbaceous**	**Herbaceous**
Consistency:	**Non-cohesive**	**Non-cohesive**	Revetment Type:	**Multiple**	**Multiple**	Bank Canopy		
Lower			Revetment Length:	**365.4**	**287.2**	Canopy %:	**51-75**	**76-100**
Material Type:	**Boulder/Cobble**	**Bedrock**				Mid-Channel Canopy:	**Closed**	
Consistency:	**Non-cohesive**	**Cohesive**						

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	**51-100**	**>100**
Sub-Dominant	**0-25**	**0-25**
W less than 25	**321**	**124**
Buffer Vegitation Type		
Dominant	**Mixed Trees**	**Mixed Trees**
Sub-Dominant	**Herbaceous**	**Herbaceous**

3.3 Riparian Corridor

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

Stream: **West Branch Passumpsic River** Reach: **T3.12-C**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: **Abundant**
4.2 Adjacent Wetlands: **Abundant**
4.3 Flow Status: **Moderate**
4.4 # of Debris Jams: **0**

4.5 Flow Regulation Type **None**
Flow Reg. Use:
Impoundments: **Unknown**
Impoundment Loc.:
4.6 Up/Down Strm flow reg.: **None**
(old) Upstrm Flow Reg.: **Unknown**

4.7 Stormwater Inputs **None**
Field Ditch: Road Ditch:
Other: Tile Drain:
Overland Flow: Urb Strm Wtr Pipe:
4.9 # of Beaver Dams: **0**
Affected Length (ft): **0**

4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Bridge	23	Yes	Yes	Yes	Yes	Scour Below
Bridge	37	Yes	Yes	No	Yes	None

Step 5. Channel Bed and Planform Changes

5.1 Bar Types
Mid: **0** Point: **1** Side: **1**
Diagonal: **0** Delta: **0** Island: **0** Braiding: **0**

5.2 Other Features
Flood chutes: **0**
5.3 Steep Riffles and Head Cuts
Steep Riffles: **1**
Neck Cutoff: **0**
Avulsion: **0**
Head Cuts: **0**
Trib Rejuv.: **No**

5.4 Stream Ford or Animal Crossing: **No**
5.5 Straightening: **None**
Straightening Length (ft.): **0**
5.5 Dredging: **None**

Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:
6.2 Pool Substrate:
6.3 Pool Variability:
Total Score: **0**
Habitat Rating: **0.00**
Habitat Stream Condition:

6.4 Sediment Deposition:
6.5 Channel Flow Status:
6.6 Channel Alteration:
6.7 Channel Sinuosity:

Stream Gradiant Type <u>Left</u> <u>Right</u>
6.8 Bank Stability:
6.9 Bank Vegetation Protection
6.10 Riparian Veg. Zone Width:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Unconfined	Score	STD	Historic
7.1 Channel Degradation		8	None	Yes
7.2 Channel Aggradation		18	None	No
7.3 Widening Channel		15	None	No
7.4 Change in Planforml		17	None	No
Total Score		58		

Geomorphic Rating **0.73**
Channel Evolution Model **F**
Channel Evolution Stage **II**
Geomorphic Condition **Good**
Stream Sensitivity **Moderate**

Phase 2 Segment Summary Report   West Branch Passumpsic

Stream: **West Branch Passumpsic River**
Reach: **T3.12-D**
Segment Length(ft): **2,640**
Rain: **No**

SGAT Version: **4.56**
Organization: **Bear Creek Environmental**
Observers: **MN, PD**
Completion Date: **8/17/2013**
Qualtiy Control Status - Consultant: **Provisional**
Qualtiy Control Status - Staff: **Provisional**
Why Not Assessed: **no property access**

Step 0 - Location:

Step 5 - Notes: **Segment was assigned "fair" condition. Segment did not appear incised on downstream end. However, channel appears straightened from VHD and the orthophotos show that farm fields may be impacting the buffer..**

Step 7 - Narrative:

Step 1. Valley and Floodplain

1.1 Segmentation: **Other Reason**

1.2 Alluvial Fan: **None**

1.3 Corridor Encroachments:

Length (ft)	One	Height	Both	Height
Berm:	0		0	
Road:	291	0	0	
Railroad:	0		0	
Imp. Path:	0		0	
Dev.:	179		0	

1.4 Adjacent Side	Left	Right
Hillside Slope:	Hilly	Flat
Continuous w/ Bank:	Never	Never
Within 1 Bankfull W:	Sometimes	Never
Texture:	N.E.	N.E.

1.5 Valley Features

Valley Width (ft): **560**
Width Determination: **Estimated**
Confinement Type: **VB**
In Rock Gorge: **No**
Human Caused Change in Valley Width?: **No**

1.6 Grade Controls: **None**

Stream: **West Branch Passumpsic River** Reach: **T3.12-D**

Step 2. Stream Channel

2.1Bankfull 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 (tf):		Bedrock:	%	Bar:	
2.4 Floodprone Width (ft.):		Boulder:	%	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):		Cobble:	%	Stream Type:	**C**
Human Elev FloodPln (ft.):		Coarse Gravel:	%	Bed Material:	**Gravel**
2.6 Width/Depth Ratio:	**0.00**	Fine Gravel:	%	Subclass Slope:	**None**
2.7 Entrenchment Ratio:	**0.00**	Sand:	%	Bed Form:	**Riffle-Pool**
2.8 Incision Ratio:	**0.00**	Silt and Smaller:	%	Field Measured Slope:	
Human Elevated Inc. Rat.:	**0.00**	Silt/Clay Present:		2.15 Sub-reach Stream Type	
2.9 Sinuosity:		Detritus:	**0.0 %**	Reference Stream Type:	**C**
2.10 Riffles Type:		# Large Woody Debris:		Reference Bed Material:	**Gravel**
				Reference Subclass Slope:	**None**
				Reference Bedform:	**Riffle-Pool**

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope: **Steep**

Bank Texture	Left	Right
Upper		
Material Type:	**Sand**	**Sand**
Consistency:	**Non-cohesive**	**Non-cohesive**
Lower		
Material Type:	**Sand**	**Mix**
Consistency:	**Non-cohesive**	**Non-cohesive**

Bank Erosion	Left	Right
Erosion Length (ft.):	**0.0**	**0.0**
Erosion Height (ft.):	**0.0**	**0.0**
Revetment Type:	**None**	**Rip-Rap**
Revetment Length:	**0.0**	**23.7**

Near Bank Vegetation Type	Left	Right
Dominant:	**Coniferous**	**Herbaceous**
Sub-dominant:	**Herbaceous**	**Shrubs/Sapling**
Bank Canopy		
Canopy %:	**76-100**	**26-50**
Mid-Channel Canopy:	**Open**	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	**51-100**	**26-50**
Sub-Dominant	**26-50**	**0-25**
W less than 25	**0**	**0**
Buffer Vegitation Type		
Dominant	**Herbaceous**	**Herbaceous**
Sub-Dominant	**Mixed Trees**	**Mixed Trees**

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	**Forest**	**Hay**
Sub-dominant	**Residential**	**Forest**
(Legacy)	Amount	Mean Hieght
Failures	**None**	
Gullies	**None**	

	Left	Right
Mass Failures		
Height		
Gullies Number	**0**	
Gullies Length	**0**	

Stream: **West Branch Passumpsic River** Reach: **T3.12-D**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps:

4.2 Adjacent Wetlands:

4.3 Flow Status:

4.4 # of Debris Jams: **0**

4.5 Flow Regulation Type **None**

Flow Reg. Use:

Impoundments:

Impoundment Loc.:

4.6 Up/Down Strm flow reg.: **None**

(old) Upstrm Flow Reg.:

4.7 Stormwater Inputs **None**

Field Ditch: Road Ditch:

Other: Tile Drain:

Overland Flow: Urb Strm Wtr Pipe:

