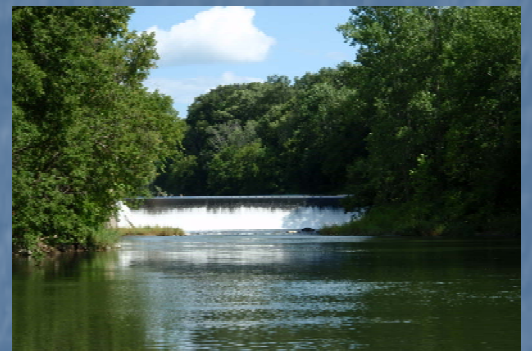


HOOSIC RIVER

Phase 2 Stream Geomorphic Assessment

Pownal, VT



FINAL REPORT

May 2009

Prepared for:



Prepared by:



Executive Summary

A Phase 2 Rapid Stream Assessment was conducted on the Hoosic River in Pownal, Vermont during the summer and fall of 2008. Phase 2, the second of three phases in the Vermont Agency of Natural Resources' Stream Geomorphic Assessment protocols, is a detailed method for gathering scientifically sound information about a stream channel and its riparian corridor. Field observations and measurements conducted during the Phase 2 assessment help verify Phase 1 stream geomorphic data and provide more specific information about stream reaches of interest. The geomorphic and habitat assessments performed on the Hoosic River provide a picture of its current condition, help to identify fluvial erosion hazards and understand changes the river system is undergoing, and can be used in watershed planning and protection efforts.

The Hoosic River's 720-square-mile drainage area is part of the larger Hudson-Hoosic basin. The Hoosic River originates in northwestern Massachusetts, where it is fed by its North Branch from Vermont in the city of North Adams, and flows for approximately 70 miles in a generally northwesterly direction through southwestern Vermont and into New York, where it empties into the Hudson River. It is fed by streams draining Mount Greylock in Massachusetts, the Green Mountains in Vermont, and the Taconic Mountains in New York. The section of the Hoosic River included in this assessment lies entirely within the town of Pownal in the southwest corner of Vermont—from the Massachusetts border just southeast of Pownal Village to the New York border just northwest of North Pownal. This section is approximately 7.5 miles long, with a drainage area of about 230 square miles. In this stretch, the natural valley is very broad, but is confined by the steep slopes of the Taconic Mountains to the left and by major roads and a railroad at the base of the Green Mountain foothills to the right. Several high-gradient streams drain steeply from the Taconic Mountains to the west, while a few lower gradient, more meandering tributaries join the Hoosic River from the east.

The Phase 2 assessment was conducted on all six reaches, or approximately 7.5 river miles, of the Hoosic River within the state of Vermont. In general, the reaches were found to be in fair geomorphic condition (major adjustment). The entire assessment area has a reference stream type of C. Although two of the reaches have departed to B-type streams and two have departed to F-type streams, reaches M04 and M05, which make up half of the assessment length, have maintained their reference stream type and thus present an important opportunity for preventative conservation actions. Stream sensitivities range from high to extreme. Habitat appears to be in generally good condition, although it is suffering from the impact of development, limited riparian buffers, and transportation infrastructure along several reaches. Three bridges were assessed. All three structures appear to be in sound condition, with intact bank armoring where present and little erosion, although significant upstream sediment deposits were observed at two bridges.

The draft Fluvial Erosion Hazard (FEH) maps developed for this assessment represent a starting point for corridor protection. Watershed planning and management measures, such as FEH mapping, river corridor conservation programs, and river corridor planning, should be further pursued in the Hoosic River watershed along with the preliminary projects for protection and restoration identified in this report, such as riparian buffer enhancement, berm offset, and mass failure alleviation. The river corridor planning process will allow further development of these preliminary concepts.

Many opportunities exist along the Hoosic River to facilitate the avoidance of flood and erosion hazards. This report should serve as a stimulus to encourage collaboration of municipalities in the watershed, the Bennington County Regional Commission, the Vermont Agency of Natural Resources, and watershed groups on future watershed management decisions. Management strategies developed in a collaborative manner will build community support and prove the most effective.

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List of Acronyms and Abbreviations

ANR	Agency of Natural Resources
BCRC	Bennington County Regional Commission
CEM	Channel Evolution Model
CR	Confinement Ratio
DEC	Department of Environmental Conservation
DMS	Data Management System
ER	Entrenchment Ratio
FEH	Fluvial Erosion Hazard
FIT	Feature Indexing Tool
GIS	Geographic Information System
GPS	Global Positioning System
HEF	Human Elevated Floodplain
IR	Incision Ratio
IR _{HEF}	Human Elevated Incision Ratio
P1	Phase 1
P2	Phase 2
QA	Quality Assurance
Q ₂	Two-year peak flow
RAF	Recently Abandoned Floodplain
RGA	Rapid Geomorphic Assessment
RHA	Rapid Habitat Assessment
RMP	River Management Program
SGA	Stream Geomorphic Assessment
SGAT	Stream Geomorphic Assessment Tool
STD	Stream Type Departure
USGS	United States Geological Survey
VT	Vermont
W/D	Width/Depth
WQD	Water Quality Division
WWTF	Wastewater Treatment Facility

1.0 Project Background

A Phase 2 Rapid Stream Assessment was conducted on the Hoosic River in Pownal, Vermont during the summer and fall of 2008. Phase 2, the second of three phases of the Vermont Stream Geomorphic Assessment (SGA) protocols, is a detailed method for gathering scientifically sound information about a stream channel and its riparian corridor. The geomorphic and habitat assessments performed on the Hoosic River will provide a picture of its current condition, will help to identify erosion hazards and understand changes the river system is undergoing, and can be used in watershed planning and protection efforts.

1.1 Goals and Objectives

The Phase 2 assessment was conducted to collect geomorphic and habitat data on the six reaches of the Hoosic River within the state of Vermont.

The objectives of the Phase 2 assessment were to:

- collect geomorphic and habitat data according to Vermont's rapid assessment protocols;
- interpret the data to determine dominant channel processes, channel type, condition, and sensitivity;
- identify where and how the river channel is responding to historic and ongoing human modifications; and
- assess bridges and culverts in the study area and determine impact on the stream.

The products of a Phase 2 Rapid Stream Assessment for each assessed reach include (VT ANR, 2007):

- an existing stream type determination;
- a geomorphic condition evaluation that includes:
 - reach condition,
 - channel adjustment process, and
 - reach sensitivity;
- a stream habitat assessment; and
- field maps and photographs detailing the reach planform, typical condition, and assessed features.

Another goal for this project was to develop a Fluvial Erosion Hazard (FEH) zone based on the scientific data collected during the Phase 2 assessment. Fluvial erosion is defined as erosion caused by rivers and streams, and can range from gradual bank erosion to catastrophic changes in river channel location and dimension during flood events (VT ANR, 2008). Development of an FEH zone identifies the probable location and sensitivity to fluvial erosion hazards on a reach-by-reach basis and gives planners an effective tool for river corridor management.

1.2 Fluvial Geomorphic Setting

The Hoosic River's 720-square-mile drainage area is part of the larger Hudson-Hoosic watershed shown in Figure 1-1. The Hoosic River originates in northwestern Massachusetts (fed by its North Branch from Vermont) and flows for approximately 70 miles in a generally northwesterly direction through southwestern Vermont and into New York, where it empties into the Hudson River. It is fed by streams draining Mount Greylock in Massachusetts, the Green Mountains in Vermont, and the Taconic Mountains in New York. The section of the Hoosic River included in this assessment lies entirely within the town of Pownal in the southwest corner of Vermont—from the Massachusetts border just southeast of Pownal Village to the New York border just northwest of North Pownal (see Figure 1-2). This section is approximately 7.5 miles long, with a drainage area of about 230 square miles. In this stretch, the natural valley is very broad, but is confined by the steep slopes of the Taconic Mountains to the west and by

major roads (Routes 346 and 7) and a railroad (Boston & Maine Railroad) at the base of the Green Mountain foothills to the east. Several high-gradient streams drain steeply from the Taconic Mountains to the west, while a few lower gradient, more meandering tributaries join the Hoosic River from the east.

The Hoosic River watershed is predominately forested (over 70%), with approximately 12% in agricultural use. Within Vermont, the Hoosic flows through several scattered residential areas, including the villages of Pownal and North Pownal, as well as along several commercial and industrial properties. Beginning over 200 years ago, most of the Northeast, including the Hoosic River watershed, was cleared of its forests, which resulted in an increase in flooding, sediment loads, and erosion. Since forests in the watershed have matured once again, the input of excess sediment and runoff to the stream system has decreased somewhat. However, many streams in Vermont, including the Hoosic River, are still undergoing adjustments set in motion by these historic human-caused disruptions and have not yet returned to a state of equilibrium.

Although the Hoosic River flows through a naturally broad valley, railroads, roads, berms, development, and other encroachments have reduced the amount of available floodplain, resulting in increased stream power. These changes in land use can have a direct bearing on the magnitude, duration, and timing of flow in the river, and can significantly increase sediment loading as well. Often, anthropogenic influences such as increased urbanization, dam construction, culverts, bridges, etc. will impact the normal conveyance of flow and sediment in a river. These influences commonly throw the watershed inputs of flow and sediment out of balance, causing channel instability in both planform and profile.

1.3 Historic Setting

Industrial Development

Following the American Revolution, more and more people began to move into the Hoosic Valley. By the mid-1800s, many mills and factories had been built along the Hoosic River to utilize it as a source of water power and waste disposal (HooRWA, 2009). In North Pownal, an 18th century grist mill along the Hoosic River was replaced by a wool mill that operated from 1849 until 1863, when it burned (Wikipedia, 2009). The Plunkett & Baker Co. Mill, built in its place in 1866, served as a cotton mill until 1930, after which Pownal Tanning Company, Inc. operated a hide tanning and finishing facility from 1935 to 1988. In 1955, the section of the river adjacent to the tannery building complex (pictured at right) was dammed and a hydroelectric generating station was installed to provide power for the tannery (EPA, 2005).



Along with industrial development came railroads to transport the goods. An important connection for the region was the Hoosac Tunnel through the Hoosac Range near North Adams, MA, which was completed in 1875 after over 20 years of construction. With a length of 4.75 miles, it was the longest tunnel in North America at the time, and remains the longest east of the Rocky Mountains. In 1907, an electric railroad through Pownal linked it to the Berkshires and Bennington. The brick power station still stands along Route 7 (Wikipedia, 2009). A rail car line also connected lime quarries in North Pownal to a mill on the west side of Route 346, which operated until 1936. The active railroad that follows the Hoosic River to the east through Pownal was once part of the extensive Boston & Maine Railroad system of New England and New York and is still in use today under the Pan Am Railways network (Wikipedia, 2009).

20th Century Development

As industries and cities continued to develop along the banks of the Hoosic River, its floodwaters became more of a threat to infrastructure and residents. Severe floods in the 1930s and 40s caused extensive damage, particularly in the city of North Adams, MA (just south of Pownal). In response to the damage, the US Army Corps of Engineers constructed a system of flood control chutes throughout the city and the nearby town of Adams in the 1940s and 50s, totaling 4.4 miles of concrete channelization. Although the flood chutes effectively prevented further flooding in these towns, they have had a significant ecological, recreational, and aesthetic cost on the river in the immediate area as well as farther downstream in Pownal. As the structures, which were only estimated to have a lifespan of 50 years, begin to require repairs, Adams and North Adams are slowly exploring options to restore the river to a more natural state (Traister, 2004).

A major development for the town of Pownal was the Green Mountain Racetrack, which opened in 1963 along the Hoosic River in Pownal Village. The track featured horse racing until 1977, then greyhound racing until 1991. The racetrack closed in 1992, just prior to Vermont's banning of greyhound racing in 1995. The 144-acre property was purchased at a public auction in 1993 and subsequently sold in 2004, after which it became known as the Green Mountain Park. In 2007, the dilapidated structures that once stabled over 850 horses were demolished. Since closing as a racetrack, the site has hosted occasional events such as car shows, concerts, bingo games, and fairs. Future plans for the property have not yet been finalized (Bush 2004 & 2007, Wikipedia 2009).

Pollution and Clean-up Efforts

Another impact of the industrial development was pollution of the Hoosic River. Mills and households used it an open sewer and even dumped garbage on the frozen river, where it stayed until swept away during the spring melt. One source of pollution in the Hoosic River upstream of Pownal was the Sprague Electric Company, which operated an electronics plant in North Adams from 1942 to 1985. From the 1950s to 70s, drummed wastes containing trichloroethylene (TCE) and other toxic chemicals were landfilled on the property. Since remedial efforts by the Massachusetts Department of Environmental Protection began in 1984, volatile organic compounds (VOCs) have been detected in the property's soil and groundwater, and polychlorinated biphenyls (PCBs) have been detected in the soil on site and nearby and in sediments along the Hoosic River. The factory buildings now house the Massachusetts Museum of Contemporary Art, and remedial activities continue (EPA, 2002).

A more direct source of pollution to the Hoosic River in the town of Pownal was the tannery operated by the Pownal Tanning Company from 1935 to 1988, as mentioned above. For many years, operations at the tannery severely affected the river. Untreated wastes containing dyes, solvents, waxes, and other harmful chemicals were discharged directly into the river until 1962. Various attempts at wastewater treatment were then employed by the tannery, including the construction and operation of five lagoons. In 1982, a state-permitted lined landfill was constructed and received excavated sludge from one of the lagoons, and the remaining four continued accepting tannery sludge (EPA, 2005).

In 1985, the VT ANR notified the company that they were in violation of state environmental requirements, and by 1988, the company declared bankruptcy and ceased operations. The Pownal Tannery Superfund Site was developed. The 28-acre site comprises three main areas: the tannery building complex that housed various plant operations, the 22-acre lagoon area, and the landfill (see Figure 2-3). Starting in 1993, the EPA took a number of clean-up actions to address site contamination at the building complex and landfill, including the removal of contaminated material in the buildings, decontamination of the warehouse, demolition of the remaining buildings, removal of underground storage tanks, and capping of the landfill. Clean-up activities at the lagoon area started in 2002 and included excavation and consolidation of lagoon wastes, construction of a low-permeability cap over the

consolidated wastes, long-term monitoring of the river sediments and groundwater, and institutional controls to protect the cap and restrict groundwater use (EPA, 2005).

In 2002, the town of Pownal acquired the former tannery building complex and lagoon area. The building complex area has since been re-developed into a park-like setting, with grass, handrails, and a plaque memorializing the historic nature of the former mill. Concrete foundation walls that remain underground were left to provide additional support for the sloped river banks. A reuse plan envisions passive recreation (e.g. a canoe/kayak launch, a playground, a picnic area, etc.) and an outdoor performance stage for this site. At the former lagoon area, a new wastewater treatment facility (WWTF) was built (pictured at right). In addition to the WWTF, the reuse plan for this site recommends both active recreational uses (e.g., playing fields, a seasonal skating rink, etc.) and passive uses (e.g. trails, a canoe/kayak launch, a picnic/lawn area, etc.). Because portions of the site are subject to flooding, a berm that was in place along the river prior to remediation efforts was lowered near its northern end and rip-rap was placed to facilitate drainage during flooding events (EPA, 2005). This area is shown in the photos below, taken during and post-remediation.



Northern end of berm at the site of former lagoon area, looking south. Left: lowering of the berm and placement of rip-rap for drainage during remediation in 2004 (from Metcalf & Eddy, 2005). Right: revegetation observed during Phase 2 assessment.

1.4 Phase 2 Assessment Study Area

The study area of the Hoosic River for this assessment lies entirely within the town of Pownal in the southwest corner of Vermont. The river flows from the Massachusetts border just southeast of Pownal Village to the New York border just northwest of North Pownal. The assessment area is approximately 7.5 miles long, with a drainage area of about 230 square miles and a moderate channel gradient (0.08% slope). During the Phase 1 assessment, this section of the river was delineated into six reaches, all of which were assessed during Phase 2 (see Figure 1-2).

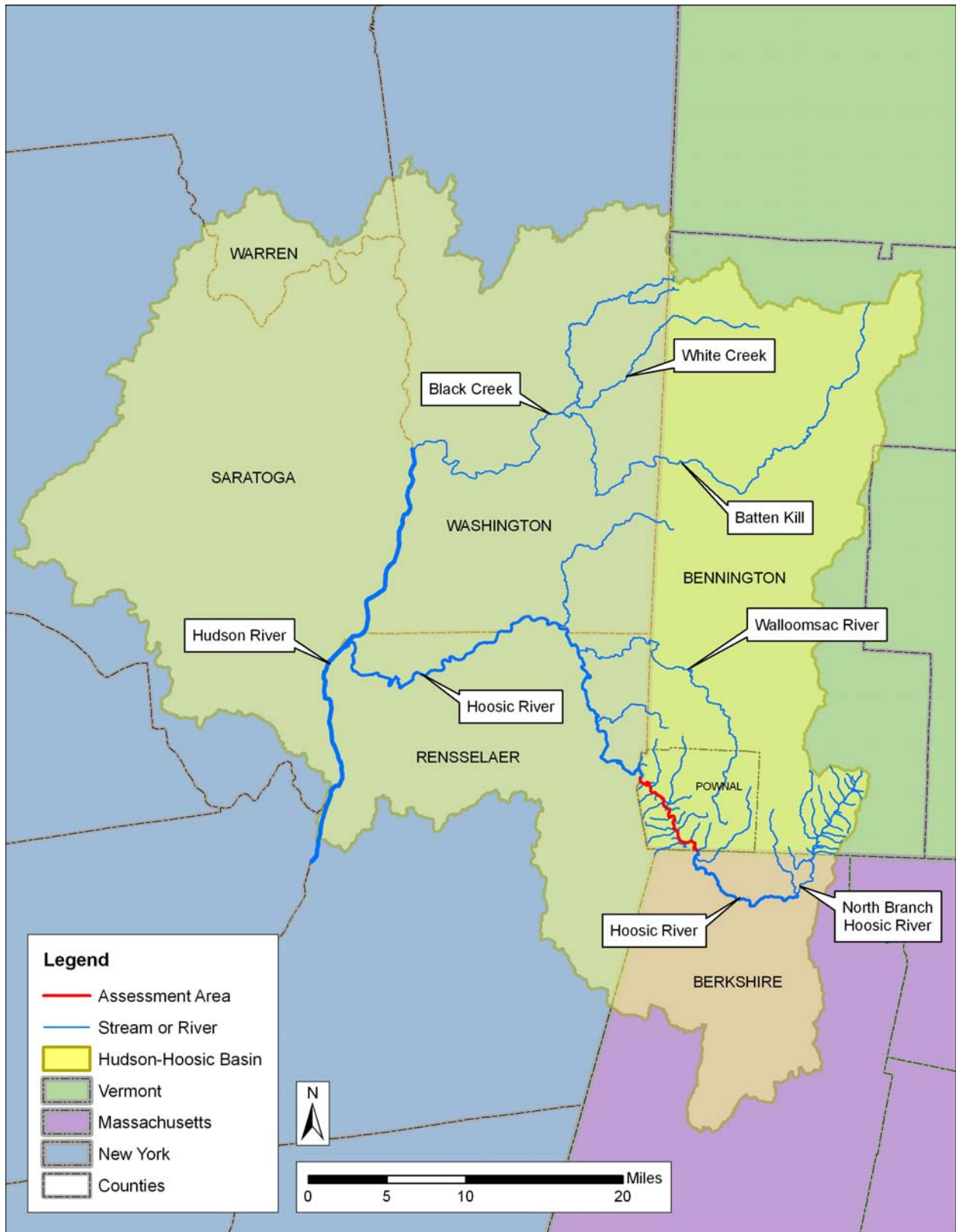


Figure 1-1: Hudson-Hoosic Basin with Major Contributing Waterways Shown

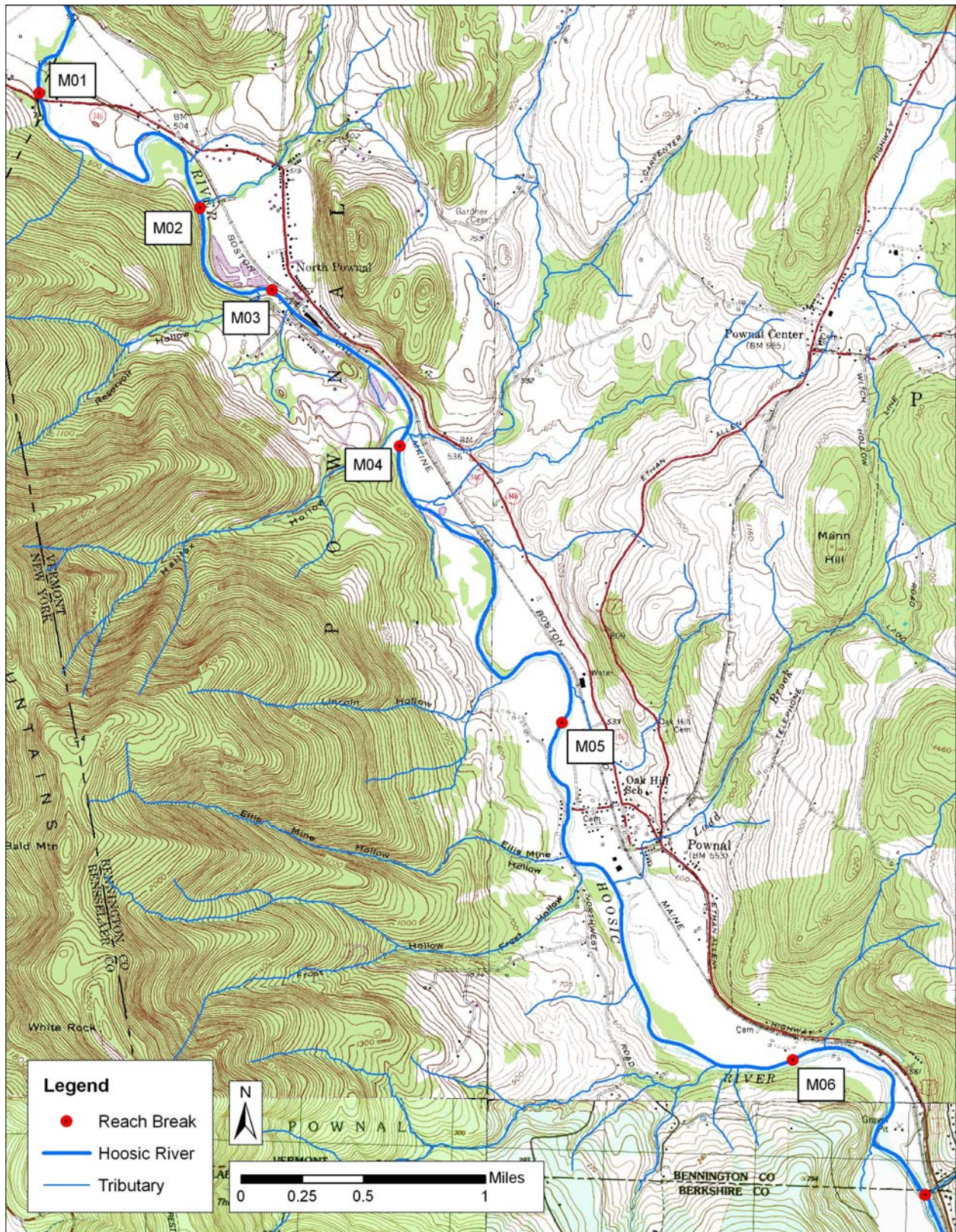


Figure 1-2: Hoosic River Phase 2 Study Area

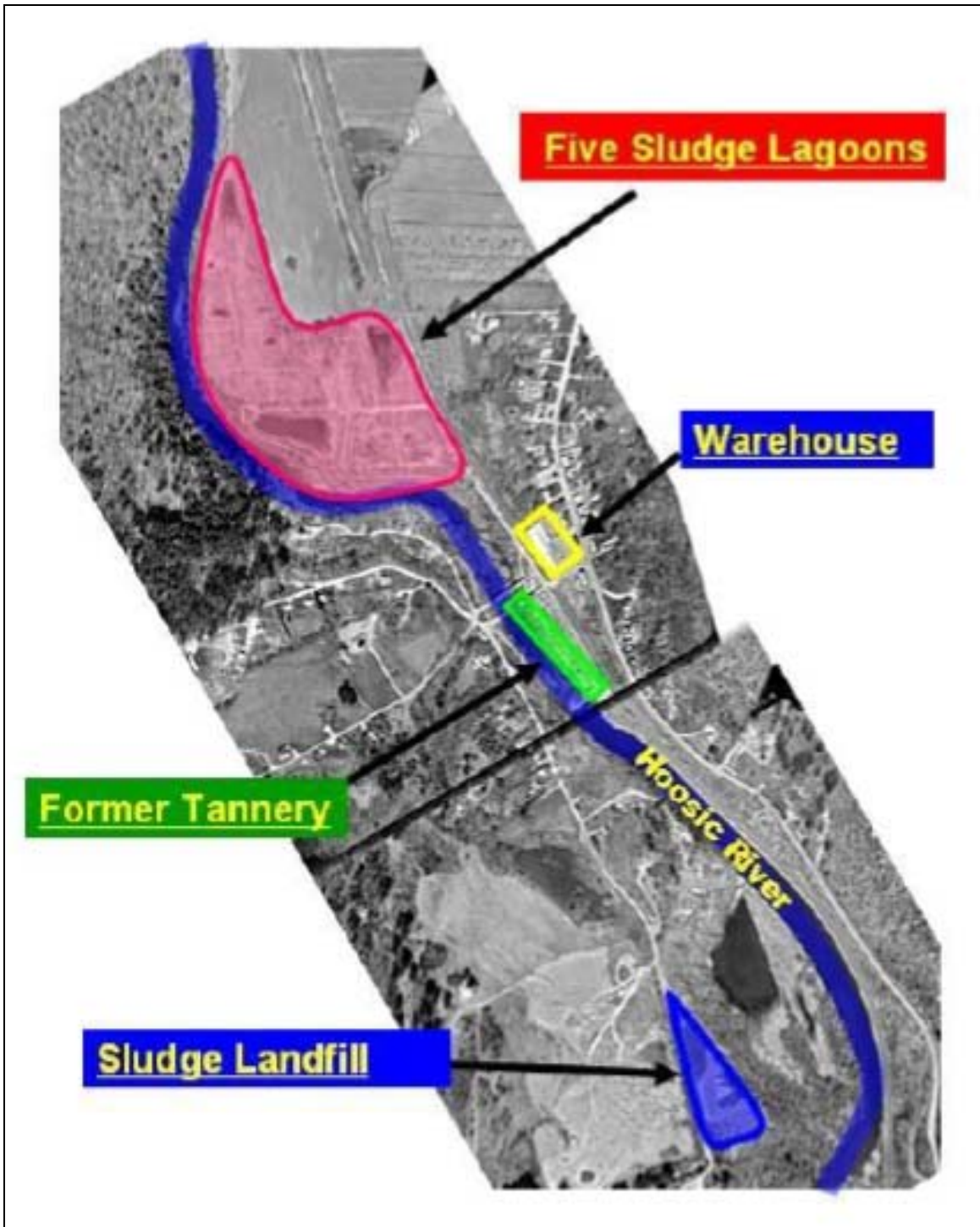


Figure 1-3: Pownal Tannery Superfund Site (Metcalf & Eddy, 2005)

2.0 Methods

This study of the geomorphic characteristics of the Hoosic River followed the methods presented in the Vermont Agency of Natural Resources' (VT ANR) Phase 2 Rapid Stream Geomorphic Assessment Field Protocols (VT ANR, May 2007). Prior to conducting the Phase 2 field assessment, the data generated for the study area during the Phase 1 assessment were reviewed. Phase 1, the remote-sensing phase of the geomorphic assessment, was conducted by the Bennington County Regional Commission (BCRC). The Phase 1 assessment involved the collection of data from topographic maps, aerial photographs, existing studies, and field reconnaissance (windshield surveys).