4.9 # of Beaver Dams: **0**

Affected Length (ft): **0**

4.8 Channel Constrictions:

Step 5. Channel Bed and Planform Changes

5.1 Bar Types Diagonal:

Mid: Delta:

Point: Island:

Side: Braiding: **0**

5.2 Other Features

Flood chutes: **0**

5.3 Steep Riffles and Head Cuts

Steep Riffles: **0**

Neck Cutoff: **0**

Avulsion: **0**

Head Cuts: **0**

Trib Rejuv.:

5.4 Stream Ford or Animal Crossing: **No**

5.5 Straightening: **Straightening**

Straightening Length (ft.): **926**

5.5 Dredging: **None**

Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:

6.2 Pool Substrate:

6.3 Pool Variability:

Total Score:

Habitat Rating:

Habitat Stream Condition:

6.4 Sediment Deposition:

6.5 Channel Flow Status:

6.6 Channel Alteration:

6.7 Channel Sinuosity:

Stream Gradiant Type Left Right

6.8 Bank Stability:

6.9 Bank Vegetation Protection

6.10 Riparian Veg. Zone Width:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type Score STD Historic

7.1 Channel Degradation

7.2 Channel Aggradation

7.3 Widening Channel

7.4 Change in Planforml

Total Score

Geomorphic Rating

Channel Evolution Model

Channel Evolution Stage

Geomorphic Condition **Fair**

Stream Sensitivity

Phase 2 Segment Summary Report **West Branch Passumpsic**

Stream: **Sutton River**
Reach: **T3.S3.01-A**
Segment Length(ft): **1,320**
Rain: **Yes**

SGAT Version: **4.56**
Organization: **Bear Creek Environmental**
Observers: **PD, EE**
Completion Date: **8/27/2013**
Qualtiy Control Status - Consultant: **Provisional**
Qualtiy Control Status - Staff: **Provisional**

Step 0 - Location: **segment located just as the stream enters "downtown" West Burke.**

Step 5 - Notes:

Step 7 - Narrative: **Extensive channel alteration and floodplain encroachment has led to extreme incision. Channel is not widening due to abundant rip rap on banks. Planform is major due to straightening. Some floodplain access on downstream end of segment, but it is short lived.**

Step 1. Valley and Floodplain

1.1 Segmentation: **Property Access**

1.2 Alluvial Fan: **None**

1.3 Corridor Encroachments:

Length (ft)	One	Height	Both	Height
Berm:	0		0	
Road:	343	0	327	0
Railroad:	0		0	
Imp. Path:	0		0	
Dev.:	287		855	

1.4 Adjacent Side	Left	Right
Hillside Slope:	Steep	Very Steep
Continuous w/ Bank:	Sometimes	Sometimes
Within 1 Bankfull W:	Sometimes	Sometimes
Texture:	N.E.	N.E.

1.5 Valley Features

Valley Width (ft):	230
Width Determination:	Measured
Confinement Type:	VB
In Rock Gorge:	No
Human Caused Change in Valley Width?:	Yes

1.6 Grade Controls: **None**

Stream: **Sutton River** Reach: **T3.S3.01-A**

Step 2. Stream Channel

2.1Bankfull Width (ft.):	**22.80**	2.11 Riffle/Step Spacing:	**145 ft.**	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	**3.00**	2.12 Substrate Composition		Bed:	**13 inches**
2.3 Mean Depth (tf):	**2.02**	Bedrock:	**0.0 %**	Bar:	**4.9 inches**
2.4 Floodprone Width (ft.):	**32.30**	Boulder:	**4.0 %**	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	**6.00**	Cobble:	**43.0 %**	Stream Type:	**B**
Human Elev FloodPln (ft.):		Coarse Gravel:	**20.0 %**	Bed Material:	**Gravel**
2.6 Width/Depth Ratio:	**11.29**	Fine Gravel:	**16.0 %**	Subclass Slope:	**c**
2.7 Entrenchment Ratio:	**1.42**	Sand:	**17.0 %**	Bed Form:	**Riffle-Pool**
2.8 Incision Ratio:	**2.00**	Silt and Smaller:	**0.0 %**	Field Measured Slope:	
Human Elevated Inc. Rat.:	**0.00**	Silt/Clay Present:	**No**	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	**Low**	Detritus:	**0.0 %**	Reference Stream Type:	
2.10 Riffles Type:	**Eroded**	# Large Woody Debris:	**19**	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope: **Steep**

Bank Texture	Left	Right
Upper		
Material Type:	**Sand**	**Sand**
Consistency:	**Non-cohesive**	**Non-cohesive**
Lower		
Material Type:	**Boulder/Cobble**	**Boulder/Cobble**
Consistency:	**Non-cohesive**	**Non-cohesive**

Bank Erosion	Left	Right
Erosion Length (ft.):	**62.9**	**63.6**
Erosion Height (ft.):	**3.0**	**2.5**
Revetment Type:	**Multiple**	**Multiple**
Revetment Length:	**885.1**	**608.3**

Near Bank Vegetation Type	Left	Right
Dominant:	**Herbaceous**	**Herbaceous**
Sub-dominant:	**Shrubs/Sapling**	**Shrubs/Sapling**
Bank Canopy		
Canopy %:	**1-25**	**1-25**
Mid-Channel Canopy:	**Open**	

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	**26-50**	**0-25**
Sub-Dominant	**0-25**	**51-100**
W less than 25	**458**	**569**
Buffer Vegitation Type		
Dominant	**Herbaceous**	**Herbaceous**
Sub-Dominant	**None**	**None**

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	**Residential**	**Residential**
Sub-dominant	**Shrubs/Sapling**	**Forest**
(Legacy)	Amount	Mean Hieght
Failures	**None**	
Gullies	**None**	

	Left	Right
Mass Failures		
Height		
Gullies Number	**0**	
Gullies Length	**0**	

Stream: **Sutton River** Reach: **T3.S3.01-A**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: **Minimal**
4.2 Adjacent Wetlands: **None**
4.3 Flow Status: **Low**
4.4 # of Debris Jams: **0**

4.5 Flow Regulation Type **None**
Flow Reg. Use:
Impoundments:
Impoundment Loc.:
4.6 Up/Down Strm flow reg.: **None**
(old) Upstrm Flow Reg.:

4.7 Stormwater Inputs
Field Ditch: **0** Road Ditch: **1**
Other: **0** Tile Drain: **1**
Overland Flow: **4** Urb Strm Wtr Pipe: **0**
4.9 # of Beaver Dams: **0**
Affected Length (ft): **0**

4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Bridge	20	No	Yes	Yes	Yes	None
Bridge	17.7	Yes	Yes	Yes	Yes	Deposition Above
Bridge	54	No	Yes	No	No	None

Step 5. Channel Bed and Planform Changes

5.1 Bar Types
Mid: **0** Point: **2** Side: **0**
Diagonal: **0** Delta: **1** Island: **0** Braiding: **0**

5.2 Other Features
Flood chutes: **2**
Neck Cutoff: **0**
Avulsion: **0**
5.3 Steep Riffles and Head Cuts
Steep Riffles: **0**
Head Cuts: **0**
Trib Rejuv.: **No**

5.4 Stream Ford or Animal Crossing: **No**
5.5 Straightening: **Straightening**
Straightening Length (ft.): **1,023**
5.5 Dredging: **None**

Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:
6.2 Pool Substrate:
6.3 Pool Variability:
Total Score: **0**
Habitat Rating: **0.00**
Habitat Stream Condition:

6.4 Sediment Deposition:
6.5 Channel Flow Status:
6.6 Channel Alteration:
6.7 Channel Sinuosity:

Stream Gradiant Type Left Right
6.8 Bank Stability:
6.9 Bank Vegetation Protection
6.10 Riparian Veg. Zone Width:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Unconfined**	Score	STD	Historic
7.1 Channel Degradation	5	C to B	Yes
7.2 Channel Aggradation	14	None	No
7.3 Widening Channel	13	None	No
7.4 Change in Planforml	8	None	No
Total Score	40		

Geomorphic Rating **0.50**
Channel Evolution Model **F**
Channel Evolution Stage **II**
Geomorphic Condition **Fair**
Stream Sensitivity **Very High**

Phase 2 Segment Summary Report West Branch Passumpsic

Stream: Sutton River
Reach: T3.S3.01-B
Segment Length(ft): 540
Rain: No

SGAT Version: 4.56
Organization: Bear Creek Environmental
Observers: PD, SP
Completion Date: 8/22/2013
Qualtiy Control Status - Consultant: Provisional
Qualtiy Control Status - Staff: Provisional
Why Not Assessed: no property access

Step 0 - Location: **Banks and buffers not completed because could not gain any access to property**

Step 5 - Notes: **Segment assigned "good" condition due to its similarity with upstream segment in "good" condition and minimal observable impacts. Corridor contained some development and buffer less than 50 feet in some locations, but overall it was dominated by forest.**

Step 7 - Narrative:

Step 1. Valley and Floodplain

1.1 Segmentation: **Property Access**

1.2 Alluvial Fan: **None**

1.3 Corridor Encroachments:

Length (ft)	One	Height	Both	Height
Berm:	0		0	
Road:	0		0	
Railroad:	0		0	
Imp. Path:	0		0	
Dev.:	521		0	

1.4 Adjacent Side	Left	Right
Hillside Slope:		
Continuous w/ Bank:		
Within 1 Bankfull W:		
Texture:		

1.5 Valley Features
Valley Width (ft):
Width Determination:
Confinement Type:
In Rock Gorge:
Human Caused Change in Valley Width?:

1.6 Grade Controls:

Stream: **Sutton River** Reach: **T3.S3.01-B**

Step 2. Stream Channel

2.1Bankfull 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 (tf):		Bedrock:	%	Bar:	
2.4 Floodprone Width (ft.):		Boulder:	%	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):		Cobble:	%	Stream Type:	**C**
Human Elev FloodPln (ft.):		Coarse Gravel:	%	Bed Material:	**Cobble**
2.6 Width/Depth Ratio:	**0.00**	Fine Gravel:	%	Subclass Slope:	**None**
2.7 Entrenchment Ratio:	**0.00**	Sand:	%	Bed Form:	**Riffle-Pool**
2.8 Incision Ratio:	**0.00**	Silt and Smaller:	%	Field Measured Slope:	
Human Elevated Inc. Rat.:	**0.00**	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:

Bank Texture	Left	Right	Bank Erosion	Left	Right	Near Bank Vegetation Type	Left	Right
Upper			Erosion Length (ft.):	**0.0**	**44.4**	Dominant:		
Material Type:			Erosion Height (ft.):	**0.0**	**4.0**	Sub-dominant:		
Consistency:			Revetment Type:	**Rip-Rap**	**Rip-Rap**	Bank Canopy		
Lower			Revetment Length:	**42.8**	**22.2**	Canopy %:		
Material Type:						Mid-Channel Canopy:		
Consistency:								

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	**51-100**	**51-100**
Sub-Dominant	**>100**	**26-50**
W less than 25	**0**	**0**
Buffer Vegitation Type		
Dominant		
Sub-Dominant		

3.3 Riparian Corridor

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

Stream: **Sutton River** Reach: **T3.S3.01-B**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps:
4.2 Adjacent Wetlands:
4.3 Flow Status:
4.4 # of Debris Jams: **0**

4.5 Flow Regulation Type **None**
Flow Reg. Use:
Impoundments:
Impoundment Loc.:
4.6 Up/Down Strm flow reg.: **None**
(old) Upstrm Flow Reg.:

4.7 Stormwater Inputs **None**
Field Ditch: Road Ditch:
Other: Tile Drain:
Overland Flow: Urb Strm Wtr Pipe:
4.9 # of Beaver Dams: **0**
Affected Length (ft): **0**

4.8 Channel Constrictions:

Step 5. Channel Bed and Planform Changes

5.1 Bar Types Diagonal:
Mid: Delta:
Point: Island:
Side: Braiding: **0**

5.2 Other Features
Flood chutes: **0**
5.3 Steep Riffles and Head Cuts
Steep Riffles: **0**

Neck Cutoff: **0**
Avulsion: **0**
Head Cuts: **0**
Trib Rejuv.:

5.4 Stream Ford or Animal Crossing: **No**
5.5 Straightening: **None**
Straightening Length (ft.): **0**
5.5 Dredging: **None**

Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:
6.2 Pool Substrate:
6.3 Pool Variability:
Total Score:
Habitat Rating:
Habitat Stream Condition:

6.4 Sediment Deposition:
6.5 Channel Flow Status:
6.6 Channel Alteration:
6.7 Channel Sinuosity:

Stream Gradiant Type Left Right
6.8 Bank Stability:
6.9 Bank Vegetation Protection
6.10 Riparian Veg. Zone Width:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type	Score	STD	Historic
7.1 Channel Degradation			
7.2 Channel Aggradation			
7.3 Widening Channel			
7.4 Change in Planforml			
Total Score			

Geomorphic Rating
Channel Evolution Model
Channel Evolution Stage
Geomorphic Condition **Good**
Stream Sensitivity

Phase 2 Segment Summary Report West Branch Passumpsic

Stream: **Sutton River**
Reach: **T3.S3.01-C**
Segment Length(ft): **1,756**
Rain: **No**

SGAT Version: **4.56**
Organization: **Bear Creek Environmental**
Observers: **PD, SP**
Completion Date: **8/22/2013**
Qualtiy Control Status - Consultant: **Provisional**
Qualtiy Control Status - Staff: **Provisional**

Step 0 - Location:

Step 5 - Notes: **Stream is in good stable condition but around bridge there is abundant rip rap on banks and in channel and sheet metal in channel may cause some adjustment in the future.**
Abundant fines seems to be a natural condition of this segment.

Step 7 - Narrative: **abundant fines - aggradation but appears to be in good condition**

Step 1. Valley and Floodplain

1.1 Segmentation: **Banks and Buffers**

1.2 Alluvial Fan: **None**

1.3 Corridor Encroachments:

Length (ft)	One	Height	Both	Height
Berm:	0		0	
Road:	0		0	
Railroad:	1,660	0	0	
Imp. Path:	0		0	
Dev.:	0		0	

1.4 Adjacent Side	Left	Right
Hillside Slope:	Steep	Very Steep
Continuous w/ Bank:	Never	Sometimes
Within 1 Bankfull W:	Sometimes	Sometimes
Texture:	N.E.	N.E.

1.5 Valley Features

Valley Width (ft): **212**
Width Determination: **Measured**
Confinement Type: **BD**
In Rock Gorge: **No**
Human Caused Change in Valley Width?: **Yes**

1.6 Grade Controls:

Type	Location	Total Height	Total Height Above Water	Photo Taken?	GPS Taken?
Ledge	Mid-segment	2.3	1.4	No	
Ledge	Mid-segment	2.3	1.3	No	
Ledge	Mid-segment	2.6	1.6	No	