Phase 1 methods included selecting study streams, dividing streams into reaches of homogeneous geomorphic channel and valley characteristics, and evaluating geology, soils, land cover, reach hydrology, in-stream channel modifications, and floodplain modifications on each reach. The evaluation of these parameters allowed for the assignment of a numeric impact rating for each reach, and provisional reference stream types were established based on valley land forms and geology. Predictions of channel condition (departure from reference), adjustment process, and reach sensitivity were based on evaluations of watershed and river corridor land use as well as channel and floodplain modifications.

The Phase 1 assessment was conducted on the entire length of the Hoosic River within the state of Vermont, totaling six reaches, all of which were selected for the Phase 2 assessment.

2.1 Field Assessment

Phase 1 reaches were divided into segments where appropriate to identify those areas of a reach that differ substantially from one another in geomorphic and/or habitat conditions. A segment has the same reference stream type as its reach but is distinct from other segments in the reach in one or more of the following parameters: grade controls, channel dimensions, substrate size, planform and slope, depositional features, corridor encroachments, banks and buffers, flow status, property access, valley width, or others. Different segments in a reach are labeled with capital letters (A, B, C...) suffixed to the reach number and assigned sequentially from downstream to upstream (VT ANR, May 2007). Segments created during the Phase 2 assessment are shown in Figure 2-1. Segments not assessed in Phase 2 (M03-B) are shown in grey.

A total of 7.5 river miles on the Hoosic River were assessed using Phase 2 protocols during the summer and fall of 2008. Field efforts consisted of identifying bankfull features and collecting field measurements of channel dimensions, stream impacts, bottom substrates, shoreline and riparian conditions, and floodplain encroachments and modifications. The measurements were collected to determine the existing stream type, condition, and sensitivity for each reach.

Each reach was traversed by a field crew of two or three persons. Each crew had a complete set of aerial photographs, topographic maps, and Phase 1 summary reports for each reach. Due to the relatively deep water along many sections of the Hoosic River, the field assessment had to be conducted in the downstream direction. Field crews used a canoe to navigate deep sections and waded shallow sections. The floodplain and terrace areas on each side of the river were examined on foot as well. A field sketch was completed for each reach and representative photographs were taken.

Cross-section analyses were performed at representative locations within each reach/segment. A survey level, rod, and tape were used to obtain elevation and width measurements of the stream channel and overbank areas. Channel dimensions and ratios were derived from the cross-sections in order to determine the existing stream type and bedform type classifications. The Phase 2 field work included a Rapid Habitat Assessment (RHA) and Rapid Geomorphic Assessment (RGA) for each reach and segment.

Bridges along the river were also assessed. This involved visiting each stream crossing and collecting information in accordance with the methods outlined in Appendix G (Bridge and Culvert Assessment) of the Vermont ANR's Phase 2 handbook (VT ANR, May 2007).

The boundaries of the valley walls delineated during the Phase 1 assessment were field-verified as part of the Phase 2 field effort. Field observations along with GPS, topographic maps, and aerial imagery were utilized to delineate the toe of the "truly confining" valley wall, which reflects the presence of natural and manmade features that would act as physical barriers to lateral migration of the river (e.g., terraces greater than 20 feet high, major roads built on fill such as Route 7, etc.). Smaller roads and other manmade features that could fail due to fluvial erosion during large flow events and are not truly confining (even if they would likely be rebuilt in the event of failure) were not mapped as valley walls. The VT ANR guidance of "when in doubt, leave it out" was followed (VT ANR, Feb 2007). This natural, or truly confining, valley wall is referred to as the Phase 1 (P1) valley wall in this report.

Using GPS data and field sketches, a GIS polygon shapefile of the P1 valley wall was developed. For the purposes of the Phase 2 analysis (confinement calculations, etc.) and Fluvial Erosion Hazard (FEH) mapping, the P1 valley wall was then adjusted to reflect manmade features that may not truly confine the river and could fail during large flow events, but that would likely be rebuilt in the event of failure (e.g., the railroad and smaller roads such as Route 346). This human-modified valley wall is referred to as the Phase 2 (P2) valley wall in this report.

2.2 Data Management

Standard field forms from Appendix A (Phase 2 Field Forms) of the Vermont ANR's Phase 2 handbook were used to record field data (VT ANR, May 2007). For each segment or reach, these forms included rapid stream assessment field notes, a tally sheet, a cross-section worksheet, a photo log, an RHA form, and an RGA form. Stream features and impacts—including surface water, roads, and major structures in the river corridor—were digitized on forms prepared prior to field mobilization for each reach at a scale of 1:3,000.

The field teams collected GPS data of in-stream features and impacts consistent with the protocols. The feature types collected with GPS are listed in Table 2-1. Data were collected in the field using a Trimble Model Pro-XH high-resolution GPS backpack unit. The GPS data collected in the field were differentially corrected in the office to improve accuracy and then reviewed with ArcGIS software. These data could not be directly imported into the Stream Geomorphic Assessment Tool (SGAT). Rather, the data were uploaded to ArcView 3 and the features collected in the field were re-created within the SGAT extension.

All of the field forms were scanned and archived. Photographs were organized into an appendix. The field data and cross-section data were entered and uploaded into the Vermont ANR's online Data Management System (DMS).

2.3 Data Interpretation

The field assessment data were compiled and evaluated using methods detailed in the Vermont ANR's Phase 2 handbook (VT ANR, May 2007). Parameters that were measured and calculated to define the stream channel geometry are described in Table 2-2. Two similar parameters that both reflect channel bed degradation are the entrenchment ratio (ER) and the incision ratio (IR). Entrenchment, calculated by dividing the width of the floodprone area by the bankfull width, is used in stream type classification. The higher the degree of entrenchment (indicated by a lower ER), the less access a stream will have to its floodplain during flood flows. However, streams in wider floodplain valleys have to degrade quite a bit and contain flood flows approaching the 50-year flood before the ER value changes substantially. In

contrast, the incision ratio is a more sensitive measurement of bed degradation. The IR is calculated by dividing the height of the recently abandoned floodplain by the bankfull maximum depth. Incision ratios greater than one may indicate that a stream underwent a downcutting in the recent past, allowing for the identification of a bed degradation process in its early stages (VT ANR, May 2007).

The entrenchment ratio, the width/depth (W/D) ratio, and the Phase 1 parameter sinuosity were used to determine an existing stream type for each assessed segment. Figure 2-2 provides the Rosgen stream channel classification system flow chart used to classify each reach or segment (Rosgen, 1996).

A Rapid Geomorphic Assessment (RGA) was completed to determine the geomorphic condition, major channel adjustment processes, and sensitivity of the stream. Stream condition is classified based on RGA scores of reference (0.85 – 1.0), good (0.65 – 0.84), fair (0.35 – 0.64), or poor (0.00 – 0.34). According to the protocols, stream segments can receive a condition descriptor outside the range of their score as long as reasonable justification is given. Channel adjustment processes include degradation, aggradation, widening, and planform adjustment—all of which can be noted as historic processes. Stream sensitivity is dependent on the existing stream type and whether the stream is in regime (reference or good condition), in major adjustment (fair condition), or has experienced a stream type departure (poor condition). All of these factors were considered to determine what stage (I-V) of the channel evolution model (CEM) the stream is currently undergoing. Diagrams and descriptions of the five stages that make up the F-stage CEM are provided in Figure 2-3.

Draft fluvial erosion hazard (FEH) maps were developed using the SGAT. The automated FEH area was modified to correct anomalous shapes and to reflect local conditions in accordance with the VT ANR's Technical Appendix to the River Corridor Protection Guide (VT ANR, 2008). The draft FEH maps were reviewed and approved by VT ANR River Management Program staff.

2.4 Quality Assurance

In order to ensure the collection of accurate and consistent data, users of the Vermont ANR's Phase 2 Rapid Stream Geomorphic Assessment Field Protocols need to establish a quality assurance (QA) program for each phase of the assessment. The protocols outline three key components of quality assurance: training, data review, and use of a data management system (DMS). Conducting a QA program at all levels of assessment ensures that data is accurate and complete.

Establishment of an effective field team is an essential factor for quality assurance. For this assessment, the field team structure consisted of a Field Team Leader (Jason George), a Trained Field Team Member (Jill Winton), and a Support Field Team Member (Jeremy Belanger). The Field Team Leader, who has received VT ANR Phase 2 training, provided complete training in protocols and field assessment techniques for the Trained Field Team Member during several other Phase 2 assessments in Vermont. The Trained Field Team Member was present for the entire field assessment, being assisted by one or both of the other two team members at all times. This member also served as the QA Team Leader.

The Phase 2 field data were first reviewed and interpreted by the field team and then entered into the DMS. After a DMS-automated QA process was completed, data were presented to River Management Program staff for their review and discussion. Data were adjusted at the direction of River Management Program staff. Data were entered into the DMS and the automatic QA process was performed.

Because so many aspects of the Phase 2 assessment depend on accurate identification and measurement of bankfull features, bankfull elevations were checked by three methods. First, the cross-sectional area at each cross-section location was calculated (bankfull width times mean bankfull depth) and the areas were compared to make sure they decreased moving upstream (Table 2-3).

Next, the drainage area and flow statistics were determined for each cross-section location using the U.S. Geological Survey (USGS) Vermont StreamStats basin delineation tool (USGS, 2007). Relative magnitudes of decrease in cross-sectional areas moving upstream were checked to see how well they corresponded with relative magnitudes of decrease in drainage areas and two-year peak flows (Table 2-3).

Finally, the cross-sectional area for each location was predicted using the following Vermont regional hydraulic geometry curve, which has an R-squared value of 0.95 (VT ANR, 2006):

$$\text{Cross Sectional Area} = 12.38 \times (\text{Drainage Area})^{0.75}$$

The field-determined cross-sectional areas were compared to the predicted cross-sectional areas to make sure magnitudes (Table 2-3) and trends (Figure 2-4) were relatively similar.

It would also be helpful to compare the drainage areas, bankfull widths, mean depths, and cross-sectional areas for each cross-section to the corresponding measurements of reference streams compiled in the Vermont hydraulic geometry dataset (VT ANR, 2006). However, the Hoosic River has much greater measurement magnitudes than any of the other streams contained in the dataset thus far, so this comparison could not be conducted.

Based upon this thorough analysis, slight changes were made to the bankfull elevation of four segments. Bankfull elevation was lowered slightly for segments M02 and M04-A, and was raised slightly for segments M03-A and M04-B. Corresponding changes in channel dimensions, calculated ratios, etc. were made and checked with River Management Program staff.

Table 2-1: Stream Impacts Documented with GPS During the Phase 2 Assessment.

	Impact	Sub-Impact
Point Features	Alluvial Fan	N/A
	Grade Control	Dam
		Ledge
		Waterfall
		Weir
	Mass Failure	N/A
	Dredging	Dredging
		Gravel Mining
		Commercial Mining
	Debris Jam	N/A
	Stormwater Input	N/A
	Beaver Dam	N/A
	Migration	Neck Cut-off
		Flood Chute
		Avulsion
		Braiding
	Head Cut or Steep Riffle	Head Cut
		Steep Riffle
	Stream Crossing	Stream Ford
		Animal Crossing
Flow Regulation and Water Withdrawal	Drinking	
	Irrigation	
	Snow Making	
	Bypass	
Gully	N/A	
Bridge or Culvert	N/A	
Constriction	N/A	
Segment Break	N/A	
Cross Section Location	N/A	
Line Features	Development	N/A
	Encroachment	Berm
		Improved Path
		Road
		Railroad
	Bank Armoring and Revetment	Rip-Rap
		Hard Bank
		Other
Erosion	N/A	
Straightening	Straightening	
	With Windrowing	

Table 2-2: Summary of Terms

Term	Definition
Bankfull Discharge	The stream discharge corresponding to the water stage that first overtops the natural banks onto the active floodplain, occurring on average about once every one to two years
Bankfull Width	The top surface width of a stream channel when flowing at bankfull discharge
Bankfull Mean Depth	The mean depth of a channel within a riffle segment when flowing at bankfull discharge
Bankfull Max Depth	The maximum depth of a channel within a riffle segment when flowing at bankfull discharge
Floodprone Width	The width of a stream when flooded to an elevation twice the maximum depth of the bankfull channel
Recently Abandoned Floodplain (RAF)	The height of the lowest floodplain feature a stream had access to within the past 200 years, but has lost access to at bankfull stage
Human-Elevated Floodplain (HEF)	The height of a feature such as a railroad, road, berm, levee, or improved path that is higher than and blocks access to the RAF
Width/Depth (W/D) Ratio	The bankfull width divided by mean the bankfull mean depth
Entrenchment Ratio (ER)	The width of the floodprone area divided by the bankfull width
Incision Ratio (IR)	The RAF height divided by the bankfull maximum depth

Table 2-3: Quality Assurance Check of Field-Measured Bankfull Geometry

Segment ID	Width (ft)	Mean Depth (ft)	Cross-Sectional Area (ft ²)	Drainage Area (mi ²)*	Q ₂ (ft ³ /s)*	Predicted Cross-Sectional Area (ft) ^{**}
M01	180	4.98	896	232	6460	736
M02	139	6.39	887	225	6280	719
M03A	169	5.24	883	224	6250	717
M04A	158	5.39	851	218	6090	702
M04B	136	5.79	788	215	6020	695
M05	127	6.12	777	209	5850	681
M06	136	5.68	772	207	5790	676

*Obtained from USGS VT StreamStats (USGS, 2007).

**Calculated based on drainage area using VT hydraulic geometry curve (VT ANR, 2006).

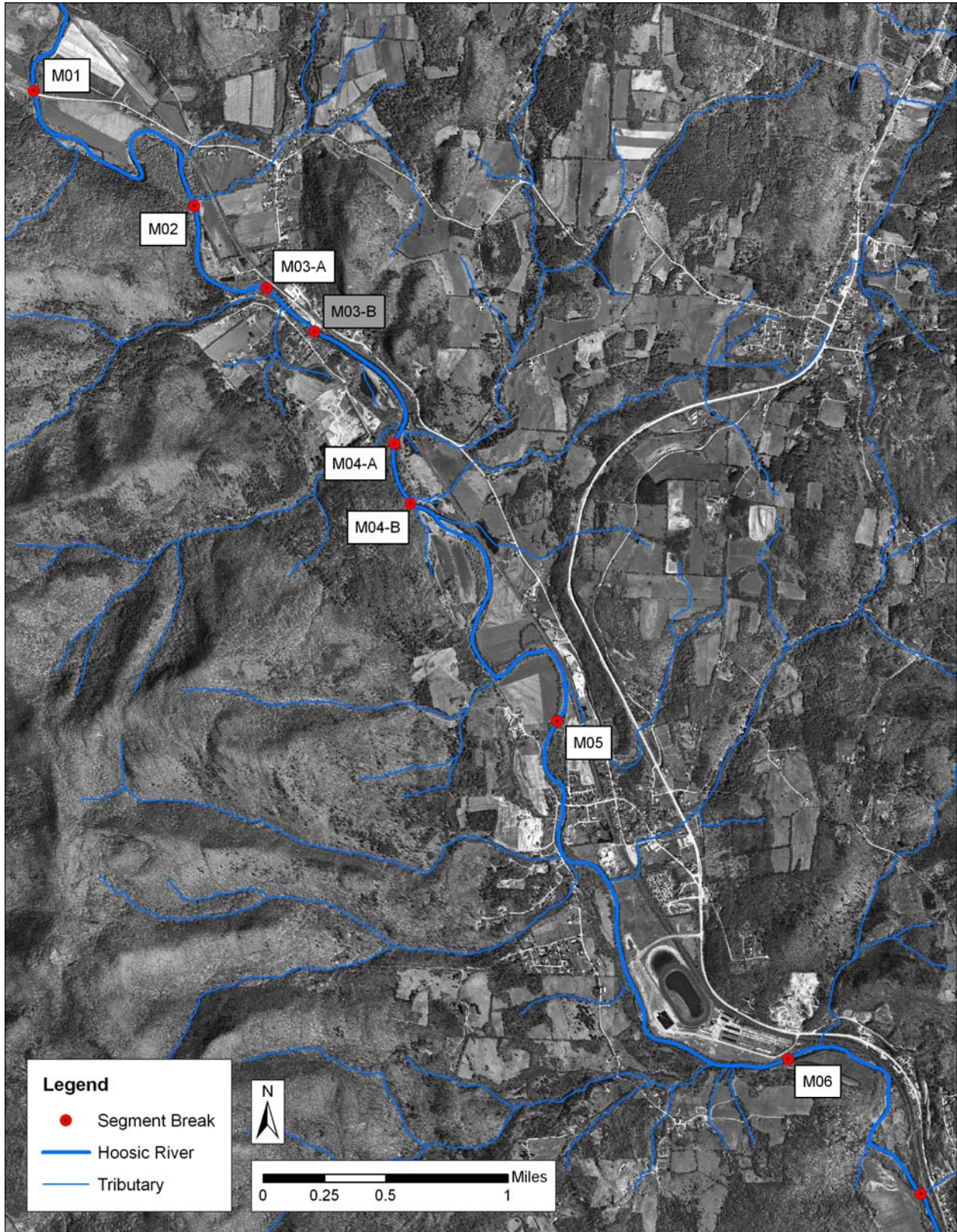


Figure 2-1: Hoosic River Phase 2 Assessment Reaches and Segments

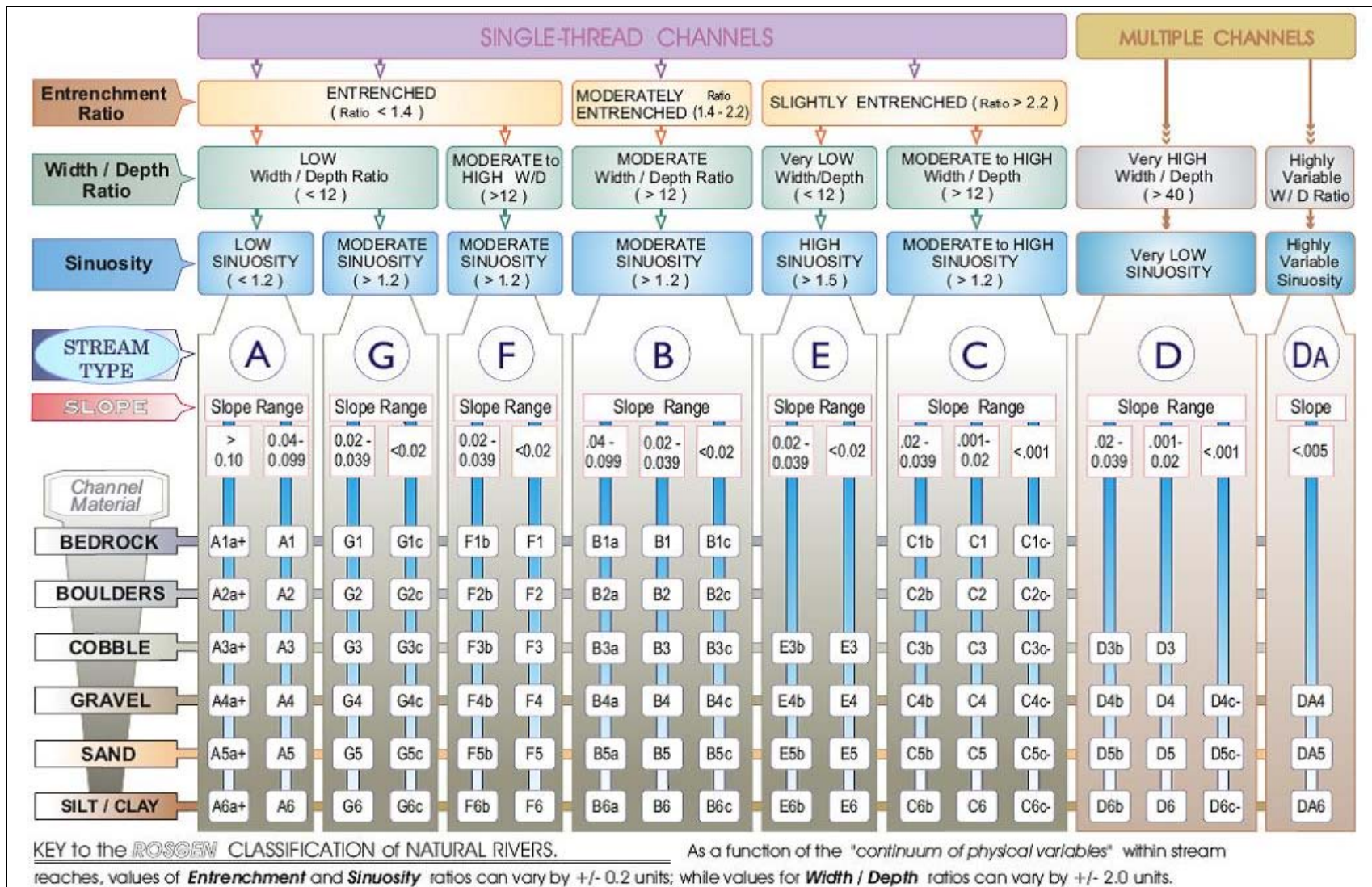


Figure 2-2: Rosgen Stream Classification System (Rosgen, 1996)