Stream: **Sutton River** Reach: **T3.S3.01-C**

Step 2. Stream Channel

2.1Bankfull Width (ft.):	**29.50**	2.11 Riffle/Step Spacing:	**98 ft.**	2.13 Average Largest Particle on	
2.2 Max Depth (ft.):	**3.10**	2.12 Substrate Composition		Bed:	**15.6 inches**
2.3 Mean Depth (tf):	**2.17**	Bedrock:	**3.0 %**	Bar:	**5.9 inches**
2.4 Floodprone Width (ft.):	**85.00**	Boulder:	**18.0 %**	2.14 Stream Type	
2.5 Aband. Floodpn (ft.):	**3.10**	Cobble:	**33.0 %**	Stream Type:	**C**
Human Elev FloodPln (ft.):		Coarse Gravel:	**10.0 %**	Bed Material:	**Cobble**
2.6 Width/Depth Ratio:	**13.59**	Fine Gravel:	**13.0 %**	Subclass Slope:	**None**
2.7 Entrenchment Ratio:	**2.88**	Sand:	**23.0 %**	Bed Form:	**Riffle-Pool**
2.8 Incision Ratio:	**1.00**	Silt and Smaller:	**0.0 %**	Field Measured Slope:	
Human Elevated Inc. Rat.:	**0.00**	Silt/Clay Present:	**No**	2.15 Sub-reach Stream Type	
2.9 Sinuosity:	**Low**	Detritus:	**0.0 %**	Reference Stream Type:	
2.10 Riffles Type:	**Complete**	# Large Woody Debris:	**135**	Reference Bed Material:	
				Reference Subclass Slope:	
				Reference Bedform:	

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope: **Steep**

Bank Texture	Left	Right	Bank Erosion	Left	Right	Near Bank Vegetation Type	Left	Right
Upper			Erosion Length (ft.):	**106.6**	**245.8**	Dominant:	**Coniferous**	**Coniferous**
Material Type:	**Sand**	**Sand**	Erosion Height (ft.):	**2.0**	**2.5**	Sub-dominant:	**Herbaceous**	**Herbaceous**
Consistency:	**Non-cohesive**	**Non-cohesive**	Revetment Type:	**Multiple**	**Multiple**	Bank Canopy		
Lower			Revetment Length:	**241.2**	**91.5**	Canopy %:	**76-100**	**76-100**
Material Type:	**Boulder/Cobble**	**Boulder/Cobble**				Mid-Channel Canopy:	**Closed**	
Consistency:	**Non-cohesive**	**Non-cohesive**						

3.2 Riparian Buffer

Buffer Width	Left	Right
Dominant	**>100**	**51-100**
Sub-Dominant	**51-100**	**26-50**
W less than 25	**0**	**0**
Buffer Vegitation Type		
Dominant	**Mixed Trees**	**Mixed Trees**
Sub-Dominant	**Herbaceous**	**Herbaceous**

3.3 Riparian Corridor

Corridor Land	Left	Right
Dominant	**Forest**	**Commercial**
Sub-dominant	**Commercial**	**Forest**
(Legacy)	Amount	Mean Hieght
Failures	**None**	
Gullies	**None**	

	Left	Right
Mass Failures		
Height		
Gullies Number	**0**	
Gullies Length	**0**	

Stream: **Sutton River**   Reach: **T3.S3.01-C**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps: **Minimal**
4.2 Adjacent Wetlands: **Minimal**
4.3 Flow Status: **Low**
4.4 # of Debris Jams: **3**

4.5 Flow Regulation Type **None**
Flow Reg. Use:
Impoundments: **Unknown**
Impoundment Loc.:
4.6 Up/Down Strm flow reg.: **None**
(old) Upstrm Flow Reg.: **Unknown**

4.7 Stormwater Inputs **None**
Field Ditch:
Road Ditch:
Other:
Tile Drain:
Overland Flow:
Urb Strm Wtr Pipe:
4.9 # of Beaver Dams: **0**
Affected Length (ft): **0**

4.8 Channel Constrictions:

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?	Problems
Bridge	**22**	**Yes**	**Yes**	**Yes**	**Yes**	**Alignment**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types
Mid: **1**
Point: **1**
Side: **1**
Diagonal: **0**
Delta: **0**
Island: **1**
Braiding: **0**

5.2 Other Features
Flood chutes: **0**
Neck Cutoff: **0**
Avulsion: **0**
5.3 Steep Riffles and Head Cuts
Steep Riffles: **0**
Head Cuts: **0**
Trib Rejuv.: **No**

5.4 Stream Ford or Animal Crossing: **No**
5.5 Straightening: **Straightening**
Straightening Length (ft.): **201**
5.5 Dredging: **None**

Step 6. Rapid Habitat Assessment Data

6.1 Epifaunal Substrate - Avl.:
6.2 Pool Substrate:
6.3 Pool Variability:
Total Score: **0**
Habitat Rating: **0.00**
Habitat Stream Condition:

6.4 Sediment Deposition:
6.5 Channel Flow Status:
6.6 Channel Alteration:
6.7 Channel Sinuosity:

Stream Gradiant Type   Left   Right
6.8 Bank Stability:
6.9 Bank Vegetation Protection
6.10 Riparian Veg. Zone Width:

Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Unconfined**	Score	STD	Historic
7.1 Channel Degradation	**16**		
7.2 Channel Aggradation	**14**		
7.3 Widening Channel	**17**		
7.4 Change in Planforml	**16**		
Total Score	**63**		

Geomorphic Rating **0.79**
Channel Evolution Model **F**
Channel Evolution Stage **I**
Geomorphic Condition **Good**
Stream Sensitivity **Moderate**

October 11, 2013

QA Notes For: **West Branch Passumpsic and Dishmill Brook**

Ph2 Assessment by Bear Creek Environmental

Data checked by Staci Pomeroy

QA response prepared by Pam DeAndrea of Bear Creek Environmental

Date: 10/22/13 Review by Staci – 10/29/13

The questions raised in this Quality Assurance assessment are meant to address potential discrepancies within the data set, uncover data entry errors, or otherwise clarify and confirm those observations that might not have been expected. It is important to take into consideration how data might be viewed or interpreted by the myriad of users who are familiar with the science and protocols but may be unfamiliar with the assessed reaches. While providing notes and comments, try to anticipate the types of questions that may arise due to outliers and exceptions observed within the reach or segment. While attempting to clarify the data for those users wishing to utilize it years after collected, it's better to err on the side of making excessive comments than it is for them to be insufficient.

After reviewing the information noted, the consultant should update this document (preferably in a second color) with what steps, if any, were taken to address the comments/questions.

General Comments:

- The notes and narratives for all reaches were well done and provide additional data to help with interpretation of the data and understanding of why certain segments/reaches were done the way they were. It is greatly appreciated that this level of effort was taken to help provide this data.
- For all reaches that have segments, please provide a comment in Phase 1 step 7.4 to indicate that the reach has been segmented and brief information about the segment. This will help folks using Phase 1 data know the reach has multiple parts and/or has sub-reaches (please note if sub-reach) of a different natural stream type. Example – M101A – 870',C4-riff/pool ; M101B- 1,030', Cb-4-riff/pool.
    - **Reaches** : **Dishmill - M101,M102,M105 ; West Branch –T3.12; T3.S301**

Entered in comments in Phase 1 step 7.4 regarding segmentation of reaches. – Thank you

- Phase 2 - Step 3.1 – revetment type. When it is noted as "multiple". Please note the type in the comments filed if other than rip-rap. This will help understand what type of bank stabilization methods are in play along the reach.
    - **Reaches: Dishmill – M102A, M102B, M103, M104;T1.01; West Branch – T3.12A; T3.S301A; T3.S301C**

Multiple revetments simply refers to hard bank and riprap present in the segment, which was often the case if there was a bridge crossing in the segment. Comments were added in DMS to reflect that multiple refers to hard bank and rip rap. If this is important to know in the future, perhaps the DMS should indicate the different types of revetments when the FIT is uploaded. - ok

Dishmill Reach Comments:

M101-A

- Step 4.8 – no bridge width entered for the second bridge. A width had been done in an early assessment, please confirm with Kerry the width and update.
- Step 7.1 – Noted as a "STD from C to B" The is no current STD. See the note indicates it is possible, but at this stage not there yet.

  Thanks for catching this Staci! The cross sectional area in the field came out much lower than what was observed in all the reaches upstream. The bankfull height was increased by 0.5 feet in the cross section worksheet to be closer to the other cross sectional areas. When the bankfull height was increased, this changed the entrenchment to 1.8 and therefore a "B" channel and not a "C". There is therefore a STD from a "C" to a "B". I neglected to update this in the DMS in steps 2 and 5. Updated step 2 and comments in step 5. - ok

- Row 2 – noted in poor , the incision ratio at this point is not >2 and entrenchment is >2, so would be in "fair" between 1.4 and 2 with entrenchment >2.