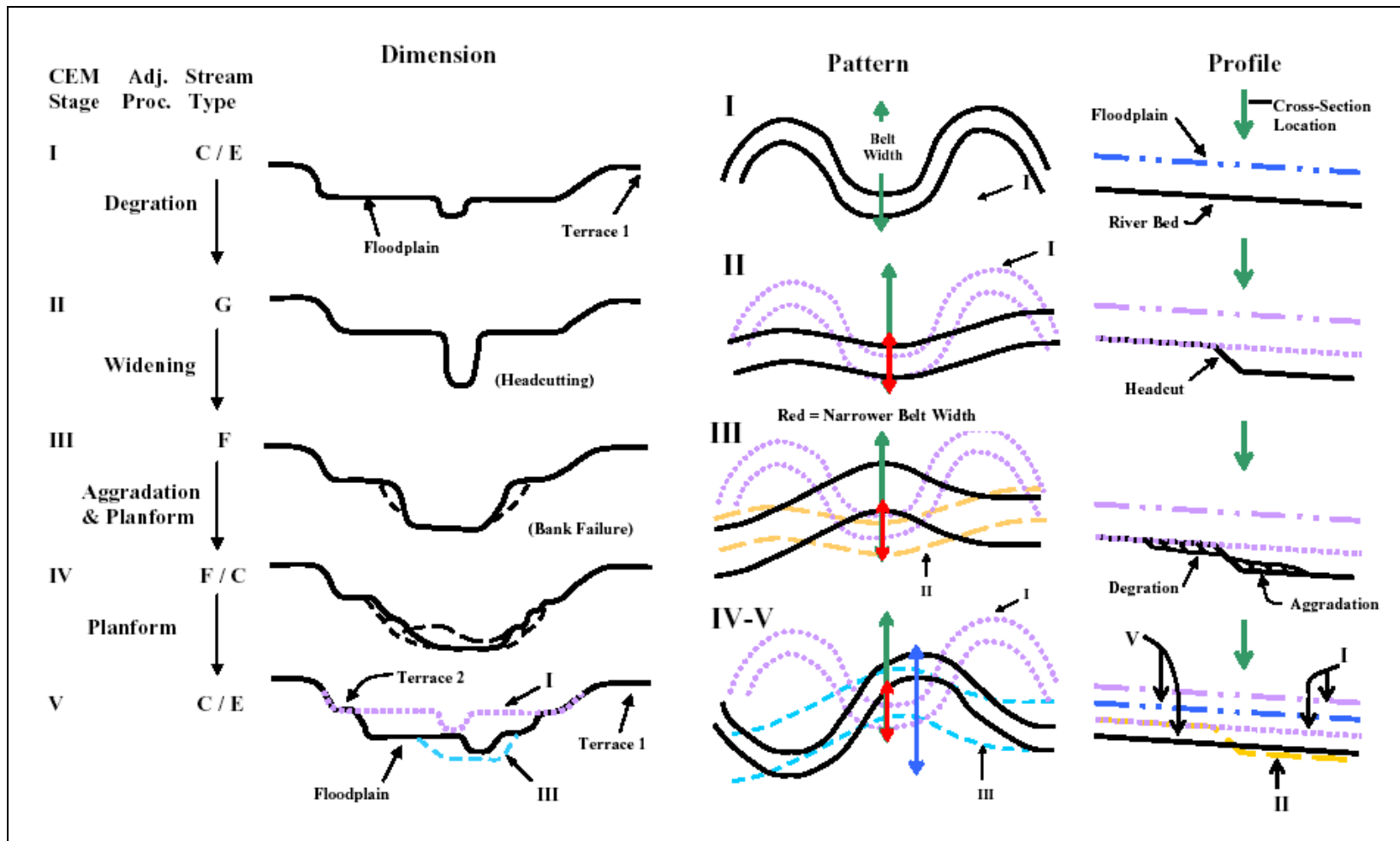


Figure 2-3: F-Stage Channel Evolution Process (VT ANR, 2007)

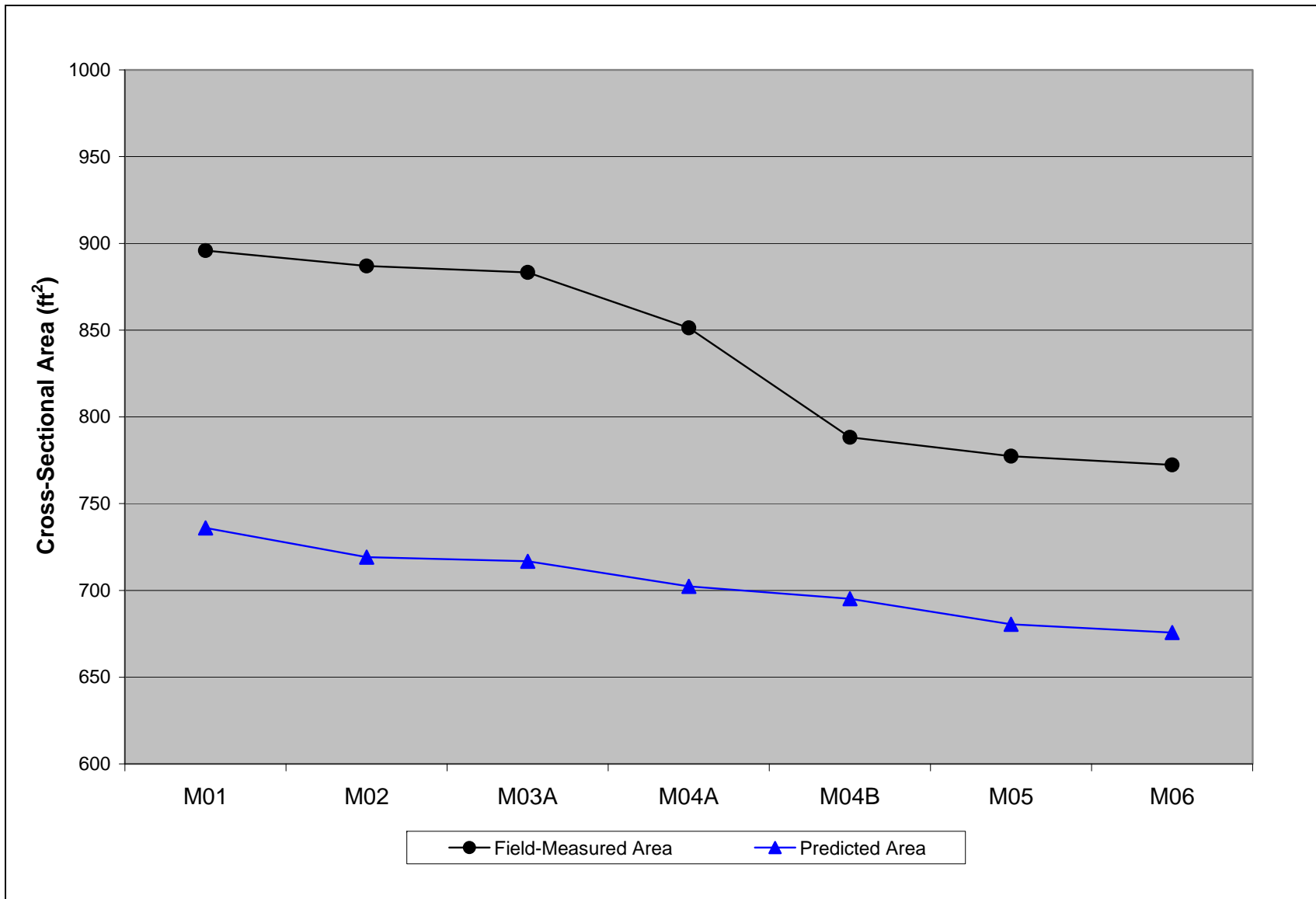


Figure 2-4: Quality Assurance Comparison of Cross-Sectional Areas for the Hoosic River

3.0 Results

Reference stream types and other characteristics determined during the Phase 1 assessment for each assessed reach are given in Table 3-1. The field-verified existing stream types and other characteristics determined during the Phase 2 assessment for each assessed segment are given in Table 3-2. Tables 3-3 and 3-4 show the measurements and associated calculations obtained from the cross-section analysis of each segment. Table 3-5 shows the results of the Rapid Habitat Assessment for each segment, and Table 3-6 shows the results of the Rapid Geomorphic Assessment (including stream type departures, adjustment processes, and sensitivity ratings). The percent of each segment's length affected by the stressors of berms, roads, development, and straightening is given in Table 3-7. Table 3-8 shows the Fluvial Erosion Hazard (FEH) ratings determined for each segment. An overview map of the draft FEH zone for the entire study area is presented in Figure 3-1.

Appendix A contains maps of each reach or segment showing the locations of stream impacts and features recorded by the Feature Indexing Tool. Cross-section diagrams produced from elevation data for each segment are provided in Appendix B. Each diagram depicts the approximate elevation of the bed/bank surface, current water surface, bankfull height, and floodprone height, as well as the location of the valley walls and any other prominent features. Appendix C contains the draft FEH maps of each reach. Appendix D presents a list of all stream impacts and features recorded by the Feature Indexing Tool (FIT) for each segment. Appendix E contains field photographs taken during the reach assessments and the bridge and assessments. Standard Phase 2 database output reports from the DMS are included in Appendix F.

A description of each reach and segment evaluated during the Phase 2 assessment is presented below. Note that left and right banks are always identified facing downstream. Also note that all channel evolution stages were identified by the F-stage channel evolution model (CEM). Field data, cross-section plots, and spatially referenced stream features are also accessible online through the DMS.

3.1 Reach and Segment Descriptions

Reach M01

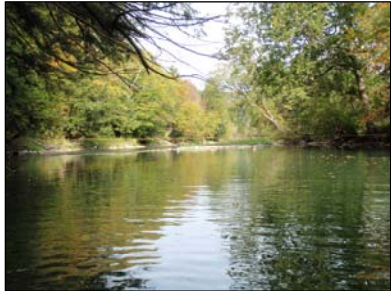


Reach M01 is the lower-most reach in the assessment area. It flows for approximately 1 ¼ miles from the downstream end of an agricultural field below the wastewater treatment facility to the Route 346 bridge at the Vermont-New York border. The left corridor is entirely forested while the right corridor is mostly agricultural, with some forested areas and shrubby buffer zones. The natural valley is very broad, but human modifications have reduced it to narrow width. The modified valley wall is defined on the left by the natural mountain slope, which is usually continuous with the bank, and on the right by the railroad, which is continuous with the bank for about 1,000 feet. In the section of railroad encroachment and for another 1,000 feet downstream along an agricultural field (totaling almost 30% of the reach length), the right bank is rip-rapped and has buffers less than 25 feet. An island and several floodchutes are also present in this reach.

M01 has a reference type of C4 but has degraded to a B4c. At the cross-section, the river is moderately entrenched (ER = 1.6) with a high width-to-depth ratio (36). Using the agricultural field on river-right as the recently abandoned floodplain (RAF) yields an incision ratio (IR) of 2.1. The reach received a rapid habitat assessment (RHA) score of 'good' and a rapid geomorphic assessment (RGA) score of 'fair'. It has experienced historic degradation and widening and is now forming a new floodplain through aggradation, as evidenced by many depositional features. Planform is also adjusting, as evidenced by

flood chutes, transverse bars, & erosion. Therefore, the reach was determined to be in Stage IV of the channel evolution model (CEM). Due to the stream type departure (STD) from C to B, the stream sensitivity is very high.

Reach M02

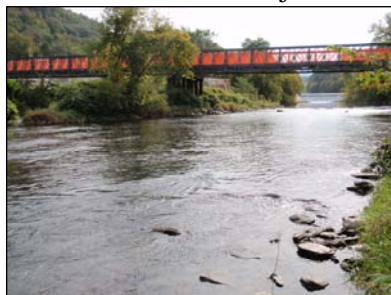


Reach M02 is the shortest reach, flowing for just over half a mile from the upper end of the wastewater treatment facility (WWTF) to the end of an agricultural field below it. The left corridor has some sparse residential development at the upper end of the reach, but is primarily forested, while the right corridor is mostly occupied by the open land of the WWTF (Photo 87), with some agricultural land at the downstream end. The naturally very broad valley is confined to narrow width by human encroachments, defined on the left by the natural mountainside slope usually continuous with the bank, and on the right by the railroad. A berm runs almost the entire length of the WWTF property on the right (over 2,200 feet). Portions of this berm were excavated and redesigned during the Superfund clean-up and redevelopment of the former tannery lagoon complex where the WWTF now sits (see Section 1.3). Between the end of the berm and the start of the agricultural field (approximately 170 feet), the buffer is less than 25 feet (Photo 100) and the bank is covered in a reinforcing carpet-like material (Photos 102 and 103). Across from the berm near the upper end of the reach, there is a substantial mass failure approximately 50 feet high where the mountainside is actively eroding (Photos 88 through 90).

Reach M02 has a reference type of C4 but berming and degradation have resulted in a departure to type F4. It is entrenched ($ER = 1.3$), with a moderate W/D ratio (22). The IR based on the RAF of the WWTF land is 1.0, but the presence of the berm yields a human-elevated IR of 2.2. The reach received an RHA rating of 'good' and an RGA rating of 'fair'. It has experienced historic degradation and floodplain build-up when it was bermed and is now attempting to widen as evidenced by the mass failure, but is confined by a steep valley wall with some bedrock sections and the berm. It was determined to be in stage III of the CEM. Due to the STD from C to F, the stream sensitivity is extreme.

Segment M03-A

Reach M03 flows for just under a mile from the upstream extent of the impoundment created by the Pownal Dam to just below the Dean Street Bridge. The reach was divided into two segments due to the grade control at the dam—segment A below the dam and segment B, the impoundment. Segment M03-A flows through a developed area, with residential development in the left corridor and mostly commercial development in the right corridor. The site of the former Pownal tannery complex lines the right bank between the dam and the bridge (see Section 1.3). Only the powerhouse and foundations of several other buildings remain; the rest has been redeveloped into an open park-like setting. The naturally broad valley is semi-confined by the slope of the hillside on the left and by the railroad, which runs within one bankfull width of the river for the entire length of the segment on the right. Roads, development, and straightening also all impact 100% of the segment length.



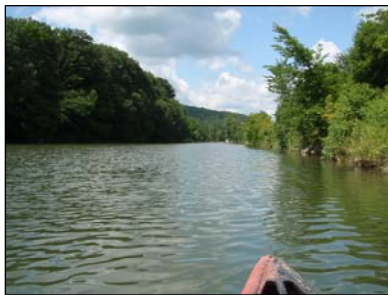
Near the center of the segment, Dean Road crosses the river. The former bridge, built in 1939, was abandoned over 20 years ago (Martinez et. al, 2005). A temporary bridge approximately 100 feet downstream (pictured above) has facilitated river crossings since then. During the Phase 2 field assessment (summer and fall of 2008), the old bridge was demolished and construction began on a new

bridge to take its place. By the end of September, the abutments and pier were in place but the deck had not yet been constructed.

Although few FIT impacts were observed (with the exception of some rip-rap under the bridges and a concrete retaining wall just off the right bank at the tannery complex), there appear to be various stream adjustment processes taking place in this segment. The slow, deep, entrenched section below the dam suddenly widens at the bridge area into a network of riffles, mid-channel bars, islands, and flood chutes. In this section, a very high (over 20 feet) right bank blocks floodprone access, while the left bank contains a series of small terraces with abandoned rip-rap and evidence of erosion-control plantings. Degradation has occurred, and the segment now appears to be aggrading and forming a new floodplain, particularly in the lower right corridor where a large island and depositional area have formed.

Segment M03-A has a reference type of C3, but floodplain build-up and historic degradation have resulted in a departure to type B3c. In the lower half of the segment where the cross-section was taken, the river is moderately entrenched (ER = 2.1) with a moderate width/depth ratio (32). The upper half of the segment (below the dam) is more entrenched with a lower width/depth ratio, but the river was too deep in that area to safely and accurately perform a cross-section. Using the terrace on the left bank as the RAF yielded an IR of 1.8. Again, the upper half of the segment would likely have yielded a higher IR due to the presence of a high bank on both sides. The segment received an RHA rating of 'good' and an RGA rating of 'fair.' It has experienced historic degradation and floodplain build-up, has become overwidened (particularly in the lower section where it is not constrained by bedrock and foundations), and is now developing new depositional features through aggradation. It was determined to be in Stage IV of the CEM, and the stream sensitivity is high.

Segment M03-B



Segment M03-B is the upstream portion of Reach M03 described above. It encompasses the majority of the impounded area upstream of the Pownal Dam. In accordance with Phase 2 protocols, this segment was not assessed because it is impounded and is too deep to allow for cross-section measurements. However, its channel dimensions and characteristics are very similar to those of Segment M04-B described below. Reach M03 has a naturally broad valley and a reference stream type of C. This segment is encroached by both the railroad and Route 346, which run within one bankfull width of the river in the right corridor for the majority of its length. Along the railroad, the right bank is rip-rapped and has a buffer less than 25 feet. The left corridor contains an open water/wetland complex.

Segment M04-A



Reach M04 flows for approximately 1 ¾ miles from just upstream of the Mack plant on river-right to the impoundment above Pownal Dam. Segment M04-A is a short (1,500-foot) section at the lower end of the reach that is still somewhat impounded by the dam. It is relatively flat, deep, and slow-moving, similar to the impoundment downstream. The naturally very broad valley is split almost in half (to narrow width) by the presence of the railroad in the right corridor. The steep mountainside natural valley wall on the left is mostly continuous with the bank, while the right corridor consists primarily of a wetland area with two small ponds. The segment is largely featureless.

Segment M04-A is classified as its reference stream type of C, but its reference substrate type of cobble has been almost entirely replaced by sand, with some silt and detritus. It is relatively unentrenched (ER = 3.7), with a moderate width/depth ratio (29). Using the right bank as the RAF yields an IR of 1.4. Although habitat condition in this segment would be considered poor for its reference high gradient stream type, a low gradient RHA form was used to facilitate management toward equilibrium in the current condition, as it is unlikely that the Pownal Dam would be removed. This yielded an RHA rating of 'good,' while the RGA rating remained 'poor.' This segment has experienced significant historic aggradation due to sediment settling out above the dam and has essentially become a featureless plane bed with little evidence of adjustment, except for the ongoing aggradation. Therefore, it was determined to be in Stage IV of the CEM and the stream sensitivity is very high.

Segment M04-B



Segment M04-B occupies the majority (almost 1.5 miles) of Reach M04. The most sinuous of the reaches, it meanders across its broad valley, defined on the left by the natural mountainside and on the right by the railroad. These two features alternately become continuous with the bank for short stretches between meanders. When the valley wall is continuous with the bank on one side of the river, the opposite floodplain area primarily consists of agricultural fields. In some areas the buffer between the river and fields is adequate, while others have buffers less than 25 feet. Other land uses of note include the forest on the left and a short section of industrial development on the right at the Mack plant near the top of the reach. Small areas of erosion are present throughout the reach, and where the right bank is encroached by the railroad it is armored with rip-rap. Several floodchutes and depositional features are also present.

Segment M04-B is still a reference stream type of C, but the dominant substrate size has decreased from cobble to gravel. It is unentrenched (ER = 5.9), with a moderate width/depth ratio (23). Using the agricultural field on the left as the RAF yields an IR of 1.2. The segment received an RHA rating of 'good' and an RGA rating of 'fair.' It has experienced historic degradation and is now narrowing to form a new floodplain through aggradation and development of bar features. Planform is also adjusting, as evidenced by several transverse bars/rifles, floodchutes, and erosion. It was determined to be in Stage IV of the CEM, and the stream sensitivity is very high.

Reach M05



Reach M05 is the longest reach in the assessment area at just over 2 miles. It flows from the upstream extent of the Green Mountain Park (former racetrack) property to just above the Mack plant property. Its naturally very broad valley has been reduced to broad width by the railroad on the right. The natural mountainside valley wall on the left is sometimes continuous with the bank and usually within one bankfull width of the river. The left corridor is mostly forested, with some scattered agricultural and residential development areas, particularly near the crossing of Main Street. The right corridor is similarly developed in this region, but a dominant feature is the 144-acre Green Mountain Park occupying almost half of the reach length at the upper end. This site of the former racetrack includes an extensive paved lot with access roads, a large spectator stand, the racetrack itself (which encircles around a pond), and an area of former stable buildings which have been demolished. The relatively flat lot is accessed when the river is at floodprone height (equal to two times the maximum bankfull depth).

Although lateral channel migration in reach M05 is restricted by development, it was found to be still in its reference condition of C3 at the cross-section. It is possible that the low slope of this reach has alleviated some of the degradation typically seen in similarly encroached streams. Furthermore, the former racetrack lot appears to be currently serving as a floodplain for the river, whereas if the lot were developed with valuable infrastructure, the river would likely be prevented from accessing this floodplain via bank armoring, berming, etc. This would certainly lead to further degradation of the reach, effectively pushing it backwards in the CEM.

Reach M05 is only slightly entrenched (ER = 3.7), with a low width/depth ratio (21), and an IR of 1.7 based on an RAF of the former racetrack lot. It received an RHA rating of 'good' and an RGA rating of 'fair.' The reach has experienced historic degradation, has developed new bar features through aggradation, and appears to be approaching relative stability near the end of Stage IV of the CEM. The stream sensitivity is high.

Reach M06



Reach M06 flows for just over a mile from the Massachusetts-Vermont border to the upstream extent of the Green Mountain Park (former racetrack) property. Its naturally broad valley is only slightly confined by the railroad and Route 7 on the right, but the valley type remains broad. The left corridor predominantly consists of two large agricultural fields, separated by a section of forest where the bank is continuous with its natural mountainside valley wall. When the river is not near the railroad (which occurs for almost 70% of the reach), the right corridor is lightly forested with a network of dirt roads and ATV trails. The right bank is often relatively high with areas of erosion

(Photos 6 and 15). The left bank is usually somewhat lower with less erosion, except in the case of the high, eroding terrace adjacent to the lower agricultural field for over 700 feet (Photos 19 through 23). Here, the nearly vertical bank is over 30 feet high and actively eroding away at what little vegetation is left in the less than 25-foot buffer between the river and the field. The right (opposite) bank is closely encroached by the railroad and is rip-rapped just upstream (Photo 18) and downstream of the erosion site. A large floodchute is also present opposite this eroding bank (between the rip-rap sections), and another can be found just upstream on the left.

Reach M06 is a reference type C3 stream that has degraded to an F3. It is entrenched (ER = 1.3) with a low width/depth ratio (24). It is also incised, with the highest IR of all assessed reaches at 2.3 (which is even higher than the human-elevated IR of 2.2 in Reach M02 with the berm). Habitat is still in relatively good condition, but the RGA condition is 'fair.' This reach has experienced historic degradation and floodplain build-up, and is now attempting to widen and migrate laterally as evidenced by the bank erosion and flood chutes. It was determined to be in Stage III of the CEM, and is extremely sensitive due to the STD.

3.2 Summary of Reaches and Segments

Reach/Segment Condition

All of the reaches and segments assessed were found to be in good habitat condition, with scores ranging from 0.67 to 0.75 out of 1.00. This was generally due to a mix of unembedded substrates and relatively well-vegetated banks and buffers in many locations. All of the segments were assessed using the high-gradient RHA form except for segment M04-A, which is recognized as a riverine impoundment that is not likely to return to reference condition due to the presence of a dam downstream, and therefore should be

managed toward equilibrium as a low-gradient segment of the river. Table 3.5 gives a summary of the RHA results for each segment.

In contrast, the geomorphic condition of all segments was found to be only ‘fair,’ with scores ranging from 0.54 to 0.64 out of 1.00. Fair condition implies that a segment is in major adjustment, having experienced major change in channel form and fluvial processes outside the expected range of natural variability, and may be poised for additional adjustment with future flooding or changes in watershed inputs that could change the stream type (VT ANR, May 2007). Fair RGA ratings for these reaches and segments were often due to historic degradation, high incision and/or entrenchment, human-caused changes in valley type, evidence of straightening, and areas of erosion, bank armoring, or encroachments. All of the segments were assessed using the unconfined RGA form. Table 3-6 gives a summary of the RGA results for each segment.

Stream Type Departure and Sensitivity

All six of the reaches assessed have a reference stream type of C, which is generally described as a low slope, meandering, point-bar, riffle/pool, alluvial channel with broad, well-defined floodplains (Rosgen, 1996). Typical C-type streams are only slightly entrenched (ER >2.2) with moderate to high width/depth ratios (>12), moderate to high sinuosity (>1.2), and low slope (0.001 – 0.02). As a stream becomes more entrenched due to degradation and floodplain build-up, it can depart to a B-type (moderately entrenched) or even an F-type (entrenched) stream. While two of the reaches in the assessment area are still in their reference stream type of C (M04 and M05), two have experienced stream type departures to type B (M01 and M03-A), and two have departed to type F (M02 and M06).

Stream sensitivity reflects the magnitude with which a stream would respond to disturbances or stressors, based on its existing stream type, substrate class, geomorphic condition, and stream type departure. Sensitivity can be classified as low, moderate, high, very high, or extreme, and generally increases with decreases in geomorphic condition. Two of the reaches (M03-A and M05) have ‘high’ sensitivity, two (M01 and M04) have ‘very high’ sensitivity, and two (M02 and M06) have ‘extreme’ sensitivity.

Table 3-6 gives a summary of the stream type departures and sensitivities for each segment.

3.3 Fluvial Erosion Hazard Mapping

Using the stream sensitivity ratings based on stream type and RGA score, a Fluvial Erosion Hazard (FEH) rating has been proposed for each stream segment in Table 3-8. Fluvial erosion hazard types are derived from the six stream sensitivity ratings using two letter descriptors (VL=Very Low, LW=Low, MD=Moderate, HI=High, VH=Very High, and EX=Extreme), followed by a number from 1 to 10 indicating the geomorphic stream type group. The stream sensitivity rating provides a basis for fluvial erosion hazard classification because major vertical or lateral channel adjustments are known to result in extensive erosion of adjacent lands causing damage to private property and public infrastructure (VT ANR, 2005).

Fluvial erosion hazard zones were developed using calculated belt widths and channel widths, definitions of valley walls and meander centerlines, and other field data documenting any unique characteristics associated with stream reach sensitivity. These data were used in the FEH module of the SGAT program to draw a first draft of the FEH corridor based on belt width guidelines established for each hazard type.

FEH ratings for the Hoosic River ranged from HI 6 to EX 9. Areas of the Hoosic River that have undergone stream type departures from reference C-type channels to F-type channels (M02 and M06) received the highest ratings (EX), whereas the reaches still in reference C-type (M04 and M05) received

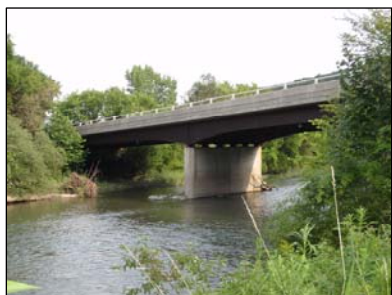
the lower ratings (HI and VH). Figure 3-1 depicts the draft FEH corridor developed for the study area. Appendix C contains the draft FEH maps of each reach/segment.

Note that for Segment M03-B (the impounded area upstream of the dam) the FEH rating is presented as ‘unassessed.’ However, the boundaries of the FEH area for this segment are defined as extending to the valley wall on each side of the river. This is because the geomorphic parameters collected at the upstream segment (M04-A) were applied to Segment M03-B due to their similarities using the Administrative Judgment feature in the DMS.

3.4 Bridge and Culvert Assessments

The bridges along the Hoosic River were assessed according to Phase 2 protocols outlined in Appendix G (Bridge and Culvert Assessment) of the Vermont ANR’s Phase 2 handbook (VT ANR, May 2007). A summary of the structure locations, types, and dimensions are given in Table 3-9. Photographs of the inlet, outlet, upstream, and downstream views of each structure are contained in Appendix E. A detailed description of each bridge is given below.

Route 346 Bridge



The Route 346 Bridge is located in Reach M01 at the downstream extent of the assessment area, where Route 346 crosses the Vermont border into New York. The largest of the three bridges, it has a span of 219 feet, a deck width of 39 feet, and a clearance of 24 feet. The span is 134% wider than the measured channel width of 164 at the bridge. The structure is primarily concrete with steel girders and reinforcements. Small side and mid-channel bars are present upstream and downstream of the bridge. The left bank is rip-rapped for about 150 feet under the bridge and extending up and downstream. The bank armoring and structure seem to be in good condition, and little evidence of erosion or scour was observed. The railroad crosses the river approximately 600 feet downstream. Additional views of the Route 346 Bridge can be seen in Photos 121 through 127 of Appendix E.

Dean Road Bridge



The Dean Road crossing is located in Segment M03-A, approximately 800 feet downstream of the Pownal Dam. The former Dean Road Bridge, built in 1939, was abandoned over 20 years ago (Martinez et. al, 2005). A temporary bridge approximately 100 feet downstream (pictured above) has facilitated river crossings since then. During the Phase 2 field assessment (summer and fall of 2008), the old bridge was demolished and construction began on a new bridge to take its place. By the end of September, the abutments (in foreground above) and pier were in place but the deck had not yet been constructed. Dimensions for the new bridge were obtained from plans provided by the construction workers. The temporary bridge was not assessed. The new Dean Road Bridge will have a span of 260 feet, a deck width of 30 feet, and a clearance of 16 feet. The span will be 160% of the channel width, which was measured to be 163 feet. It will be of concrete construction with steel girders and reinforcements. Already, a significant mid-channel bar greater than half of bankfull elevation is present upstream and downstream of the bridge site. Rip-rap is present on the left bank under both the temporary bridge and new bridge site (pictured above). Additional views of the temporary bridge and new bridge construction can be seen in Photos 73 through 79.

Main Street Bridge



The Main Street Bridge is located toward the end of Reach M05. With a span of 178 feet, a deck width of 24 feet, and a clearance of 14 feet, it is the smallest of the three bridges. The span is 123% of the 145-foot-wide channel. Structure material is concrete with steel girders and reinforcements. Both banks are rip-rapped under the bridge, and a large mid-channel bar greater than half of bankfull height is present upstream (photo 34). At the time of the assessment, construction for a new town wastewater collection system was in progress. A new drainage pipe had been installed on the right bank just below the bridge (Photo 41), and both banks had been re-graded, freshly rip-

rapped (under the bridge), and re-planted. Additional views of the bridge can be seen in Photos 36 through 42.

Failure mode and problem condition reports produced by the DMS are provided in Table 3-10. According to the reports, the only potential failure mode affecting all three bridges is failure due to ice or debris jam. The Route 346 Bridge also has the potential to fail due to scour, while the Dean Road and Main Street bridges pose a threat for structure-related damage due to erosion of adjacent property. There is also concern for the Dean Road Bridge due to the fluvial condition or process of the reach.

Existing problems for the Route 346 Bridge include downstream scour and/or erosion and roadway approaches filling the floodplain. For the Dean Road and Main Street bridges, problems include upstream sediment deposits greater than half of bankfull elevation and poor location or alignment, which could cause an avulsion to follow the road.

Table 3-1: Phase 1 Stream Characteristics

Reach ID	Channel Length (ft)	Channel Slope	Reference Valley Width (ft)	Reference Confinement Type	Sinuosity	Reference Stream Type	Bedform
M01	6666	0.08%	2579	Very Broad	1.35	C4	Riffle-Pool
M02	3011	0.17%	2502	Very Broad	1.04	C4	Riffle-Pool
M03	4855	0.31%	778	Broad	1.03	C3	Riffle-Pool
M04	9302	0.05%	1934	Very Broad	1.33	C3	Riffle-Pool
M05	11062	0.02%	1582	Very Broad	1.09	C3	Riffle-Pool
M06	5571	0.05%	1100	Broad	1.30	C3	Riffle-Pool

Table 3-2: Phase 2 Stream Characteristics

Segment ID	Channel Length (ft)	Channel Slope	Human-Modified Valley Width (ft)	Human-Modified Confinement Type	Existing Stream Type	Sinuosity	Bedform
M01	6666	0.08%	890	Narrow	B4c	Moderate	Riffle-Pool
M02	3011	0.17%	737	Narrow	F4	Low	Riffle-Pool
M03-A	1419	0.31%	386	Semi-Confined	B3c	Low	Riffle-Pool
M04-A	1500	0.00%	802	Narrow	C5	Low	Plane Bed
M04-B	7802	0.05%	1284	Broad	C4	Moderate	Riffle-Pool
M05	11062	0.02%	1257	Broad	C3	Low	Riffle-Pool
M06	5571	0.05%	890	Broad	F3	Moderate	Riffle-Pool

Table 3-3: Cross-Section Measurements

Segment ID	Bankfull Width (ft)	Floodprone Width (ft)	Valley Width (ft)	Max Depth (ft)	Mean Depth (ft)	RAF Height (ft)
M01	180	296	890	6.72	4.98	13.95
M02*	139	183	737	8.50	6.39	18.67
M03-A	169	356	386	8.35	5.24	15.25
M04-A	158	591	802	6.60	5.39	9.35
M04-B	136	802	1284	9.43	5.79	11.55
M05	127	474	1257	7.88	6.12	13.39
M06	136	172	890	7.39	5.68	16.85

*RAF height for M02 represents the human-elevated floodplain (HEF), which is a berm.

Table 3-4: Cross-Section Calculations

Segment ID	Confinement Ratio	Entrenchment Ratio	Width/Depth Ratio	Incision Ratio
M01	4.9	1.64	36.2	2.08
M02*	5.3	1.32	21.7	2.20
M03-A	2.3	2.11	32.2	1.83
M04-A	5.1	3.74	29.3	1.42
M04-B	9.4	5.89	23.5	1.22
M05	9.9	3.74	20.7	1.70
M06	6.5	1.26	23.9	2.28

*Incision ratio for M02 is calculated from the human-elevated floodplain (HEF), which is a berm.

Table 3-5: Rapid Habitat Assessment (RHA) Results

Segment ID	RHA Score	RHA Condition
M01	0.72	Good
M02	0.75	Good
M03-A	0.68	Good
M04-A*	0.67	Good
M04-B	0.70	Good
M05	0.74	Good
M06	0.71	Good

**Used low-gradient RHA form.*

Table 3-6: Rapid Geomorphic Assessment (RGA) Results

Segment ID	RGA Score	RGA Condition	STD	Evolution Stage	Adjustment Processes	Sensitivity
M01	0.50	Fair	C to B	IV	Aggradation & planform after historic degradation & widening	Very High
M02	0.51	Fair	C to F	III	Widening after historic degradation	Extreme
M03-A	0.55	Fair	C to B	IV	Aggradation after historic degradation & widening	High
M04-A	0.59	Fair	None	IV	Aggradation after historic degradation	Very High
M04-B	0.64	Fair	None	IV	Aggradation & planform after historic degradation & widening	Very High
M05	0.63	Fair	None	IV	Aggradation after historic degradation & widening	High
M06	0.51	Fair	C to F	III	Widening after historic degradation	Extreme

Table 3-7: Percent of Stream Segments Impacted by Stressors

Segment ID	Berms	Roads	Railroad	Development	Straightening
M01	0%	29%	35%	26%	9%
M02	75%	22%	100%	30%	81%
M03-A	0%	100%	100%	100%	100%
M03-B	0%	88%	100%	36%	82%
M04-A	0%	0%	92%	0%	0%
M04-B	0%	0%	57%	18%	13%
M05	0%	32%	2%	81%	66%
M06	0%	49%	67%	29%	22%

Table 3-8: Fluvial Erosion Hazard (FEH) Ratings

Segment ID	Sensitivity	Stream Type Group	Existing Stream Type	Natural Valley Type	Departure from Equilibrium	FEH Rating	
M01	Very High	7	B4c	Very Broad	Stream Type Departure	VH	7
M02	Extreme	9	F4	Very Broad	Stream Type Departure	EX	9
M03-A	High	5	B3c	Broad	Stream Type Departure	HI	5
M04-A	Very High	7	C5	Very Broad	Major Adjustment	VH	7
M04-B	Very High	7	C4	Very Broad	Major Adjustment	VH	7
M05	High	6	C3	Very Broad	Major Adjustment	HI	6
M06	Extreme	8	F3	Broad	Stream Type Departure	EX	8

Table 3-9: Bridge Dimensions

Segment ID	Road Name	Bridge Width (ft)	Bridge Clearance (ft)	Bridge Span (ft)	Channel Width (ft)	Bridge Span / Channel Width
M01	Route 346	39	24	219	164	134%
M03-A	Dean Road	30	16	260	163	160%
M05	Main Street	24	14	178	145	123%

Table 3-10: Bridge Failure Modes Report

				Route 346 Bridge	Dean Road Bridge	Main Street Bridge
FAILURE MODES	F1	Concern for structure due to fluvial condition or process			X	
	F3	Potential failure due to scour		X		
	F4	Potential failure due to ice or debris jam		X	X	X
	F6	Structure related damage due to erosion of adjacent property			X	X
EXISTING PROBLEMS	P1	Upstream sediment deposit			X	X
	P3	Downstream scour and/or erosion present		X		
	P5	Poor location or alignment			X	X
	P7	Floodplain filled entirely or partially by roadway approaches		X		
PROBLEM CAUSES	Upstream Sediment Deposition	C2	Sediment deposits >= half bankfull		X	X
	Poor Location or Alignment	C14	Avulsion follow road		X	X

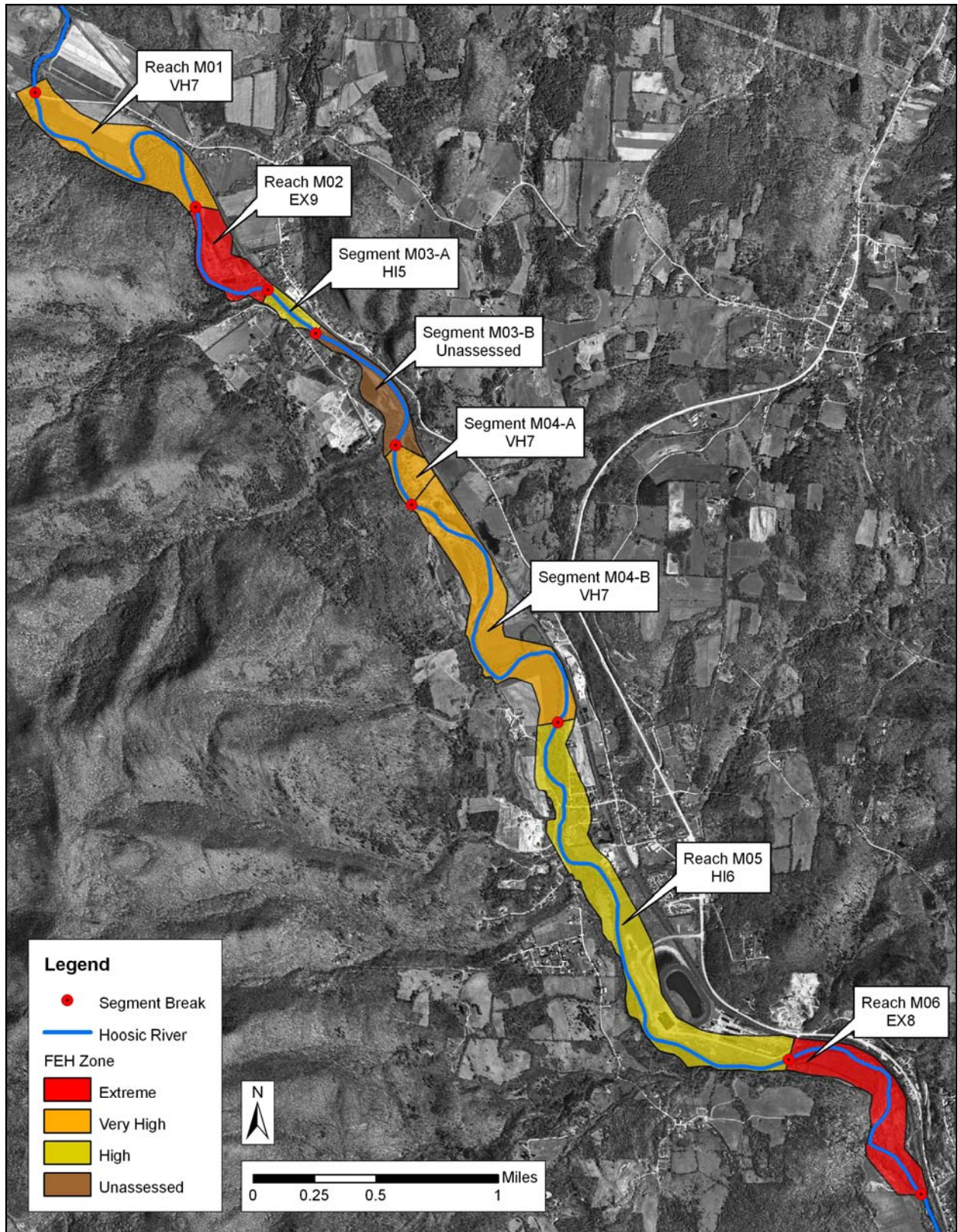


Figure 3-1: Draft Fluvial Erosion Hazard Zone

4.0 Conclusions and Recommendations

4.1 Summary

In general, the Hoosic River within the assessment area was found to be in fair geomorphic condition (major adjustment). However, within that category, some reaches are in better condition than others. Reaches within relatively undeveloped corridors (i.e., M01, M04, and M06) are able to meander more freely across the valley floor, although M06 has degraded to a type F stream and has little floodplain access. In contrast, reaches that are more encroached by roads, railroads, and development (M02, M03, and M05) are laterally constrained, and therefore tend to cut down into the channel, reducing floodplain access.

The entire assessment area has a reference stream type of C. Two of the reaches are still in reference condition (M04 and M05), two have departed to B-type streams (M01 and M03), and two have departed to F-type streams (M02 and M06). These entrenched areas have lost some or all access to the floodplain due to encroachment of the roads, railroads, berms, and development. Stream sensitivities range from high (M03 and M05) to very high (M01 and M04) to extreme (M02 and M06).

Habitat appears to be in generally good condition, although it is suffering from the impact of development along several reaches (primarily M03-A and M05). In addition, many agricultural fields in the corridor have thin or inadequate riparian buffers. In most areas where the railroad is close to the river on the right, the bank is sparsely vegetated and often rip-rapped.

Three bridges (no culverts) are located within the assessment area. The Route 346 Bridge crosses the river at the VT-NY border in Reach M01. The Dean Road bridge (which is currently being re-constructed and serviced by a temporary bridge) crosses the river just below the dam in Segment M03-A. The Main Street Bridge crosses the river near the lower end of Reach M05. All three structures appear to be in sound condition, with intact bank armoring where present and little erosion, although significant upstream sediment deposits were observed at the latter two bridges.

4.2 Watershed Planning Management Measures

Vermont has many programs in place to facilitate protection and restoration of river corridors. The following programs should be further pursued for the Hoosic River assessment area.

Fluvial Erosion Hazard Mapping

One passive approach that would help to protect undeveloped land from future development within the riparian corridor is to implement a Fluvial Erosion Hazard (FEH) zone. The Bennington County Regional Commission (BCRC) has expressed an interest in working with the town of Pownal to examine potential avenues for FEH corridor protection implementation (e.g., ordinance, zoning, overlay districts, etc.). A protected FEH corridor would allow for more natural adjustment of the streams, protect floodplain areas required for flow dispersal and sediment storage, decrease erosive forces within the channel, and allow for the rejuvenation and protection of a wooded corridor with increased erosion protection and ecological function. In particular, areas in relatively good condition or with a high recovery potential would benefit from such protection.

The draft FEH maps developed for this assessment represent a starting point for corridor protection. The Town should work with the BCRC to modify the FEH zone to reflect local political and administrative considerations in accordance with VT ANR guidelines. For example, VT ANR guidance suggests that new developments should avoid the FEH area and that modifications to the FEH may need to occur to recognize existing facilities (VT ANR, 2008). Many opportunities for protection exist along the Hoosic River to encourage avoidance of flood and erosion hazards.

River Corridor Protection Program

The River Corridor Protection Program, established in Vermont to conserve river corridors identified as high priority attenuation areas, provides an opportunity to obtain river corridor easements as a means to supplement fluvial erosion hazard zoning. Under this program, landowners are compensated for a perpetual easement on the river corridor and the easement is held by a non-profit organization such as the Vermont Land Trust, the Vermont River Conservancy, or another local land trust. The perpetual easement restricts the uses within the corridor and is intended to allow the river to re-establish a natural slope, meander pattern, and floodplain access in order to provide flood inundation and fluvial erosion hazard mitigation benefits; improve water quality through hydrologic, sediment, and nutrient attenuation; and protect riparian habitats and the natural processes by which they form (VT ANR, 2008).

There are several large tracts of floodplain in agricultural use along the Hoosic River assessment area where this program could provide mutual benefits. In particular, Reaches M01, M04 and M06, which are primarily undeveloped, are allowed to meander relatively freely across the valley floor, but areas of erosion and floodchutes along these reaches provide evidence that the river seeks to expand its meander pattern. Preserving agricultural areas or other undeveloped areas in these reaches as effective floodplains will help facilitate the return of the river to a more natural state, thus reducing fluvial erosion hazards to human investments further downstream.

Additional programs exist that can provide some amount of river corridor protection. Programs such as the Conservation Reserve Enhancement Program (CREP) can be used to contractually take riparian buffer lands out of production. In Vermont, CREP contracts may be formed to re-establish herbaceous and woody buffers for the entire meander belt area of highly unstable and sensitive streams (VT ANR, 2008).

River Corridor Planning

A River Corridor Protection and Channel Management Plan is the next logical step to comprehensively implement management measures to address watershed stressors. The information obtained from Phase 1 and Phase 2 stream geomorphic assessments has allowed for the recommendation of preliminary protective and restorative efforts, presented in the next section. The river corridor planning process will allow further development of these preliminary concepts. It will also guide watershed decisions made by federal, state, and local agencies, organizations, and interest groups. Management strategies that resolve immediate site-specific conflicts in the context of broader, problem-solving goals will build community support and prove the most effective.

4.3 Preliminary Project Identification

Management efforts can be classified as passive geomorphic approaches, active geomorphic approaches, channelization approaches, or no action approaches. Passive approaches involve strategies that remove constraints to a river's ability to establish geomorphic stability over time, and can include corridor conservation and land acquisition as described in the previous section, as well as berm removal/offsetting and infrastructure alteration. Active geomorphic approaches attempt to restore the river to a geomorphically stable state through the construction of channel bed, bank, and/or floodplain modifications using process-driven and natural channel design concepts. Channelization approaches seek to maintain rivers through dredging and bank armoring applications where the dimension, pattern, and profile are not consistent with the condition. The no action approach takes no action whatsoever to address management conflicts. Erosion of bed and banks are allowed to continue and no effort is made to improve corridor ecological condition and function.

Based on the results of the Phase 2 assessment, the following projects for protection and restoration efforts within the Hoosic River watershed are preliminarily recommended for further investigation.

Enhance Riparian Buffers

One protective technique that would help prevent further bank erosion, which can lead to bank armoring and degradation, is to plant stream buffer vegetation to help stabilize the banks. Target areas should include locations where the buffer is currently less than 25 feet, such as the eroding high terrace in Reach M06 (pictured at left), as well other areas along the river where adjacent land use has limited the extent of natural riparian buffers (primarily along agricultural fields and railroad embankments). In locations such as the eroding high terrace in Reach M06, dynamic-process conservation areas, or erosion easements, may be a better alternative than large investments such as vegetative plantings due to the tendency of the bank to erode in this area and the agricultural land use. Natural regeneration can be a cost effective way to restore the vegetation on the banks.



Offset Berm

In Reach M02, adjacent to the new water treatment facility (WWTF), a berm on river right (pictured below) is reducing sediment and flood flow storage capacity on the floodplain and appears to be increasing erosion and sediment transport as evidenced by the mass failure on river left. Floodplain storage and corridor width could be increased in this area by removing the berm. To protect developments such as the WWTF and residential properties behind it, the berm may need to be offset back from its current position to provide at least a small floodplain for flow and sediment attenuation.