Incision ratio for the human elevated floodplain (berm) is 2.0, therefore the RGA should be scored in poor according to the protocol (see page 28). When the RAF is on the other side of the berm, the protocol indicates to use the IRHef for the RGA. Entrenchment is actually less than 2.0 (1.8), there was a data entry error in Step 2. - ok

- Row 6 – in poor - "major existing flow alteration, greater flows and/or reduction in sediment load". - - What are you considering the major existing flow/greater flows or reduction of sediment. There are minimum stormwater inputs, no flow modifiers; or indication that sediment is being reduced, so it is not clear as to what the modifier is; please help provide additional comments to support this as "poor".

  I chose poor under this because Kerry had mentioned to us that the Dam on the East Branch causes significant backwater into this segment. Stormwater input was present of course, but I did not select poor alone for that reason. Sediment was not reduced, just more water and sediment from the East Branch. If you don't think I should select that since it does not relate to the degradation, let me know. I can add to the comments to reflect why poor was selected for this parameter if you like. Adding a comment will clarify the potential influence from the East Branch reach on this segment and how it is contributing to the impacts noted. It is not easily picked out in the data, so having it in the comments will help folks see why the score was in poor.

  - This gets a little confusing with the Aggradation choices (see next comment), so that is why I'm looking to clarify this a bit more.

- Step 7.2
  - Row 5 – in poor "major existing alterations, extreme reduction in flow and/or increase in sediment load." - See note above for Degradation. Help explain what the major existing flow reduction is and/or increase in sediment load. As both the degradation and aggradation categories indication "existing" situations, they seem to contradict each other, so clarification is needed.

    Again I chose poor here because of backwater into M101-A from the dam on the East Branch. Let me know if we should change this. Same as above, the comment to help capture the influence of the dam on the segment will help clarify what why this was captured in poor.

M101B-

- Step 7.1 – Row 4 – in fair "significant human caused change in confinement. Enough to change valley type". There has been minimum valley width change (394 in P1, 388' in P2) and no change in valley type (VB – P1, VB-P2). Looks like this could be in "good", please review and update as needed.

  This was a data entry error. It has been changed to "good". There was a minor change in valley width and no change in valley type. -ok

M102

- Phase 1 – step 6.3 channel bars – is noted as "not evaluated". Please update based on Phase 2 info and update the impact score.

  This step in Phase 1 was previously not updating correctly in the DMS. Now phase 1 is updated to show depositional features observed during Phase 2. -ok

M102A:

- Step 1.1 – segmentation – Please change this to "sub-reach". While grade controls were certainly the contributor, the "sub-reach" category will help flag that is a natural change in the stream type.

The sub-reach stream type is listed as “F” in step 2. The reason we segmented was because of the numerous grade controls and different stream type. Changed segmentation reason to sub-reach and put grade controls in the comment. – thank you

M102B:

- No comments

M103:

Phase 1 – step 6.3 channel bars – is noted as “not evaluated”. Please update based on Phase 2 info and update the impact score.
This step in Phase 1 was previously not updating correctly in the DMS. Now phase 1 is updated to show depositional features observed during Phase 2. - ok

- Step 2.10 – With the level of incision were you surprised to see “complete” riffles?
  It is a step-pool system and determining whether the riffles are eroded or not was difficult. They did appear complete in the field. No head cuts were present. - ok
- Step 7 narrative – The incision ratio of 1.8 is indicated in the cross-section data in step 2, and in the cross-section worksheet. The note of the incision ratio of 1.3 in the cross-section is a little confusing. To help show both conditions, please update the cross-section worksheet to have an un-modified cross-section, where your incision is the 1.3 indicated. Add a note that this is the cross-section that helps capture the minor areas of floodplain connection; but that the other incision ratio/ modified cross-section is the one used to represent dominant condition. The note you currently have in the worksheet for that cross-section is fine.
  Updated cross section worksheet to show both conditions; one with an IR of 1.3 and one with an IR of 1.8. Added the following comment in Step 7: “This cross section helps capture the minor areas of floodplain connection, but the other incision ratio of 1.8 is the dominant condition for this segment.” - ok

M104:

- Phase 1 – step 6.3 channel bars – is noted as “not evaluated”. Please update based on Phase 2 info and update the impact score.
  This step in Phase 1 was previously not updating correctly in the DMS. Now phase 1 is updated to show depositional features observed during Phase 2. - ok
- Step 2 – LWD – Wow 102 pieces! Does the wood seem to be playing a large role in the storage of sediment and/or planform change? Does it seem like it is coming from upstream and/or in the reach? See the same , 102, number of LWD in M105A. Seems like this is a good source of material in the system, but not much making its way to downstream reaches. Thoughts?
  There is a power line cut at the upstream end of M105A where some of the trees may have come from. Just downstream of the power line cut, there are abundant trees in the stream holding back sediment and creating planform change. For the kingdom trails some trees have also been cut down that may be contributing to the debris in the channel. We didn’t see much of this material in M105-B so it may just be from the power line and trail cutting. However, there is so much debris that it may have been transported from sources upstream of M105. Added a comment in Step 5. - ok

M105

- Phase 1 – step 6.3 channel bars – is noted as “not evaluated”. Please update based on Phase 2 info and update the impact score.
  This step in Phase 1 was previously not updating correctly in the DMS. Now phase 1 is updated to show depositional features observed during Phase 2. - ok

M105A:

- Step 1.1 – segmentation – Please change this to “sub-reach”. While depositional features were certainly the contributor, the “sub-reach” category will help flag that is a natural change in the stream type.

The only difference in the stream type is the substrate. I really segmented because the process was so different with all the aggradation. Would you not have captured it as a different reference stream type without the aggradation? I did change it to subreach in the DMS, but it seems that the depositional features indicate why I segmented more than the subreach category. Do we select sub-reach no matter what when indicating reasons for segmentation? If it is a different reference stream type, then it should always be segmented, regardless of the adjustment process happening compared to the other segments; thus becoming a "sub-reach". If the deposition was causing it to be in a different adjustment process then the overall reach, but the reference stream type was the same, then I'd capture that as the reason for the segmentation. Flagging it as a sub-reach we can more easily see where we may have potentially different management strategies/needs given the reference stream type is different than the overall reach. It is more difficult to pick that out by sorting through the Step 2 data or notes.