Aerial view berm along the Hoosic River in Reach M02 (Microsoft Virtual Earth, 2009)

However, this former floodplain area is particularly sensitive due to the remediation of historic hazardous wastes from the tannery (see photographs on the following page), so berm removal or offset may not be feasible here.



Lagoon area prior to remediation in March 2004 on left (Metcalf and Eddy, 2005) and after remediation during the Phase 2 assessment in August 2008 on right. (The Hoosic River is out of view on the left.)

Address Mass Failure



As described above, Reach M02 is artificially confined on the right bank by a berm to prevent inundation of the hazardous waste remediation site, and to protect the new waste water treatment facility. It is well established that many hard bank protective structures, designed to protect investments in the corridor, may not be sustainable in the long-term and will either fail or transfer excess stream energy, and thus the erosion problem, further downstream. In the case of the mass failure in Reach M02, due to the confined nature of the reach, localized resistive or redirective methods may be implemented to prevent further erosion.

A conceptual restoration design for this area would likely address the mass failure from the bank up. That is, in order to separate the stream from the eroding cliff, a floodplain bench could be constructed that keeps the eroding bank sediment from entering the stream. Planting live vegetation on the floodplain bench will allow the cliff to repair itself from the bottom up. A hard bank from waters edge to the bankfull elevation may be necessary. Potential restoration options must consider the slope of the bank so the appropriate angle of repose can be designed. If the confining berm across the river is left as-is, however, the best alternative may be to allow for natural revegetation of the mass failure.

More in-depth Phase 3 stream geomorphic assessments of target areas may be required before site-specific measures for corridor protection and/or restoration can be developed and implemented.

4.4 Conclusions

Although it may be tempting to focus on the restoration of highly visible problem areas in poor condition, this strategy often requires intensive and potentially expensive in-stream management practices. Furthermore, elaborate channel restoration projects have the potential to fail, especially if the adjustment processes in the reach as well as upstream and downstream are not fully understood. Instead, using a watershed approach that places high priority on protecting those reaches that are currently in good condition or have a high recovery potential has proven to be a cost effective, long-term benefit to both the river and community as a whole. This approach will require coordination at the local, state, and federal level to educate the public and provide incentives to landowners.

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APPENDIX A
Reach Maps

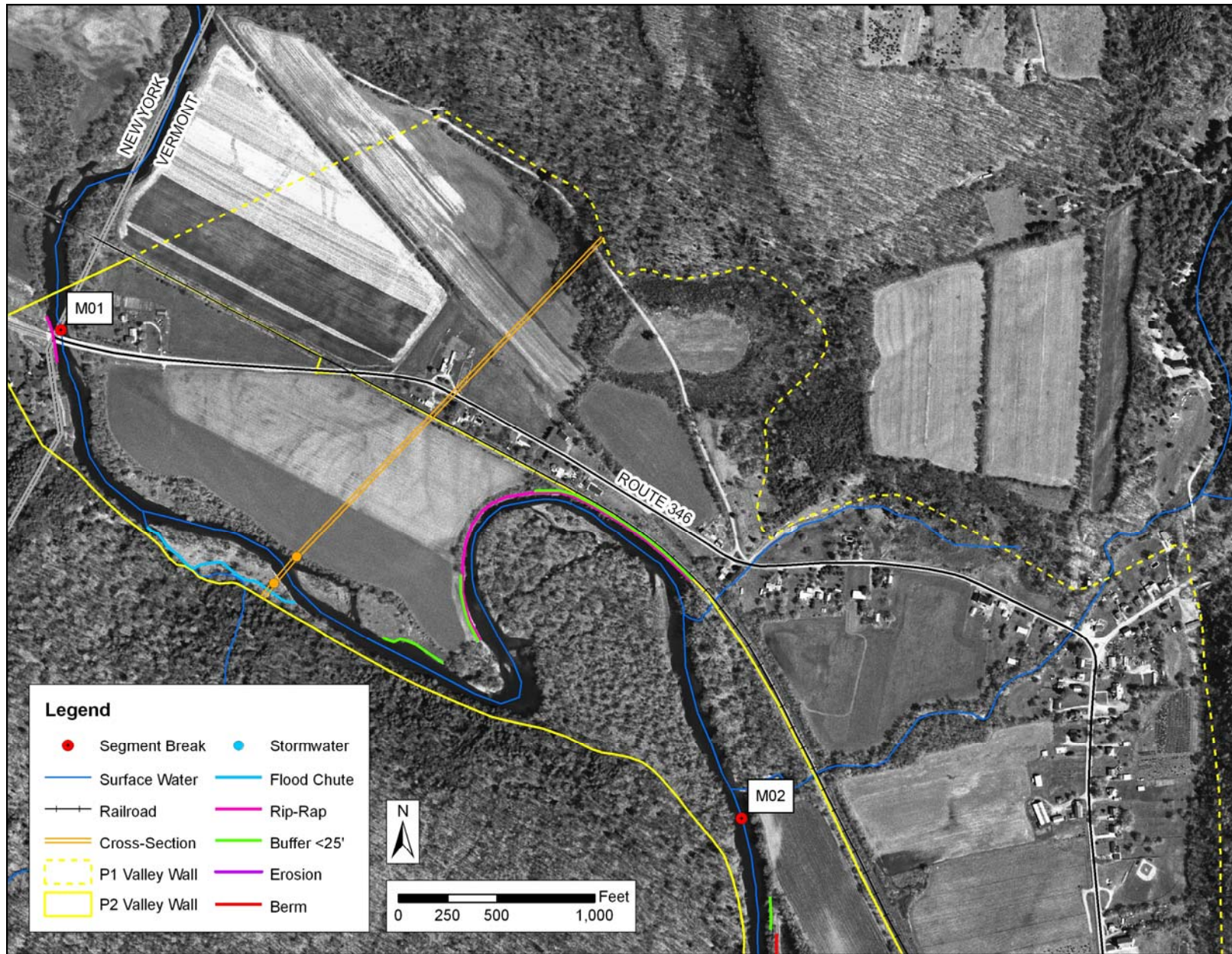


Figure A-1: M01 Reach Map

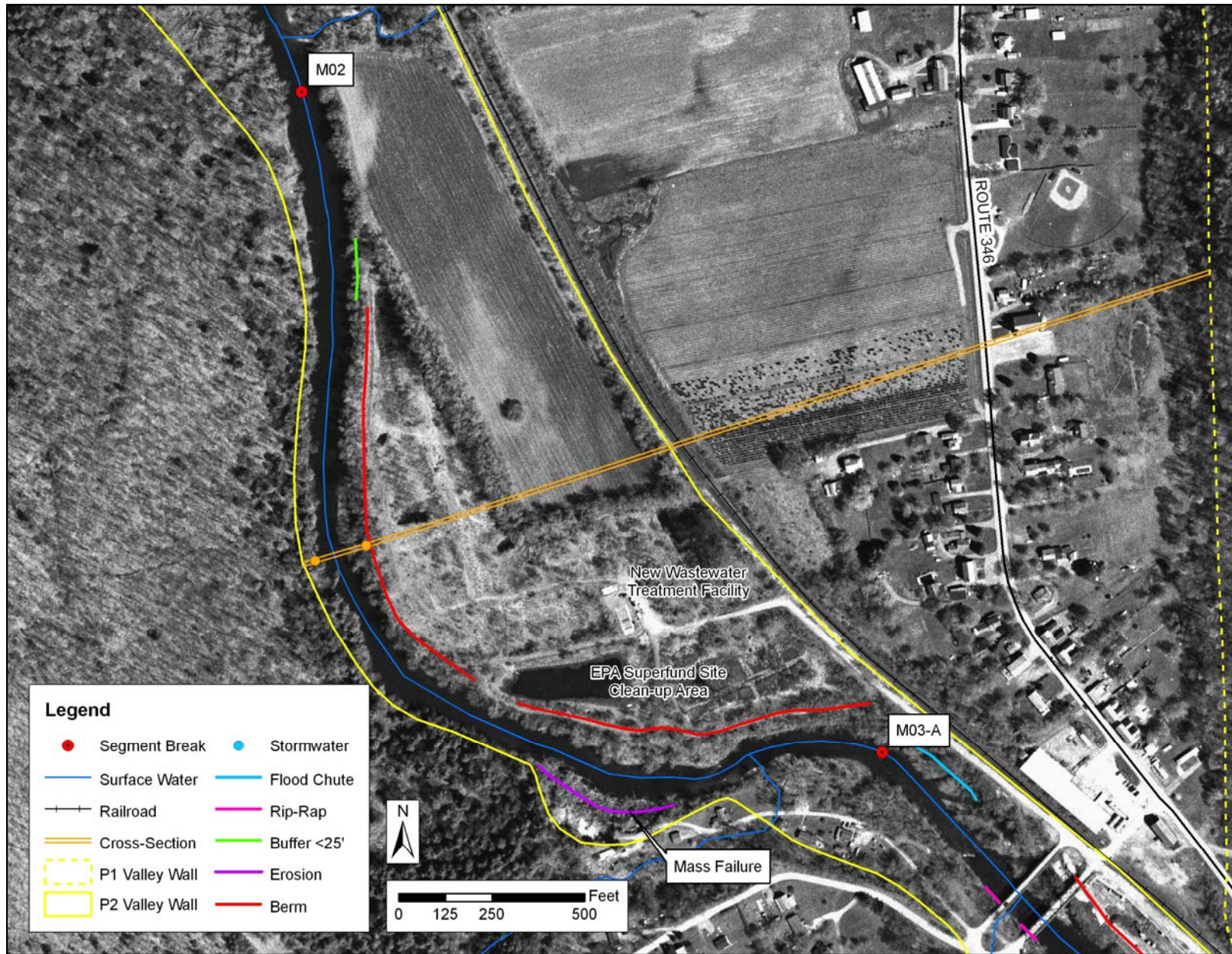


Figure A-2: M02 Reach Map

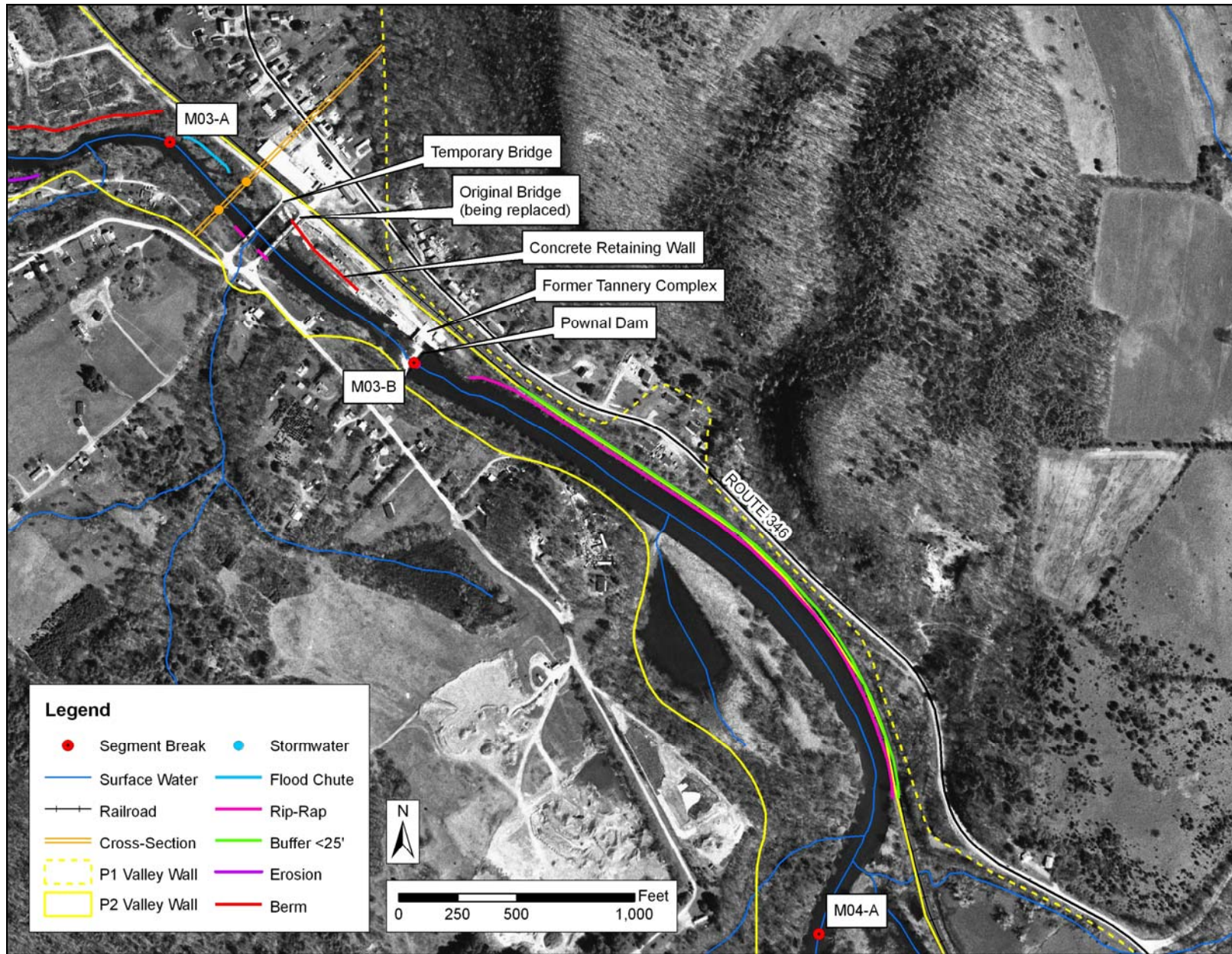


Figure A-3: M03 Reach Map (Segments A & B)

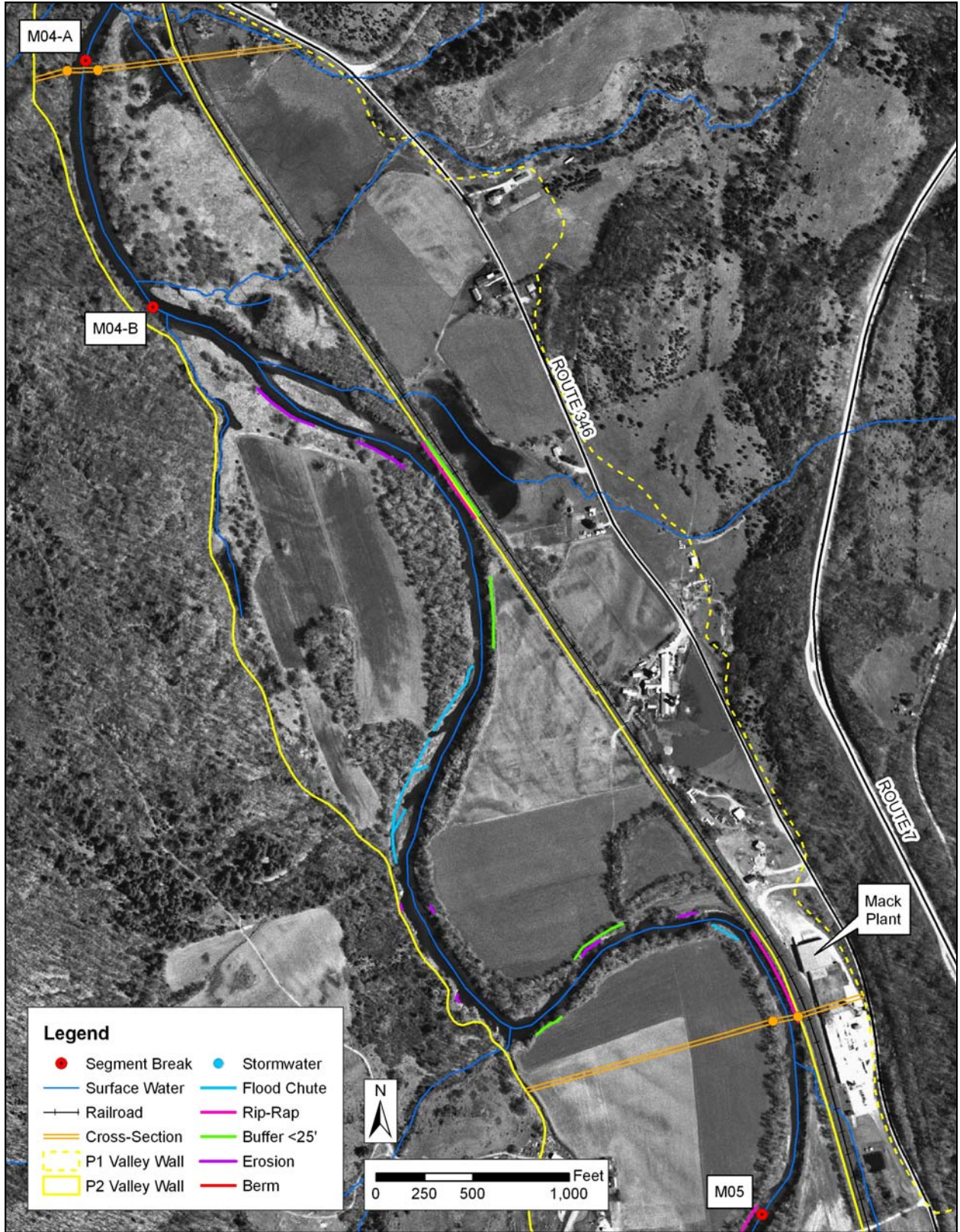


Figure A-4: M04 Reach Map (Segments A & B)

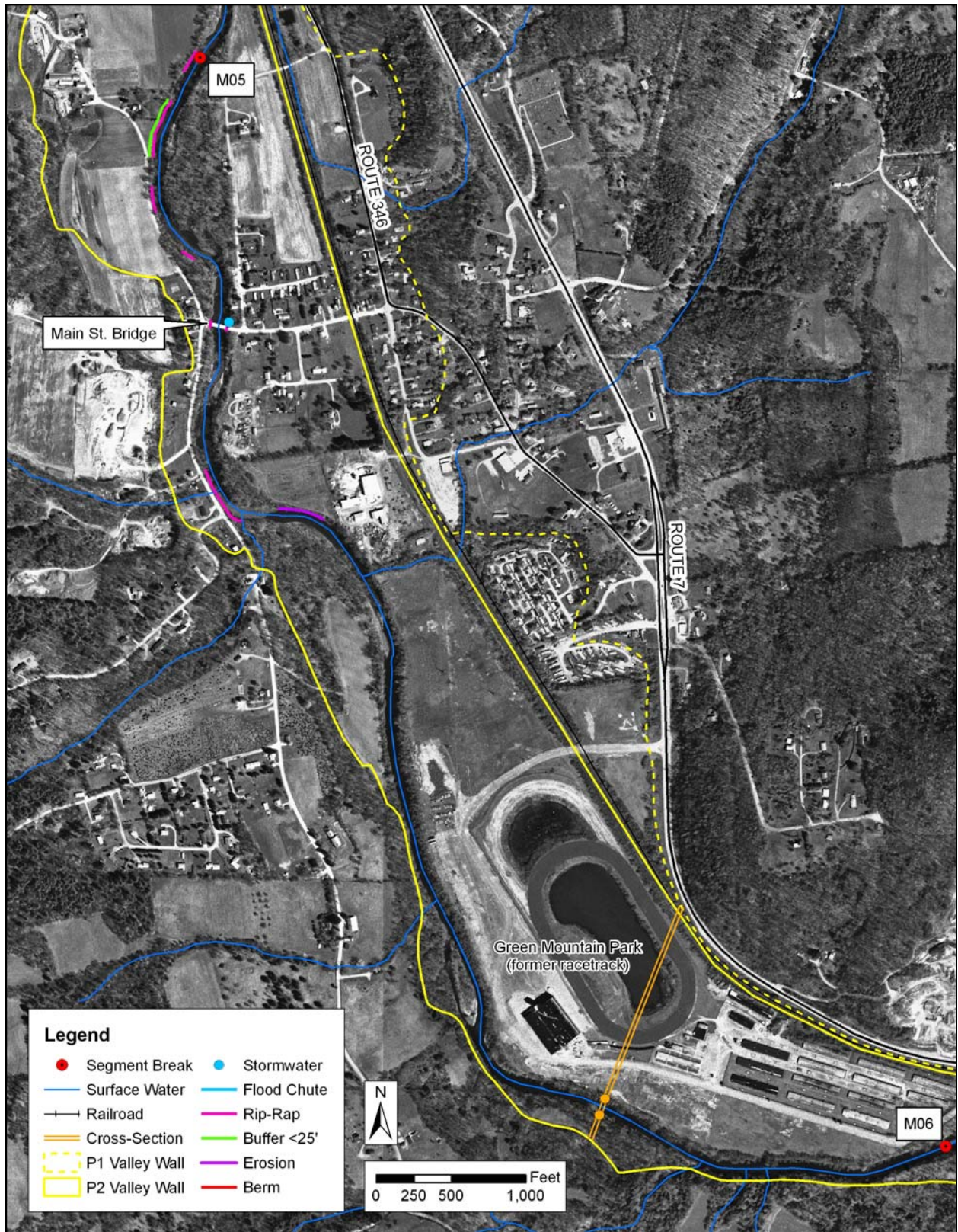


Figure A-5: M05 Reach Map

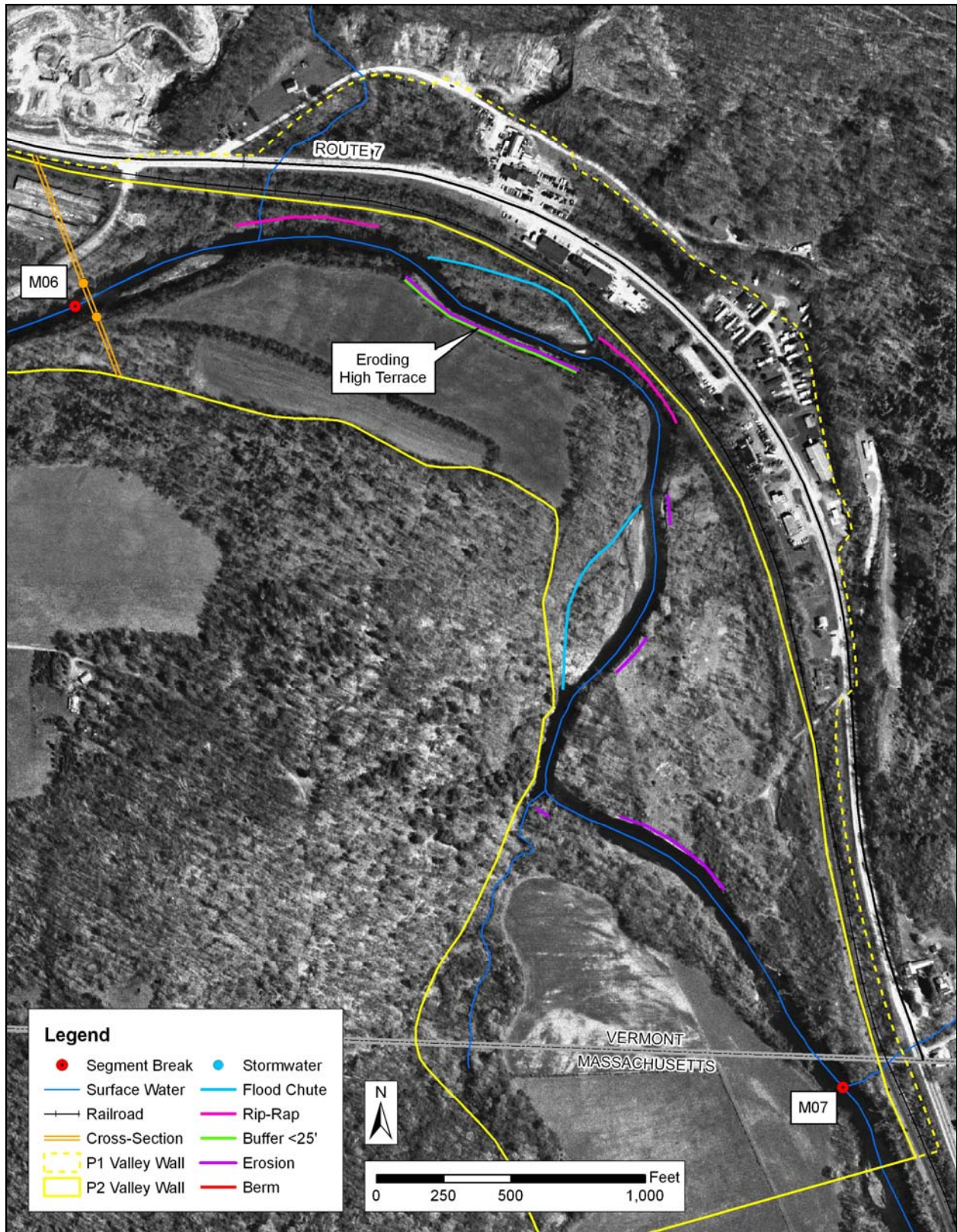


Figure A-6: M06 Reach Map

APPENDIX B
Cross-Section Diagrams

Figure B-1
M01 Cross-Section Diagram

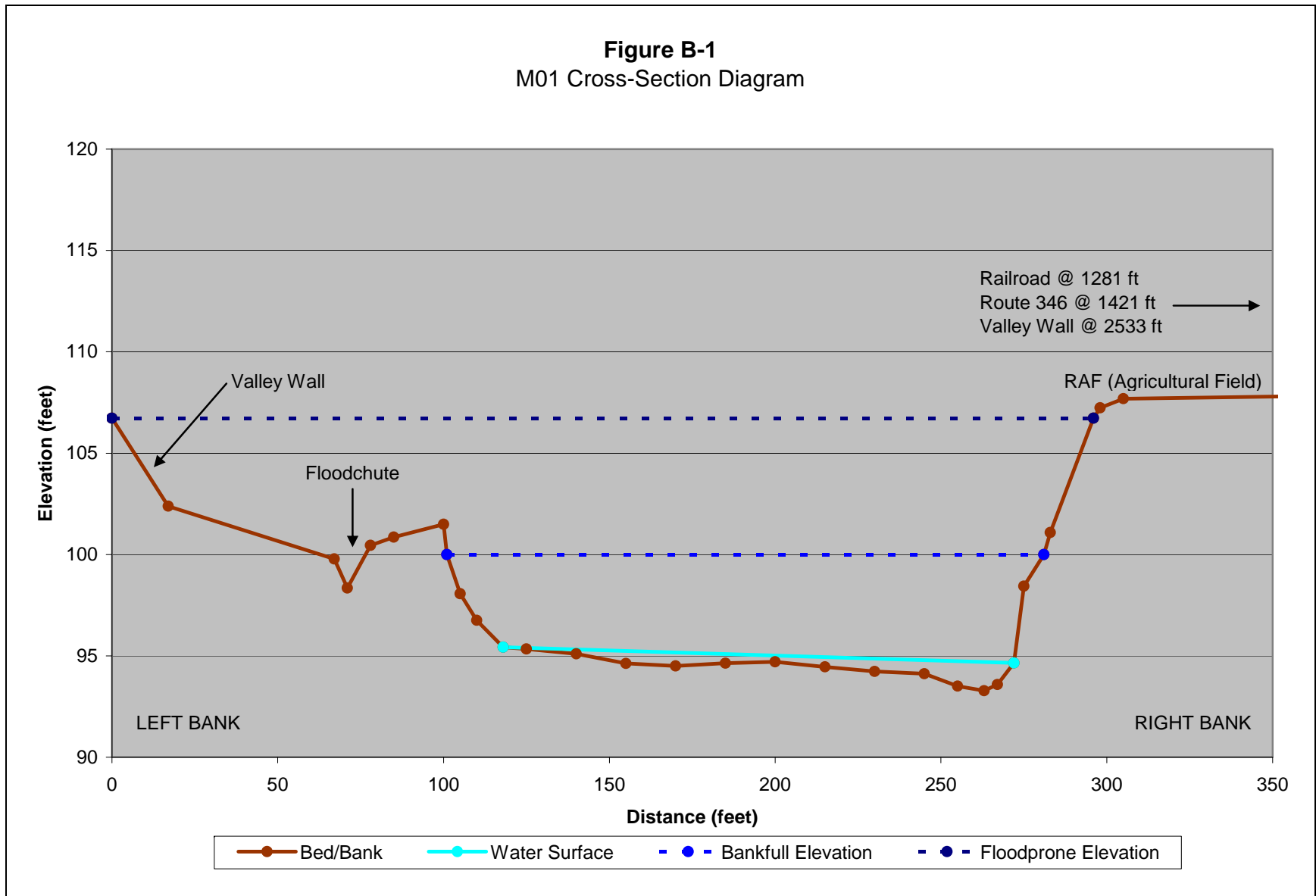


Figure B-2
M02 Cross-Section Diagram

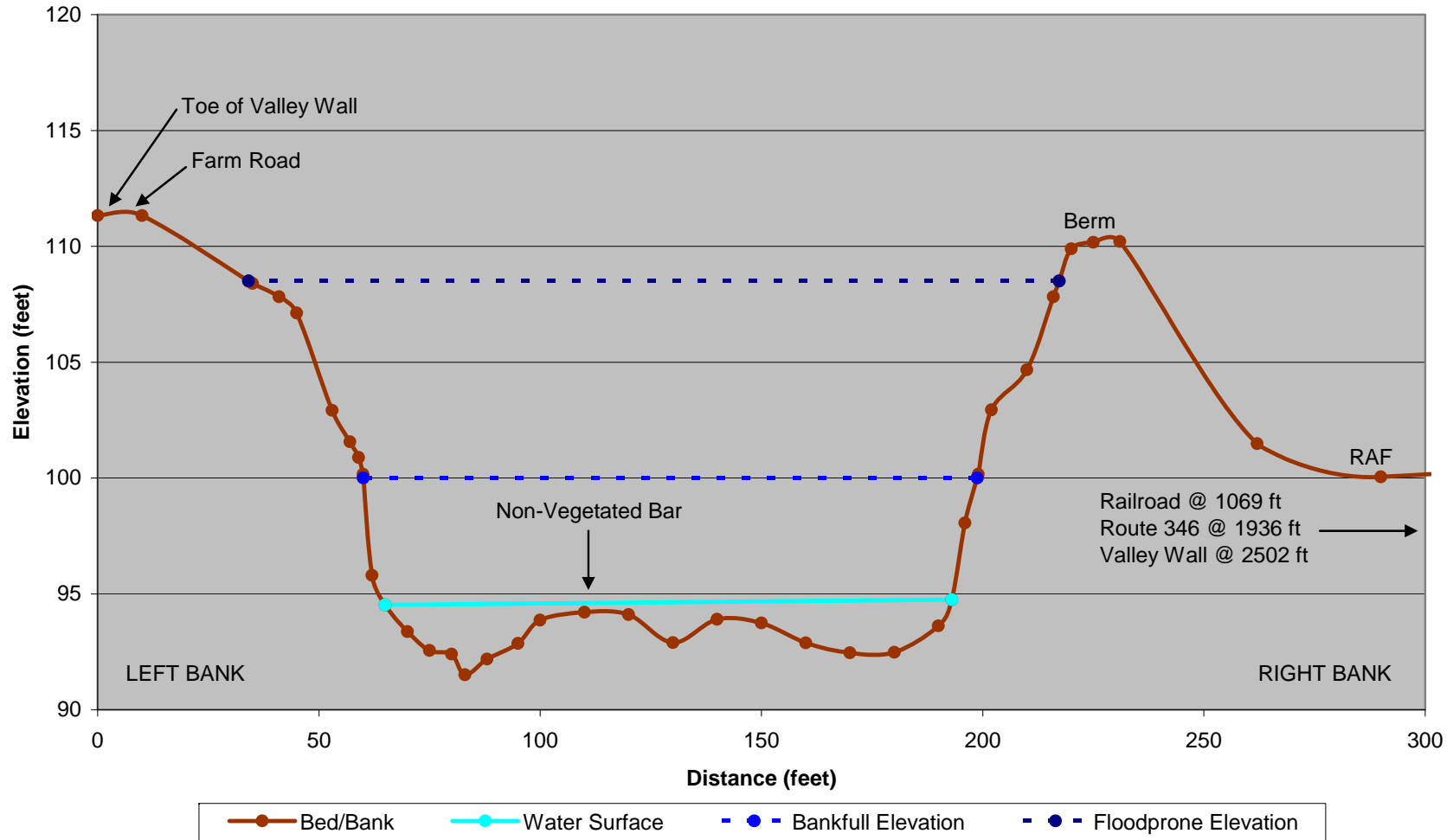


Figure B-3
M03-A Cross-Section Diagram

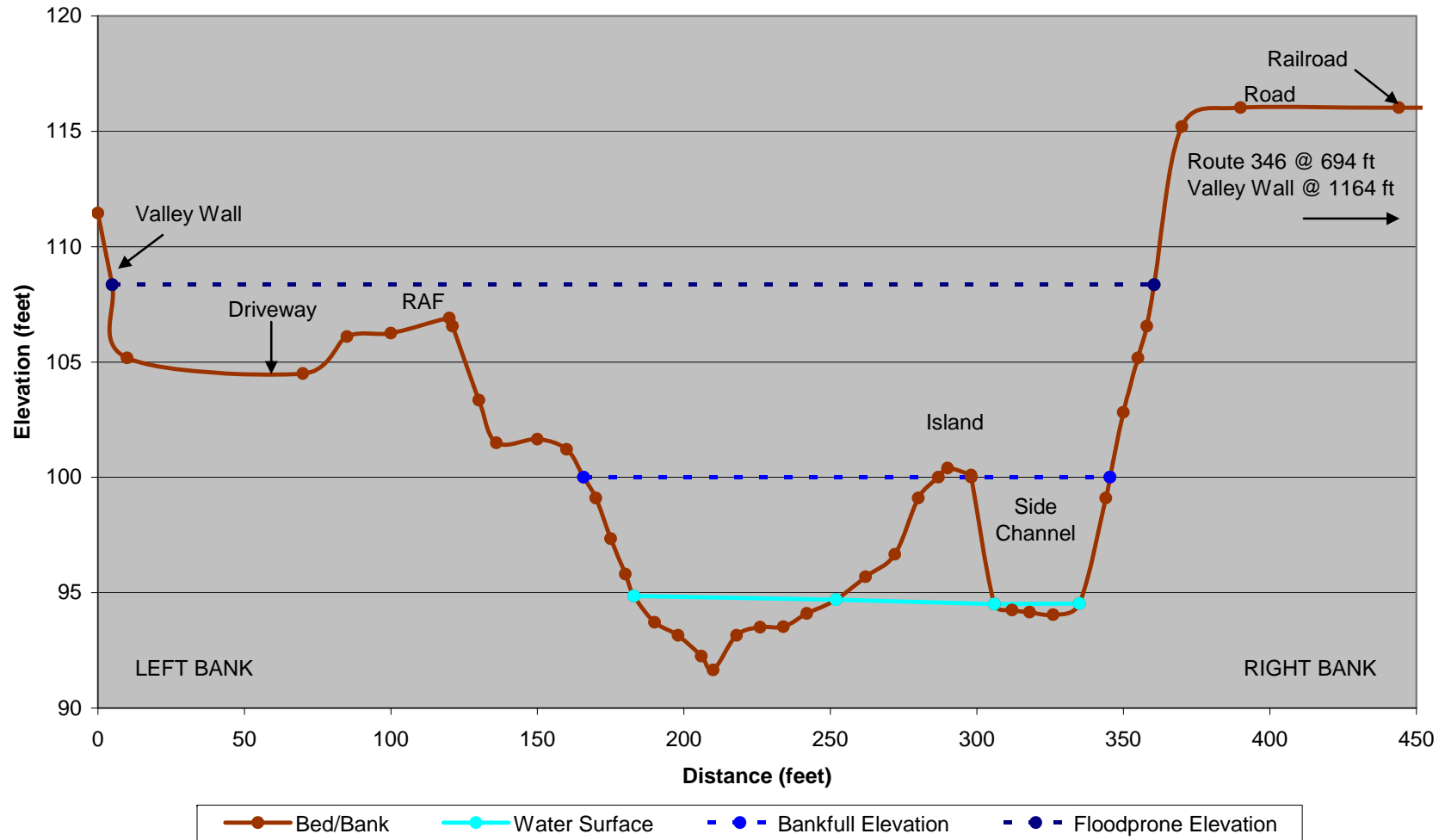


Figure B-4
M04-A Cross-Section Diagram

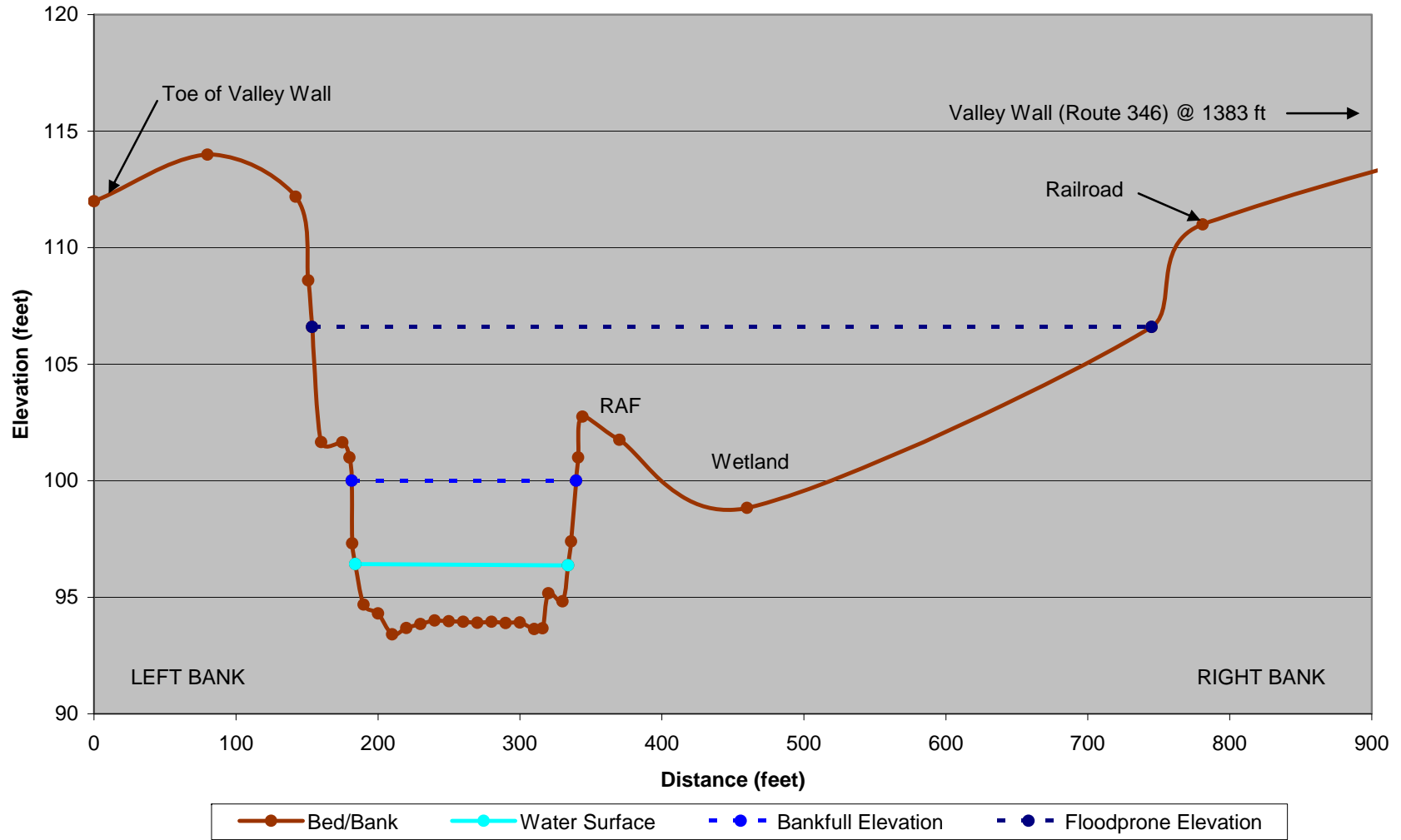


Figure B-5
M04-B Cross-Section Diagram

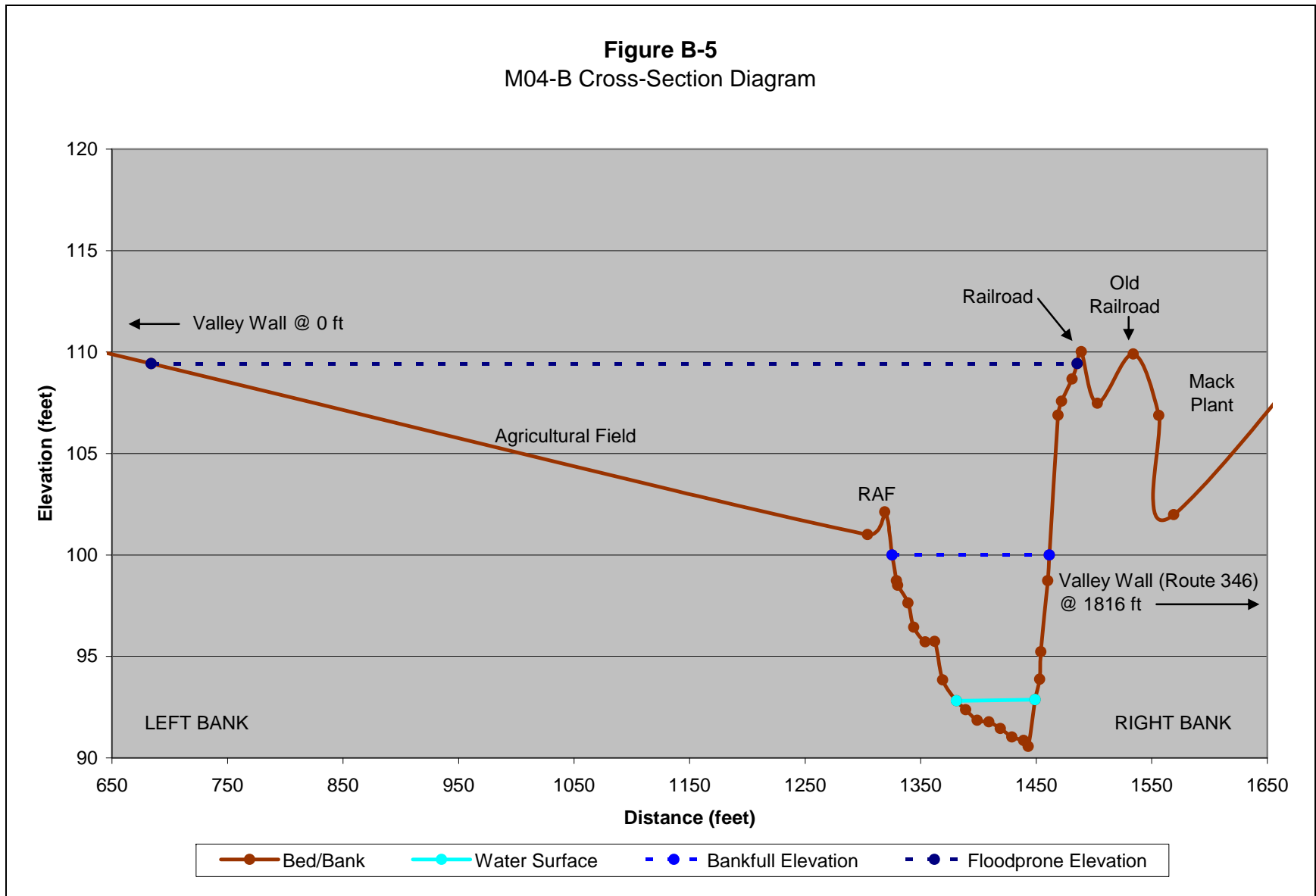


Figure B-6
M05 Cross-Section Diagram

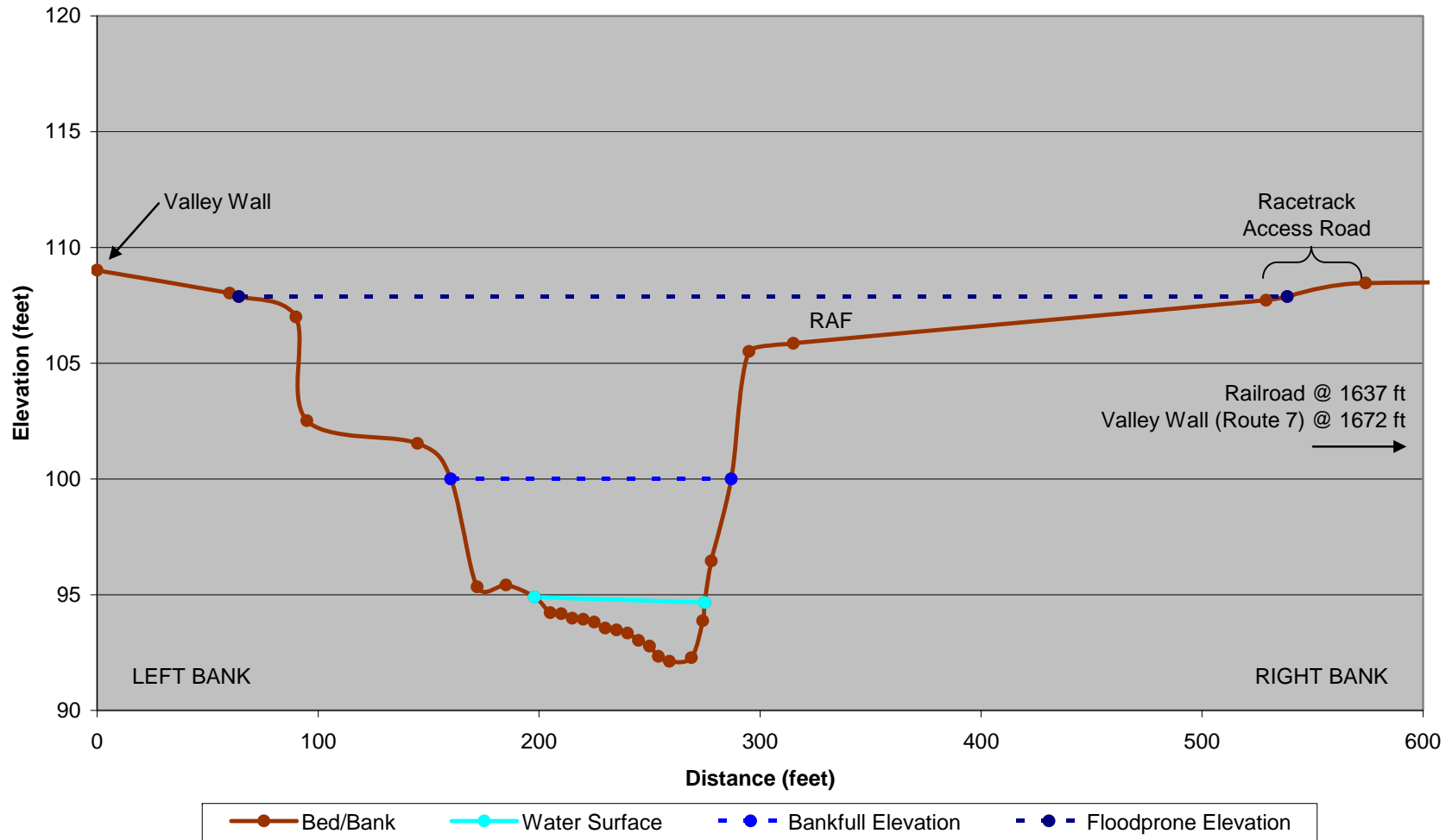
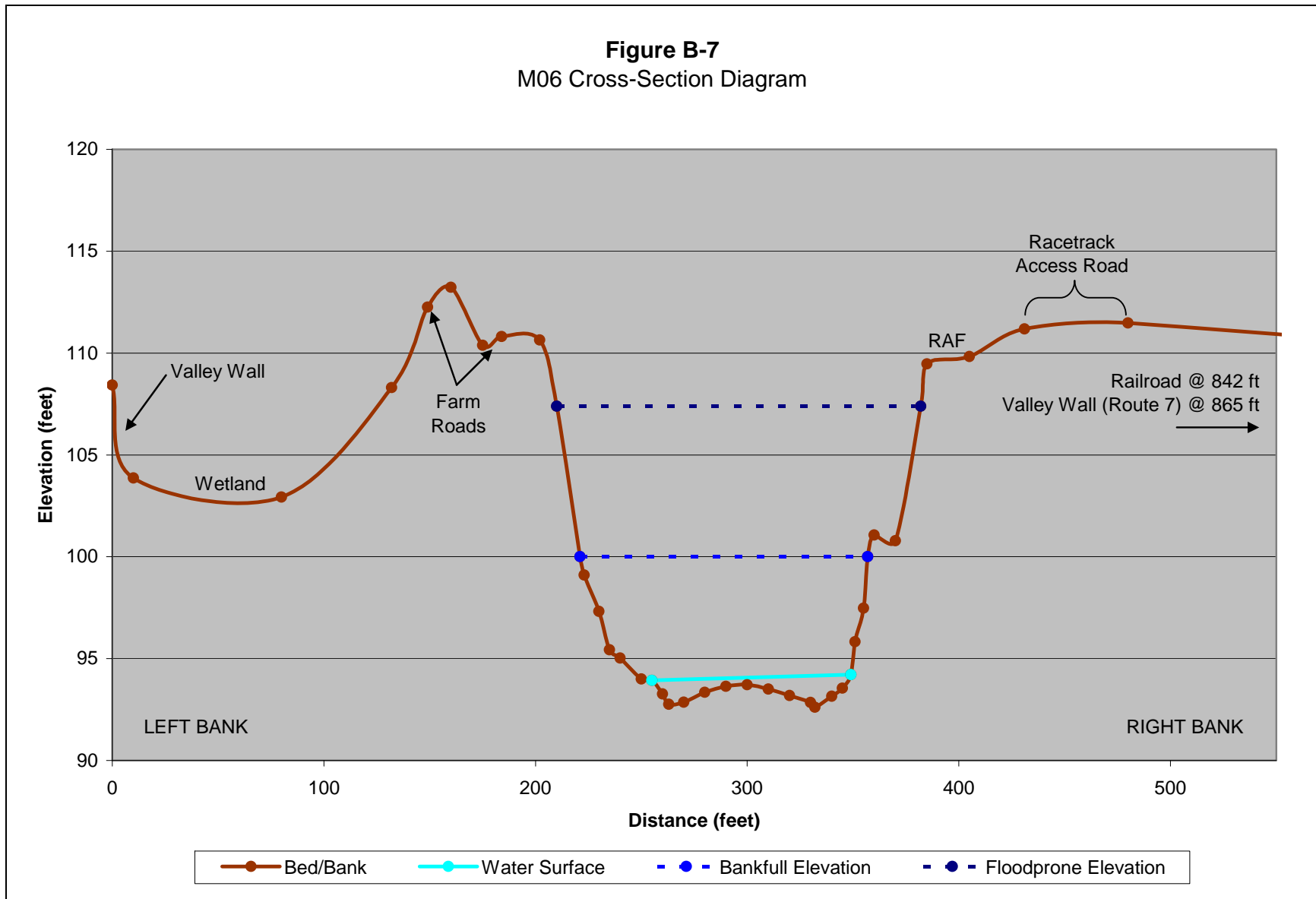