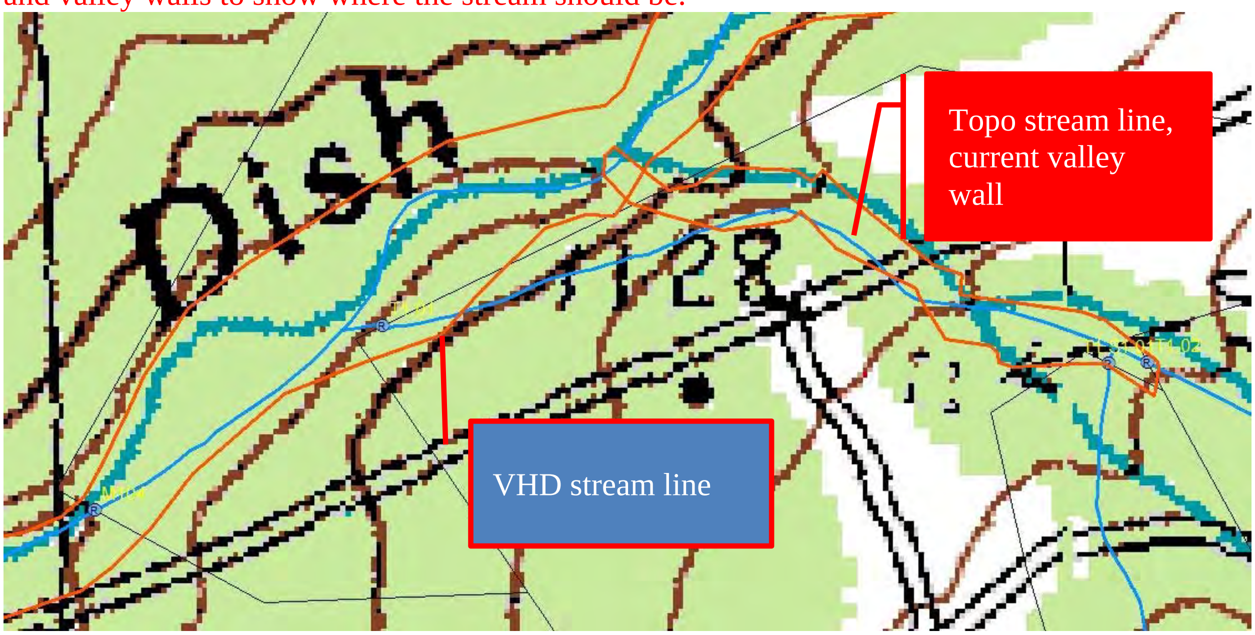
- Step 2.14 – subclass slope noted as "b". In the step 7 narrative, it notes "change in slope in the segment has led to ……" Both segments have a "b" slope indicated. What change in slope do you feel is contributing to the aggradation? Do you think this is still a "b" slope in this segment, or does it have a lower slope than upstream segment causing the sediment deposition?
  I think the change in slope is a factor in the deposition in addition to the debris storing sediment here. If you look at the contours, you can see the slight change in slope. I did not take an instream slope measurement in segment A, but most of the segment from the contours has a slope of about 2%. The slope for M105-B using the contours is about 3% so there is a change in slope. I changed the slope designation for M105-A from "b" to none. - ok
- Step 5 notes - noted that the power line may have been a source of the abundant debris just downstream of it. Is there evidence of recent clearing, or that there was erosion of the power line area that would send debris into the stream? Looking to see if there are issues at the power line and/or possible issues with how the lines are cleared that would send abundant debris into the stream. Something we'd want to work with the power company on if this is a source of debris.
  The area of the power line is very steep. Not sure when the cut was done and I did not see evidence of recent clearing or significant erosion, but the debris jams started right after the cut so it is suspect. – ok. Perhaps that is something CCNRCD can look at to determine potential clearing dates to get an idea of how this area may influence debris in the stream.
- Step 7 narrative – notes cross-section in area with less aggradation lower width/depth. Do you think the other areas of major aggradation would bump the channel into a different stream type or just show how much widening is happening?
  No I think it would still be a "C" throughout most of the reach, but it would be wider. Unfortunately, due to time, I did not get another cross section in. - ok
- Step 7.1 – degradation – score of 13 seems low, as has 5 of the categories in reference and 1 in good. Thoughts as to what score of 13 helps indicate? (*this is also looking at that T1.01had a score of 18 with 3 reference and 3 good; just trying to get a feel for how scores are assigned)
  Good catch. I had adjusted bankfull in the cross section worksheet which resulted in no incision, but neglected to change the degradation score. Thanks. The DMS has been updated with a score of 18. - ok

M105B:

- Step 1.1 – segmentation reason – noted as planform and slope. As noted above, checking on the slope in the segments to see if that is different between segments and part of the reason why we may see the differences in the segments.
  Not sure what your comment is here. Change in slope using topos is from 3 to 2 percent. Upstream is also more step-pool while the other is mostly riffle-pool. - ok
- Step 7.2 (Row 2) Step 7.3 (Row 4). Both in Good "single to multiple mid- channel side bars….". Seems like this could be in "fair" as there are multiple bars and flood chutes. Thoughts?
  M105-A was much more aggradational than this segment despite the number of bars. The good category is appropriate for this segment when compared to the upstream one. There were mostly larger side bars as shown in this photo and a few small mid-channel bars, but I think it was more natural for this segment. - ok

T1.01 –

- Discussion note – question on the Phase 2 valley wall. It does note line up with the current VHD stream line; it looks like it lines up with the topo stream line, which enters further upstream. Is the stream located as the VHD has it or as the topo has it?
  The VHD is off. I can provide you with the GPS points we took in the field for line and point impacts and valley walls to show where the stream should be.

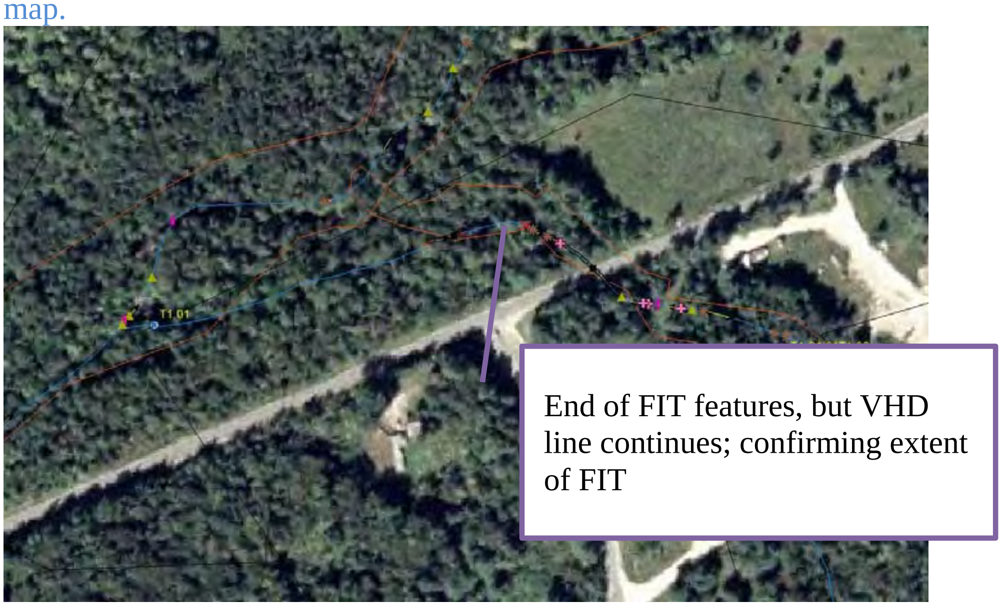


This could represent a difference in stream and valley length –changes in slope as well. As we are tied to the VHD at the moment and SGAT has been run with this configuration; this will need to be documented in the Phase 1 notes if the VHD stream line is not correct. Corrections in stream and valley length may be able to manually corrected in the DMS or updated in the notes for correct length/slopes.

There is a change in stream length as a result. The stream length should be about 940 feet and the valley length about 920 feet. I added a note in the phase 1 data and I updated the stream and valley lengths in the Phase 1 and 2 DMS. – ok, thank you

How is the FIT features in relation to the VHD; are the FIT at the end of the reach or is there additional stream length that didn't have anything going on so that is reason for no FIT in lower ~635'. Trying to make sure if FIT location indicates end of reach and/or information not in correct location spatially due to VHD off we can track it.

I used the current line to index the impacts so it would generate the lengths, but luckily I did not have any impacts in the downstream end. Again I can send you our points from the field so you can see where the impacts ended. – ok, just good to know that current features are in correct location and ended as noted on the map.