Figure B-7
M06 Cross-Section Diagram



APPENDIX C

Draft Fluvial Erosion Hazard Zone Maps

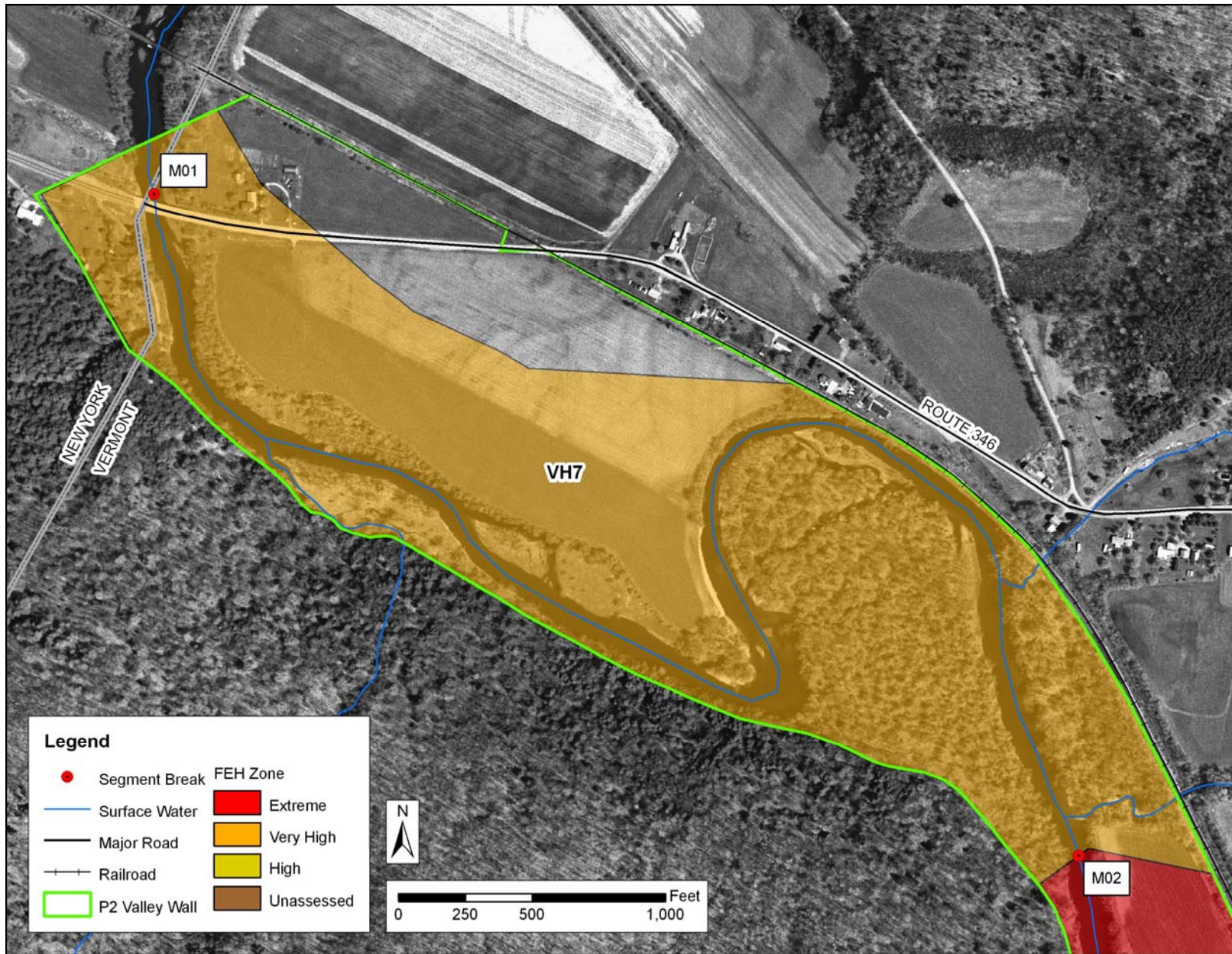


Figure C-1: M01 Draft FEH Map

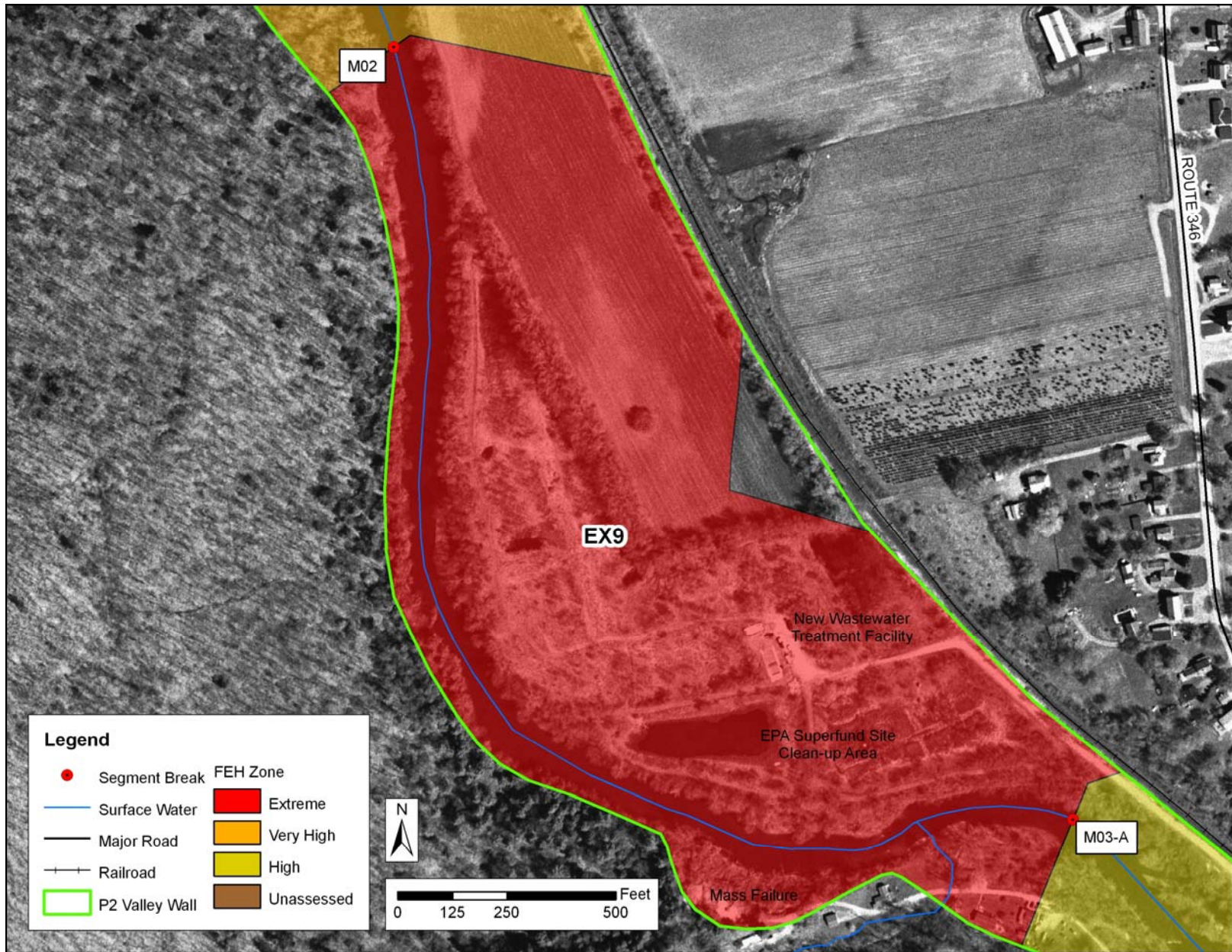


Figure C-2: M02 Draft FEH Map

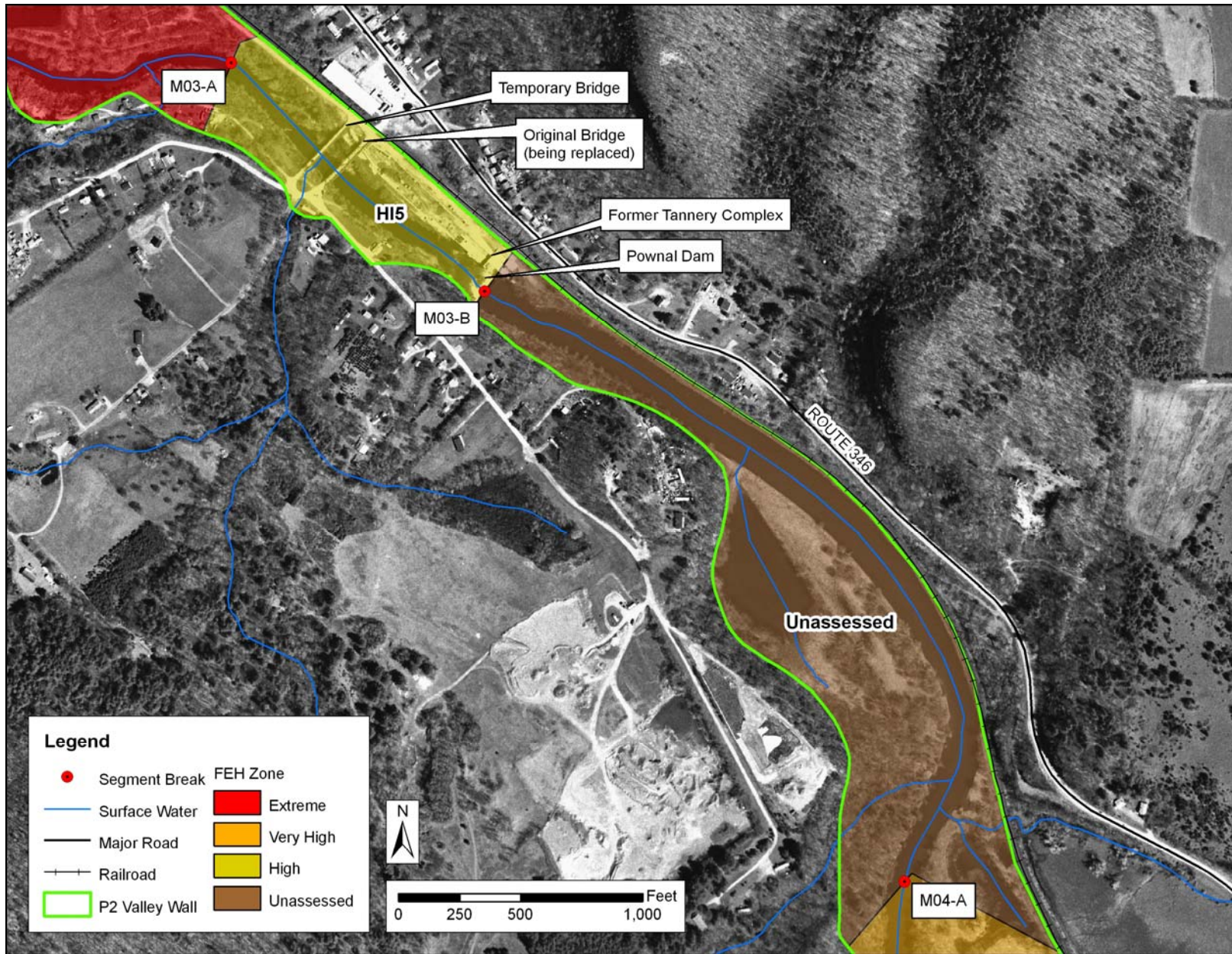


Figure C-3: M03 Draft FEH Map (Segments A & B)

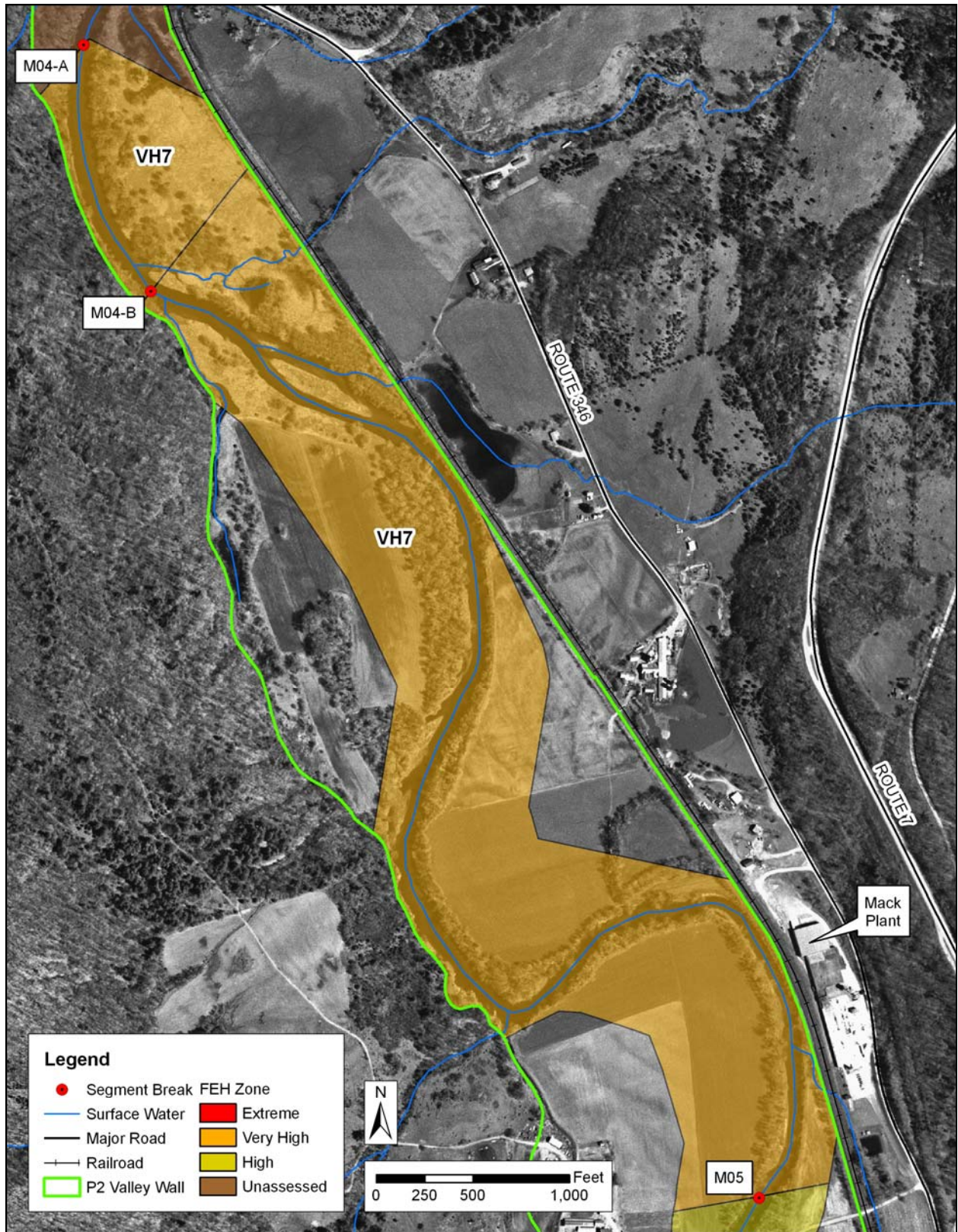


Figure C-4: M04 Draft FEH Map (Segments A & B)

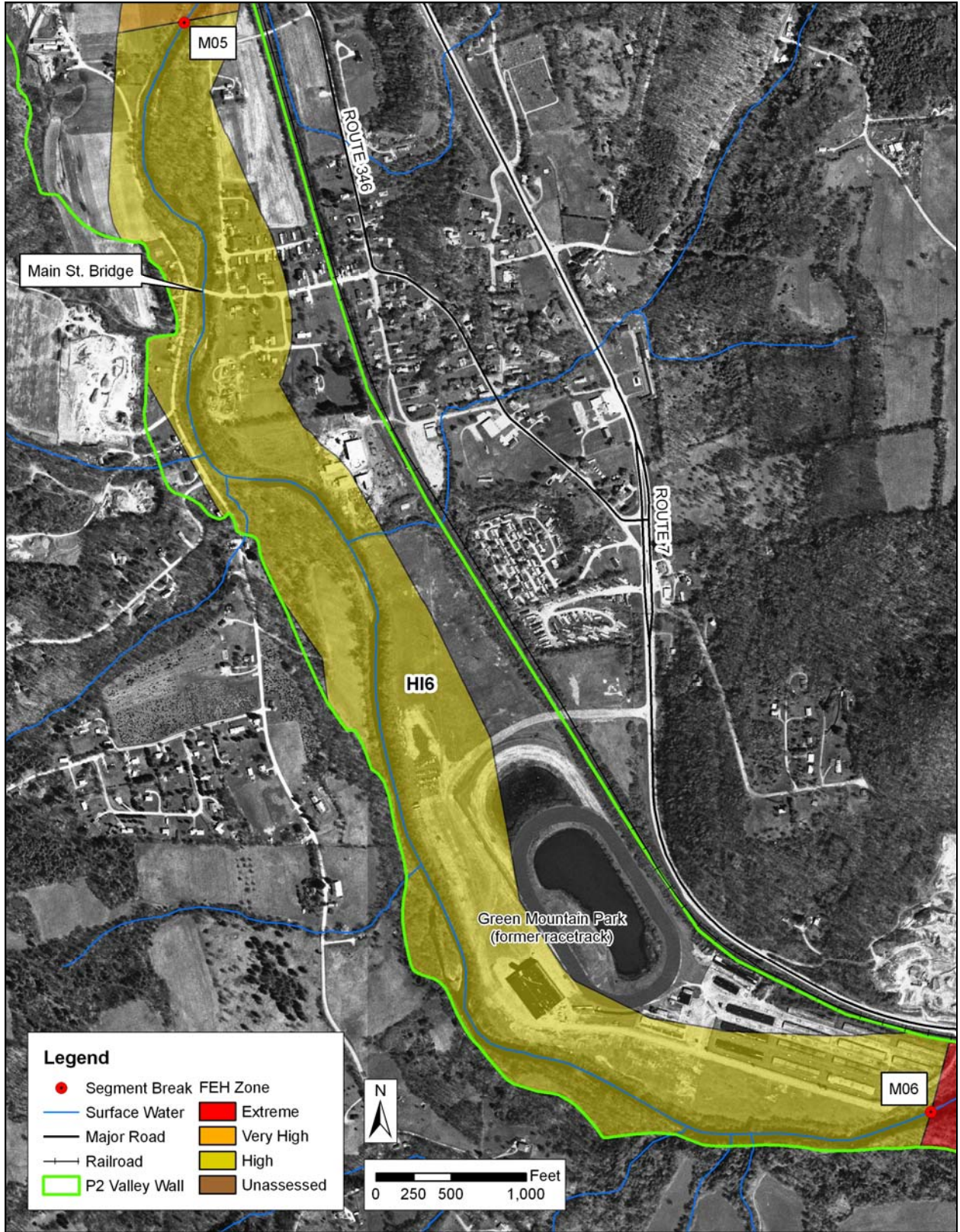


Figure C-5: M05 Draft FEH Map

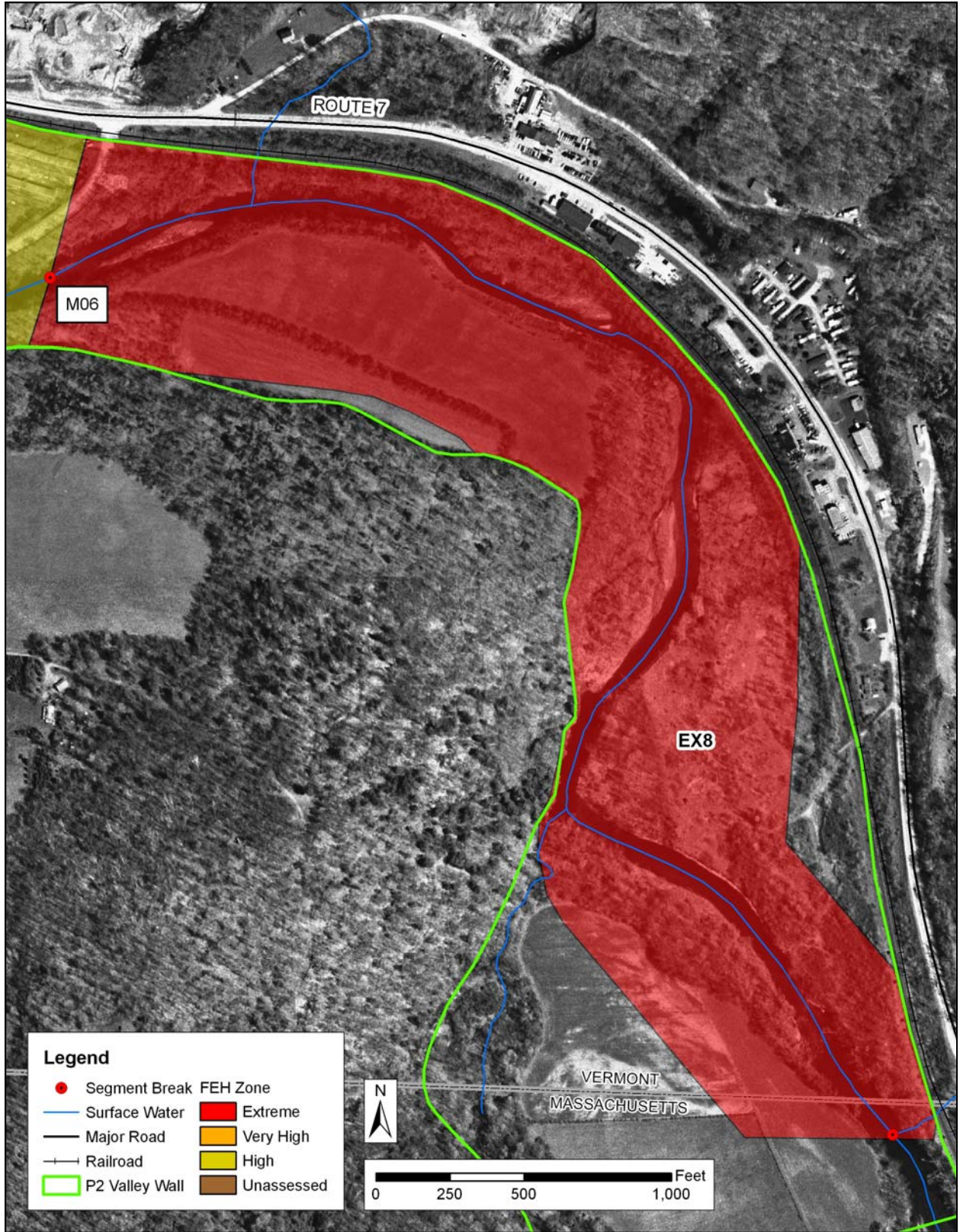


Figure C-6: M06 Draft FEH Map

APPENDIX D

List of Stream Features & Impacts

Table D-1: List of Stream Features and Impacts (Continued on pages D-2 and D-3)