- Phase 1 – step 6.3 channel bars – is noted as “not evaluated”. Please update based on Phase 2 info and update the impact score.
  This step in Phase 1 was previously not updating correctly in the DMS. Now phase 1 is updated to show depositional features observed during Phase 2. - ok
- Step 2.10 – riffle type. Were you surprised to see the riffles were complete with the level of sediment noted? Does it seem to be transported well through the reach such that the riffles are not being impacted?
  There were some diagonal bars present in the riffles. Changed to sedimented and updated the RGA. - ok
- Step 2.14 stream type – I was surprised to see a “Ca – riffle pool” stream type. I went back to check slope and seems okay, but as this is not typical wanted to confirm that the entire reach has this type of slope, or if there is a change of slope downstream of the road crossing, or in a valley type change. Does the slope seem correct in the field, given what can be estimated from the topo?
  I estimated the slope as 7% from the topo, which is an “a” slope. The slope was variable through the reach with steep sections and some not as steep. It is true that a Ca is rare, but despite the steep slope, the channel still had floodplain access and was a “C” overall. A comment was added to the DMS. – ok, just trying to make sure we help capture notes about those outliers, as it will likely get flagged if someone just sorting through data. Thanks for adding notes.
  - It is not in the usual categories of stream type, so please provide a comment in Phase1/Phase 2 how this reach is naturally a “Ca”. This will help reduce it getting flagged as an error and help highlight where we may have stream types that are not typical.
- Step 4.8 – Bridge is noted as channel constriction. Width is 26 ft. Channel width is 17. What other indicators are there a that the bridge is a channel constrictor with a width wider than bankfull?
  Below is a photo of the bridge crossing. The channel is wider both upstream and downstream of the crossing and this is a major channel constriction. The road width was inadvertently entered as the structure width and vice-versa. This has been corrected in the DMS. – ok. Yikes that is a tight squeeze☺

- Step 5 notes – noted "aggradation major process". Do you think it is a natural process for the location or an increase in what you might expect?
  I think it is increased from what we might expect in this small stream. There was quite a lot of stormwater runoff at the top of the reach coming in from a trail as well as other stormwater issues along the road that may be getting into the stream. It is at the bottom of the watershed, which would naturally receive sediment, but there are stormwater inputs entering the stream. - ok
- Step 6 – The tally sheet for LWD, pools, etc. is blank in the DMS. Please update.
  Tally sheet has been entered into the DMS. - ok
- Step 7 narrative – notes "quite a bit of fine sediment…..some stormwater input from Mt. Rd" The stormwater types noted are overland. Are there any direct ditch connections or is the sediment enough that it is making its way through the buffer (51-100') and into the stream…or are there just some localized spots near the road/crossing that are a high input of sediment? Trying to get a feel for extent and option for possible project needs.
  As mentioned above in the explanation for aggradation being a major process, sediment is definitely entering the stream via stormwater runoff as observed at the crossing just upstream of the top reach break. There is a trail crossing here and stormwater runoff around the culvert is causing sediment to enter (see photo below).

Stormwater runoff off of trail crossing by culvert in T1.02

We did not see any direct ditch connections. We observed overland stormwater runoff that is making its way into the stream (see photo below). – ok, these type of sediment inputs often get missed with such a wide buffer, and no direct type of input seen; so this help demonstrate the issue ; thanks for the photos and will be helpful to highlight in the report.

Overland stormwater runoff in T1.01

Overland stormwater runoff making its way to stream

- Step 7.1 – Degradation score of 18 seems high given several in good category.
  We usually weight the top two categories most heavily when scoring for step 7.1. Given that the incision was 1.08 is why we chose to score in reference. We see your point about there being some rows in the good category and have lowered the score to 15. – ok, I don't want to have folks change scores just to change scores; just providing a second set of eyes and checking in to see if scores still seem reasonable.

West Branch Reach Notes:

T3.11 –

- Phase 1 – step 6.3 channel bars – is noted as "not evaluated". Please update based on Phase 2 info and update the impact score.
  This step in Phase 1 was previously not updating correctly in the DMS. Now phase 1 is updated to show depositional features observed during Phase 2. - ok
- Phase 1 – step 2. 8 – channel width – noted as "30" and in meta data is noted as "field survey". This is significantly different than the RHGC estimate of 53' for a watershed of 24 sq. miles. It is also much narrower than the upstream reach or what was measured in the Phase 2 cross-section. What would be reasons for the significant difference in estimated channel width in the RHGC and that entered for the reference width? Would the narrower width have occurred due to the straightening? It would explain much if the channel were made narrower when straightened and now trying to widen to a more stable width. Or are we way over widened and now it will look to have channel narrowed up? Please provide comments as to why the narrower width would be considered the reference width/where measured.
  The reference widths were off for the reaches we assessed in this stream. What factors do you consider were reasons for the widths to be off? It is helpful to have some ideas as to why the stream is an outlier for the curves and/or expected widths. Reference was 53 feet and we observed a channel width in our cross section of about 40 feet. The cross sections we did in the upstream reach had channel widths that ranged from about 23 to 32. We spoke with the landowner right near our cross section that informed us

that the channel has widened. The tree in the following photograph used to be on the bank according to him. I changed the reference width to 30 feet to reflect this information considering that the channel is now about 40 feet wide. The channel was not straightened in the upstream reach and the channel width was also narrower than reference, so I don't think straightening had to do with the narrower actual channel width. While the curves do not always predict exact measures; a difference of ~23' in expected width raises questions. Given that this is a C stream type the width would be expected to be reasonably close to the expected curve estimate. Were there soils, slopes, valley constraints, etc. that would have caused the widths to be that much narrower than expected? What clues did you see that led you to 30'f or a reference width, was it only based on the landowner's comments?

Both T3.11 (613' out of 939') and T3.12A (1,013' out of 1,400') were identified as straightened segments. Perhaps when it was straightened it may have been narrowed? There were dams noted in the T3.12 reach, perhaps this has also influenced the widths in these reaches? It is likely the landowner is seeing the channel become wider if given the watershed size and other factors; the expected width would be wider. Given all factors, would we expect to be trying to manage this channel back to a width of 30ft?

- Step 1.5 valley type – noted as NW. Phase 1 is noted as Broad. There is no human change in the valley type noted. It looks like the channel width is significantly wider than that of Phase 1. If the channel with is due to adjustment and Phase 1 is more accurate of what it should be; then Phase 1 channel width should be used to determine valley type. Please review and update as needed.
  Valley type is Broad for Phase 1 and Phase 2. This was updated for Phase 2. Adjusted Phase 1 channel width (30 feet) was used to calculate confinement. Given that the upstream reach reference width is 40 ft, ; 30' may be too narrow for the actual reference width. It may not be 53' as the curves suggest given it's watershed size; but 30'does not seem accurate for this size watershed. It may be more accurate to use the Phase 2 width for your valley confinement given the question of what is the actual reference width.
- Step 2.10 – riffle type noted as "sedimented". There are not many sediment features noted, and aggradation noted as minor in the notes. Were there fines or other features that were impacting the riffles to be more sedimented. There is only one steep riffle noted, is the sedimented riffle? With such an extent of straightening would "eroded" be a reason limited riffles seen?
  Note that this is a very short reach (939 feet). There was one steep riffle in there and it was a very long riffle from what I remember. Aggradation is not major since there were not abundant depositional features. We had four riffles in the reach, so I don't think riffles are limited. Sedimented describes the riffles better than eroded even though there is only one steep riffle. If I called the riffles eroded, it would not make sense if there was a steep riffle present. Ok – looking to see if the other areas where riffles may have been expected were more eroded than the one riffle noted; but if there were no other riffles seen and only the steep riffle that is fine.

- Step 2.14 – subclass noted as “b”; there is no subclass noted in Phase 1. Slightly greater than 2% slope, is this reflected in what was seen in the field? Please review and update as needed.
  Updated reference slope to be “b”. - ok
- Step 5.5 – straightening – with high straightening and minimal erosion on left bank or rip-rap, what do you think is allowing this to maintain the straighter condition? The riparian veg? Would it start to unravel if veg. removed? Looking at a couple ortho dates, looks like there was veg. removed in the upper portion but not in area where erosion is noted. Thoughts?
  As mentioned above the channel is widening and the left side has lost floodplain. The channel will probably try to obtain a more sinuous pattern in the future, but perhaps it has not happened yet. There is some riprap on the left, but you are right, it is minimal. The right side is well vegetated and has a steeper bank so there is not much room for it to migrate on that side. The landowner here is interested in a planting project so perhaps this could be investigated more during that phase. ok

T3.12A –

- Phase 1 – Step 6.3 – channel bars – only “point” is noted, several types noted in Phase 2, please review and update.
  This step in Phase 1 was previously not updating correctly in the DMS. Now phase 1 is updated to show depositional features observed during Phase 2. ok
- Step 1.5 / Step 2.4- valley type is noted as “narrow”. Phase 1 valley type is broad. Looking at the floodprone area of 206 in step 2.4 seems like there is areas of wider valley type. What is more representative for this segement. The wider floodprone area at the cross-section would seem to be a broad valley.
  The confinement at the cross section is Broad, but the average Phase 2 confinement for the segment is narrow (145/26=5.5). The Phase 1 valley type is Broad because the Phase 1 valley width is wider in the upstream end of the segment. The Phase 2 confinement is probably about half narrow and half broad, but the average comes out to be narrow.
- Step 2.1 bankfull width – noted as 26. This is much narrower than RHGC estimate in Phase 1 of 40. Do you think this occurred when the channel was straightened? Do you think it will move towards a wider width?
  I think the reference width was just lower for this watershed. we are not sure why this would be the case. Please note the bankfull cross sectional areas that we measured in the field for West Branch and the Sutton River were approximately 70% of the regional curve.
- Step 7 CEM noted as stage 1. An incision ratio of 1.3 is moderate, and given the level of channel straightening do you think it is still in a stable form?
  True the channel has incised somewhat, but given the grade controls in this segment, further incision is unlikely. ok
- Step 7.4 – Planform in the notes is indicated as historic for the low score, but the “historic” in step 7 is indicated as “no”. Do you feel there is still planform happening?
  No planform change is due to the historic channel straightening. Historic in step 7 was changed to “yes”. ok

T3.12B:

- Step 1.1 – segmentation – Please change this to “sub-reach”. While grade controls were certainly the contributor, the “sub-reach” category will help flag that is a natural change in the stream type.
  We entered sub-reach as the reason for segmentation. ok
- Step 1.5 – Rock Gorge is noted as “no”. The “why not assessed” is noted as “bedrock gorge”. Is this a gorge or not? Provide notes in the comments if this reach does not meet the criteria of a gorge, but is used for the “why not assessed”.
  Changed reason for not assessing to other and provided explanation in comments that it is not a true bedrock gorge, but due to the extensive bedrock, it did not need a full Phase 2 Assessment. ok

- Step 1.5 – human caused change – noted as "yes". I see the road encroachment, and that P1 valley type is broad. Would you have expected a naturally broad valley for this segment, given its bedrock/gorge stream type; or has there been such an encroachment that it has shifted this to a semi-confined valley? If it has changed from broad to semi confined due to encroachment, seems like it could have shifted the stream type; do you think there has been a stream type departure due to a shift in the valley type?
  The road encroachment most likely caused a change in stream type from a "C" to a "B", but now the channel is very stable due to the extensive bedrock. Since the stream will not migrate back to a "C" and it is in stable condition, a modified reference stream type of "B" was assigned. Comment was added to the DMS. ok
- Step 2.14/2.15 – The sub-class is noted as "none" in step 2.14 and as "c" in step 2.15. Does the reference stream type for this segment have a "c" slope" or is a steeper "b" slope? Please review and update to be consistent and/or provide comments if subclass slopes remain different.
  Changed Phase 2 subslope to "c". ok
- Step 7 – geomorphic condition noted as "good". Please provide a note as to why you feel the reach is in "good" condition. This will help with knowing what you were looking at in making that decision and potential needs/opportunities down the road.
  The segment is in "Good" condition due to its stability and lack of aggradation, recent planform change, and widening. Comment was added to the DMS. ok

T3.12C:

- Step 2.10 – Riffle type – noted as "eroded"; In RGA for degradation (row 3) and aggradation (row1) riffles are noted as complete and/or mostly complete. Are features starting to reestablish themselves?
  Changed row 1 aggradation to mostly complete. Riffles incomplete due to erosion not aggradation. Not dominated by plane bed, therefore, "fair" category was not chosen for degradation (row 3) in RGA. ok
- Step 7 notes – "old mill dams….may have caused historic channel incision…." I see lots of ledge in the reach. Do you think this has incised down to bedrock? Is the current dam on the downstream side capturing sediment /flow upstream of it? Do you think the mill ponds were perhaps bigger and this has incised through old mill pond sediments?
  Yes channel has incised to bedrock. Comment added to DMS step 7. The dam on the downstream end is a run-of-river dam. Some sediment is being held back, but flow is not. It's possible that the channel has incised through old mill pond sediments, but more information would need to be collected of the historic nature of the dams and the ponds to answer this question. ok
- Step 7.3 – widening – the score of 18 seemed high with a couple categories in the "fair" range.
  We usually weight the first two categories more when scoring for widening, but we see your point with two categories in "fair" that this should be scored lower. Score changed to 15. ok

T3.12D:

- Step 1.4 – valley width - Please look to get valley width off the map.
  Average valley width estimated as 560 feet and entered into DMS. ok
- Step 2.14 – Stream type noted as C4-riff/pool. Would this be a sub-reach with a different ref. stream type given the channel material is gravel vs the cobble ; or is this an impact that has shifted the channel material to be smaller than expected?
  Given that we did not assess this part of the reach due to landowner permission, it is difficult to say whether there is an impact causing a change in substrate. We observed gravel as dominant looking upstream into this segment. Changed this to a sub-reach given the difference in substrate. ok
- Step 7 – geomorphic condition noted as "good". Please provide a note as to why you feel the reach is in "good" condition. This will help with knowing what you were looking at in making that decision and potential needs/opportunities down the road.
  Segment did not appear incised looking upstream into segment since there was good floodplain access on left side, which is why we originally assigned the "good" condition. In looking at the orthophotos again, it looks like the channel was probably straightened upstream for agriculture and may be in a "fair"

condition as a result. There appears to be some limited buffer as well upstream due to farm fields. Condition changed to “fair” in DMS and comment was added. ok

T3.S301A –

- Step 7 - please add the “none” / “no” for the step 7.2 – 7.3 STD and Historic.
  Updated step 7 in Phase 2 DMS. ok

T3.S301B:

- Step 1.1 – Please add segmentation reason “property access”. Done. ok
- Step 1.5 – valley information – please capture off a map. An average valley width of 410 feet was estimated from map and entered into the DMS. ok
- Step 3.2 – buffer information – please capture off an ortho.
  We updated this in the DMS. ok
- Step 3.3 – corridor land use – please capture off an ortho.
  We updated this in the DMS. ok
- Step 7 – geomorphic condition noted as “good”. Please provide a note as to why you feel the reach is in “good” condition. This will help with knowing what you were looking at in making that decision and potential needs/opportunities down the road.
  The channel was similar to upstream, which was in “good’ condition and aside from the one house in the corridor and associated impacts, the rest of the segment had few observable impacts. Comment was added to DMS. ok

T3.S301C:

- Phase 1 – Step 6.3 – channel bars – noted as “no data”; please update and impact score with Phase 2 data.
  This step in Phase 1 was previously not updating correctly in the DMS. Now phase 1 is updated to show depositional features observed during Phase 2. ok
- Step 1.6 – grade controls – photo taken noted as “no” – I believe we took photos of the ledge along the way. Confirm.
  Staci, unfortunately the photos you took that day were not retrievable from the camera. Apparently the SD card was corrupt. Perhaps that was why you were having trouble in the beginning getting the camera to be on photo mode. It seemed to be working though when you looked back at the photos. Ok - ahh…equipment ☺
- Step 7 narrative – please add “abundant fines seems to be a natural condition of this reach”.
  Comment was added to step 5 in the DMS. ok