Segment	Impact	Sub-Impact	Location	Comment	Length (ft)	Field	Value
M01	Bank Armoring or Revetment	Rip-Rap	Left Bank	Under bridge	159	----	----
M01	Bank Armoring or Revetment	Rip-Rap	Right Bank	3 ft high	1821	----	----
M01	Bridge or Culvert	Bridge		Route 346 Bridge	----	Length	218
M01	Buffers Less than 25 feet		Right Bank	Agricultural field	343	----	----
M01	Buffers Less than 25 feet		Right Bank	Agricultural field	339	----	----
M01	Buffers Less than 25 feet		Right Bank	Railroad	899	----	----
M01	Cross Section Location	Representative			----	Number	1
M01	Development		One Side	Residential	252	----	----
M01	Development		One Side	Residential	1465	----	----
M01	Encroachment	Railroad	One Side		2322	Height	15
M01	Encroachment	Road	One Side	Route 346	733	Height	15
M01	Encroachment	Road	One Side	Route 346	1228	Height	15
M01	Migration	Flood Chute			----	----	----
M01	Straightening	Straightening			598	----	----
M02	Buffers Less than 25 feet		Right Bank	Agricultural field	170	----	----
M02	Cross Section Location	Representative			----	Number	1
M02	Development		Both Sides	WWTF, residential, old tannery site, etc.	896	----	----
M02	Encroachment	Berm	One Side	WWTF	1233	Height	15
M02	Encroachment	Berm	One Side	WWTF	1021	Height	15
M02	Encroachment	Railroad	One Side		3011	Height	15
M02	Encroachment	Road	Both Sides	Route 346 and secondary roads	665	Height	15
M02	Mass Failure		Left Bank		379	Height	50
M02	Straightening	Straightening			2431	----	----
M03-A	Bank Armoring or Revetment	Other	Right Bank	Concrete retaining wall at old tannery site	425	----	----
M03-A	Bank Armoring or Revetment	Rip-Rap	Left Bank	Under/near bridge - 8 ft high	58	----	----
M03-A	Bank Armoring or Revetment	Rip-Rap	Left Bank	Under bridge - 8 ft high	63	----	----
M03-A	Bridge or Culvert	Bridge		New Dean St. Bridge (under construction)	----	Length	260
M03-A	Bridge or Culvert	Bridge		Temporary Dean St. Bridge	----	Length	260
M03-A	Cross Section Location	Representative			----	Number	----
M03-A	Development		Both Sides	WWTF, residential, old tannery site, etc.	1409	----	----
M03-A	Encroachment	Railroad	One Side		1409	Height	15
M03-A	Encroachment	Road	Both Sides	Route 346 and secondary roads	954	Height	15
M03-A	Encroachment	Road	One Side	Route 346	452	Height	15
M03-A	Migration	Flood Chute			----	----	----
M03-A	Straightening	Straightening			1349	----	----

Segment	Impact	Sub-Impact	Location	Comment	Length (ft)	Field	Value
M03-A	Straightening	Straightening			62	-----	-----
M03-B	Bank Armoring or Revetment	Rip-Rap	Right Bank	Loose broken bedrock - 2 ft high	2581	-----	-----
M03-B	Buffers Less than 25 feet		Right Bank	Railroad	2375	-----	-----
M03-B	Development		Both Sides	WWTF, residential, old tannery site, etc.	1253	-----	-----
M03-B	Encroachment	Railroad	One Side		3446	Height	15
M03-B	Encroachment	Road	One Side	Route 346	3047	Height	15
M03-B	Grade Control	Dam	Picture	Old tannery site (estimated heights)	-----	Height	25
M03-B	Straightening	Straightening			1974	-----	-----
M03-B	Straightening	Straightening			866	-----	-----
M04-A	Cross Section Location	Representative			-----	Number	1
M04-A	Encroachment	Railroad	One Side		1373	Height	15
M04-B	Bank Armoring or Revetment	Rip-Rap	Right Bank	Sparse, 2 ft high	464	-----	-----
M04-B	Bank Armoring or Revetment	Rip-Rap	Left Bank	Loose broken bedrock, 9 ft high	35	-----	-----
M04-B	Buffers Less than 25 feet		Right Bank	Railroad	463	-----	-----
M04-B	Buffers Less than 25 feet		Right Bank	Loose dumped rocks at base of bank	365	-----	-----
M04-B	Buffers Less than 25 feet		Left Bank		165	-----	-----
M04-B	Buffers Less than 25 feet		Right Bank	Agricultural field	292	-----	-----
M04-B	Cross Section Location	Representative			-----	Number	1
M04-B	Development		One Side	Industrial (Mack Plant)	1403	-----	-----
M04-B	Encroachment	Railroad	One Side		2679	Height	15
M04-B	Encroachment	Railroad	One Side		1746	Height	15
M04-B	Erosion		Left Bank	Silt bank w/ some slumped/eroded areas	323	Height	4
M04-B	Erosion		Left Bank		309	Height	5
M04-B	Erosion		Left Bank		27	Height	6
M04-B	Erosion		Left Bank		39	Height	6
M04-B	Erosion		Left Bank		36	Height	6
M04-B	Erosion		Right Bank		105	Height	6
M04-B	Erosion		Right Bank		98	Height	6
M04-B	Migration	Flood Chute			-----	-----	-----
M04-B	Migration	Flood Chute			-----	-----	-----
M04-B	Migration	Flood Chute			-----	-----	-----
M04-B	Migration	Flood Chute			-----	-----	-----
M04-B	Straightening	Straightening			983	-----	-----
M05	Bank Armoring or Revetment	Rip-Rap	Left Bank	Loose broken bedrock, 9 ft high	133	-----	-----
M05	Bank Armoring or Revetment	Rip-Rap	Left Bank	Loose broken concrete/bedrock, 6 ft high	398	-----	-----
M05	Bank Armoring or Revetment	Rip-Rap	Left Bank	4 ft high	163	-----	-----
M05	Bank Armoring or Revetment	Rip-Rap	Left Bank	8 ft high	101	-----	-----

Segment	Impact	Sub-Impact	Location	Comment	Length (ft)	Field	Value
M05	Bank Armoring or Revetment	Rip-Rap	Left Bank	Under bridge	54	-----	-----
M05	Bank Armoring or Revetment	Rip-Rap	Right Bank	Under bridge	55	-----	-----
M05	Bank Armoring or Revetment	Rip-Rap	Left Bank	6 ft high	381	-----	-----
M05	Bridge or Culvert	Bridge		Main Street Bridge	-----	Length	178
M05	Buffers Less than 25 feet		Left Bank	Residential	398	-----	-----
M05	Cross Section Location	Representative			-----	Number	1
M05	Development		One Side	Residential	478	-----	-----
M05	Development		Both Sides	Residential	1627	-----	-----
M05	Development		One Side	Residential, industrial	1404	-----	-----
M05	Development		One Side	Abandoned racetrack grounds	5501	-----	-----
M05	Encroachment	Improved Path	One Side	Farm road	1200	Height	15
M05	Encroachment	Railroad	One Side		241	Height	15
M05	Encroachment	Road	Both Sides	Residential streets	2678	Height	15
M05	Encroachment	Road	One Side	Residential streets	842	Height	15
M05	Erosion		Right Bank		289	Height	12
M05	Stormwater Input	Urban SW Pipe		New 3'D HDPP pipe on right bank	-----	-----	-----
M05	Straightening	Straightening			651	-----	-----
M05	Straightening	Straightening			6702	-----	-----
M06	Bank Armoring or Revetment	Rip-Rap	Right Bank	Sparse, loose blast debris, 3 ft high	521	-----	-----
M06	Bank Armoring or Revetment	Rip-Rap	Right Bank	6 ft high	391	-----	-----
M06	Buffers Less than 25 feet		Left Bank	Agricultural field	708	-----	-----
M06	Cross Section Location	Representative			-----	Number	1
M06	Development		One Side	Abandoned racetrack grounds	361	-----	-----
M06	Development		One Side	Residential, commercial	1260	-----	-----
M06	Encroachment	Improved Path	One Side	Farm road	506	Height	15
M06	Encroachment	Railroad	One Side		3067	Height	15
M06	Encroachment	Railroad	One Side		676	Height	15
M06	Encroachment	Road	One Side	Route 7	2382	Height	15
M06	Encroachment	Road	One Side	Route 7	321	Height	15
M06	Erosion		Left Bank	Eroding agricultural field terrace	709	Height	30
M06	Erosion		Right Bank		108	Height	12
M06	Erosion		Right Bank	Silt UB & gravel LB	161	Height	9
M06	Erosion		Left Bank		52	Height	7
M06	Erosion		Right Bank	Loose cobble LB w/ eroding silt UB	450	Height	9
M06	Migration	Flood Chute		Right bank	-----	-----	-----
M06	Migration	Flood Chute		Left bank	-----	-----	-----
M06	Straightening	Straightening			1216	-----	-----

APPENDIX E
Field Photographs

Appendix E – Field Photographs





Photographs are presented in roughly the order in which they would be observed if traveling downstream, from the top of reach M06 to the bottom of reach M01. Cross-section photos and bridge photos are intermixed with the reach photos in the order they appear. The beginning of photos for each reach can be found on pages listed in the Table of Contents. Abbreviations used can be found in the List of Abbreviations below.





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Reach M05..... E-8
Reach M04..... E-13
Reach M03..... E-18
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List of Abbreviations





- DS – Downstream
- US – Upstream
- LB – Left bank
- RB – Right bank
- RL – River-left
- RR – River-right
- L – Left
- R – Right





Segment ID: M06	Photo #: 1	Date: 7/31/08	View: DS	Segment ID: M06	Photo #: 2	Date: 7/31/08	View: US
Description: Top of reach M06				Description: Bottom of reach M07			
							
Segment ID: M06	Photo #: 3	Date: 7/31/08	View: RB	Segment ID: M06	Photo #: 4	Date: 7/31/08	View: DS RB
Description: Tributary entrance at M06/M07 reach break				Description: 9' erosion along RB below reach break			
							





Segment ID: M06	Photo #: 5	Date: 7/31/08	View: DS	Segment ID: M06	Photo #: 6	Date: 9/25/08	View: DS RB
Description: Side bar on L, erosion on R				Description: RB erosion DS of reach break			
							
Segment ID: M06	Photo #: 7	Date: 6/25/08	View: US	Segment ID: M06	Photo #: 8	Date: 6/25/08	View: LB
Description: US from sharp bend				Description: Across channel at sharp bend (RL erosion, riffle, manmade jetty)			
							





Segment ID: M06	Photo #: 9	Date: 6/25/08	View: LB	Segment ID: M06	Photo #: 10	Date: 6/25/08	View: LB
Description: Close-up of erosion at sharp bend above trib				Description: Trib entrance & pool below sharp bend			
							
Segment ID: M06	Photo #: 11	Date: 7/31/08	View: DS	Segment ID: M06	Photo #: 12	Date: 6/25/08	View: DS
Description: Bedrock LB below sharp bend (manmade jetty in foreground)				Description: DS from sharp bend (start of RL floodchute in background)			
							





Segment ID: M06	Photo #: 13	Date: 7/31/08	View: DS LB	Segment ID: M06	Photo #: 14	Date: 6/25/08	View: US
Description: Top of RL flood chute				Description: US from head of floodchute toward sharp bend			
							
Segment ID: M06	Photo #: 15	Date: 7/31/08	View: RB	Segment ID: M06	Photo #: 16	Date: 7/31/08	View: RB
Description: 9' erosion across from flood chute/bar				Description: 12' erosion across from flood chute outlet			
							





Segment ID: M06	Photo #: 17	Date: 6/25/08	View: US	Segment ID: M06	Photo #: 18	Date: 7/31/08	View: US RB
Description: US from island/terrace area (rip-rap on L)				Description: Close-up of RR loose rip-rap below railroad			
							
Segment ID: M06	Photo #: 19	Date: 6/25/08	View: DS	Segment ID: M06	Photo #: 20	Date: 6/25/08	View: DS
Description: 30' eroding terrace (island in foreground)				Description: 30' eroding terrace (island in foreground)			
							





Segment ID: M06	Photo #: 21	Date: 7/31/08	View: DS	Segment ID: M06	Photo #: 22	Date: 6/25/08	View: LB
Description: 30' eroding terrace (island in foreground)				Description: 30' eroding terrace			
							
Segment ID: M06	Photo #: 23	Date: 7/31/08	View: DS LB	Segment ID: M06	Photo #: 24	Date: 9/24/08	View: US
Description: Field above high terrace on LB				Description: M06 x-section (note tape line)			
							





Segment ID: M06	Photo #: 25	Date: 9/24/08	View: RB	Segment ID: M06	Photo #: 26	Date: 9/24/08	View: LB
Description: M06 x-section				Description: M06 x-section			
							
Segment ID: M06	Photo #: 27	Date: 7/31/08	View: US	Segment ID: M05	Photo #: 28	Date: 7/31/08	View: DS
Description: Bottom of reach M06				Description: Top of reach M05			
							





Segment ID: M05	Photo #: 29	Date: 8/18/08	View: US	Segment ID: M05	Photo #: 30	Date: 8/18/08	View: DS
Description: US from M05 x-section				Description: DS from M05 x-section			
							
Segment ID: M05	Photo #: 31	Date: 8/18/08	View: RB	Segment ID: M05	Photo #: 32	Date: 8/18/08	View: LB
Description: M05 x-section				Description: M05 x-section			
							





Segment ID: M05	Photo #: 33	Date: 7/31/08	View: US	Segment ID: M05	Photo #: 34	Date: 7/31/08	View: US
Description: Mid-channel bar above bridge; RR channel on left				Description: Mid-channel bar above bridge; main channel on right			
							
Segment ID: M05	Photo #: 35	Date: 7/31/08	View: RB	Segment ID: M05	Photo #: 36	Date: 7/31/08	View: DS
Description: Concrete foundation on RR above bridge				Description: Inlet of Main Street Bridge			
							

Segment ID: M05	Photo #: 37	Date: 7/30/08	View: DS RB	Segment ID: M05	Photo #: 38	Date: 7/30/08	View: US
Description: Main St. Bridge inlet (residential development in background)				Description: US from Main Street Bridge (diagonal bar in background)			
							
Segment ID: M05	Photo #: 39	Date: 7/30/08	View: DS	Segment ID: M05	Photo #: 40	Date: 7/30/08	View: DS LB
Description: DS from Main Street Bridge				Description: DS LB re-vegetation area at Main Street Bridge			
							





Segment ID: M05	Photo #: 41	Date: 7/30/08	View: DS RB	Segment ID: M05	Photo #: 42	Date: 7/30/08	View: US RB
Description: DS RB new drainage pipe at Main Street Bridge				Description: Outlet of Main Street Bridge (re-vegetation area in foreground)			
							
Segment ID: M05	Photo #: 43	Date: 8/1/08	View: US LB	Segment ID: M05	Photo #: 44	Date: 8/1/08	View: US
Description: LB heavy rip-rap at reach break				Description: Bottom of reach M05			
							





Segment ID: M04-B	Photo #: 45	Date: 8/1/08	View: DS	Segment ID: M04-B	Photo #: 46	Date: 8/1/08	View: DS
Description: LB rip-rap at reach break and sedimentation downstream				Description: Top of reach M04 (sedimentation on L)			
							
Segment ID: M04-B	Photo #: 47	Date: 8/1/08	View: US	Segment ID: M04-B	Photo #: 48	Date: 8/1/08	View: RB
Description: Bottom of vegetated PB; flood chute outlet on R				Description: 6' RB erosion across from flood chute outlet in photo 47			
							



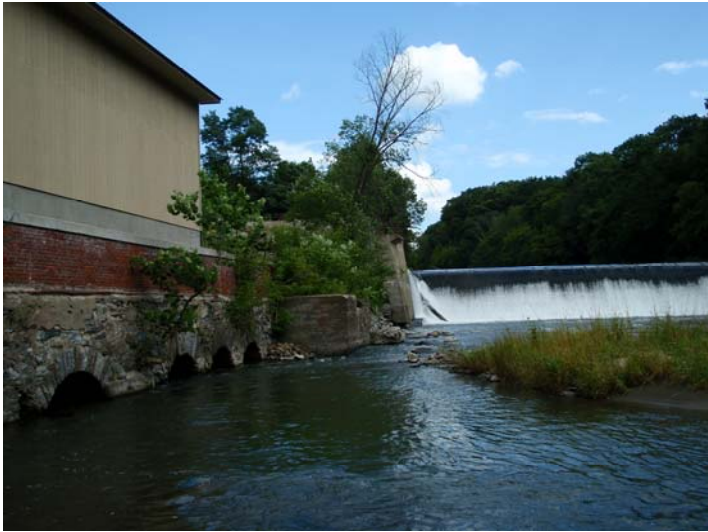

Segment ID: M04-B	Photo #: 49	Date: 9/25/08	View: US	Segment ID: M04-B	Photo #: 50	Date: 9/25/08	View: DS
Description: From M04B x-section				Description: From M04B x-section			
							
Segment ID: M04-B	Photo #: 51	Date: 9/25/08	View: LB	Segment ID: M04-B	Photo #: 52	Date: 9/25/08	View: LB
Description: M04B x-section from bottom of RB				Description: M04B x-section from top of RB (ag field in background)			
							

Segment ID: M04-B	Photo #: 53	Date: 9/25/08	View: US RB	Segment ID: M04-B	Photo #: 54	Date: 8/1/08	View: US LB
Description: Right bank near M04B x-section				Description: Buffer <25' US of sharp bend			
							
Segment ID: M04-B	Photo #: 55	Date: 8/1/08	View: DS	Segment ID: M04-B	Photo #: 56	Date: 8/1/08	View: US
Description: Bedrock (L) and deposition (foreground) at sharp bend				Description: US from sharp bend (deposition in foreground)			
							

Segment ID: M04-B	Photo #: 57	Date: 8/1/08	View: DS LB	Segment ID: M04-B	Photo #: 58	Date: 8/1/08	View: US
Description: Small erosion site between bedrock DS of sharp bend				Description: Large transverse riffle			
							
Segment ID: M04-B	Photo #: 59	Date: 8/1/08	View: US	Segment ID: M04-B	Photo #: 60	Date: 8/1/08	View: US RB
Description: Bottom of PB with multiple flood chute outlets				Description: Buffer <25' on RB before railroad			
							

Segment ID: M04-B	Photo #: 61	Date: 8/1/08	View: US	Segment ID: M04-B	Photo #: 62	Date: 8/1/08	View: DS
Description: US from island showing buffer <25' & rip-rap along railroad				Description: Top of island			
							
Segment ID: M04-B	Photo #: 63	Date: 8/1/08	View: DS LB	Segment ID: M04-B	Photo #: 64	Date: 8/1/08	View: DS RB
Description: Erosion on LB across from island				Description: End of buffer <25', top of island/RR channel			
							

Segment ID: M04-B	Photo #: 65	Date: 8/1/08	View: LB	Segment ID: M04-A	Photo #: 66	Date: 8/1/08	View: US
Description: Second erosion site near DS end of island				Description: Bottom of reach M04 (start of M04-B just past bend)			
							
Segment ID: M03-B	Photo #: 67	Date: 8/1/08	View: DS	Segment ID: M03-B	Photo #: 68	Date: 8/1/08	View: DS
Description: Top of reach M03				Description: Towards dam			
							





Segment ID: M03-A	Photo #: 69	Date: 8/1/08	View: US	Segment ID: M03-A	Photo #: 70	Date: 8/1/08	View: US
Description: Dam (sedimentation in foreground, bedrock R, foundations L)				Description: Dam			
							
Segment ID: M03-A	Photo #: 71	Date: 8/1/08	View: US RB	Segment ID: M03-A	Photo #: 72	Date: 8/1/08	View: US LB
Description: Old tannery foundations below dam				Description: Bedrock on LB below dam (sedimentation in foreground)			
							




Segment ID: M03-A	Photo #: 73	Date: 7/30/08	View: DS RB	Segment ID: M03-A	Photo #: 74	Date: 8/1/08	View: LB
Description: From new bridge abutment towards temp bridge & islands				Description: New bridge construction on LB			











Segment ID: M03-A	Photo #: 75	Date: 7/30/08	View: LB	Segment ID: M03-A	Photo #: 76	Date: 7/30/08	View: LB
Description: From RB across R channel toward new bridge pier & island				Description: From RB under temp bridge across R channel to island			










Segment ID: M03-A	Photo #: 77	Date: 7/30/08	View: US	Segment ID: M03-A	Photo #: 78	Date: 9/25/08	View: RB
Description: From temp bridge towards dam (new bridge construction on L)				Description: X-section (from LB looking over main channel to island & RB)			
							
Segment ID: M03-A	Photo #: 79	Date: 9/25/08	View: US	Segment ID: M03-A	Photo #: 80	Date: 9/25/08	View: DS
Description: US from x-section LB toward temp bridge, new pier, & dam				Description: DS from x-section LB (island on R)			
							





Segment ID: M03-A	Photo #: 81	Date: 8/1/08	View: LB	Segment ID: M03-A	Photo #: 82	Date: 9/25/08	View: LB
Description: Looking towards LB at x-section site; note exposed pipe				Description: X-section from top of RB looking over island; R chan. not visible			
							
Segment ID: M03-A	Photo #: 83	Date: 9/25/08	View: LB	Segment ID: M03-A	Photo #: 84	Date: 8/1/08	View: US
Description: X-section (from base of RB looking over R channel to island)				Description: Bottom of M03 (temp bridge in background)			
							





Segment ID: M02	Photo #: 85	Date: 8/1/08	View: DS	Segment ID: M02	Photo #: 86	Date: 8/18/08	View: DS RB
Description: Top of reach M02				Description: WWTF property (berm along treeline on L)			
							
Segment ID: M02	Photo #: 87	Date: 6/24/08	View: RB	Segment ID: M02	Photo #: 88	Date: 6/24/08	View: LB
Description: Wastewater treatment facility (WWTF) in right floodplain				Description: Mass failure across from WWTF			
							





Segment ID: M02	Photo #: 89	Date: 8/18/08	View: LB	Segment ID: M02	Photo #: 90	Date: 8/18/08	View: LB
Description: Mass failure across from WWTF				Description: Mass failure across from WWTF			
							
Segment ID: M02	Photo #: 91	Date: 9/25/08	View: DS LB	Segment ID: M02	Photo #: 92	Date: 9/25/08	View: DS RB
Description: M02 x-section (LB)				Description: M02 x-section (RB)			
							





Segment ID: M02	Photo #: 93	Date: 9/25/08	View: LB	Segment ID: M02	Photo #: 94	Date: 9/25/08	View: RB
Description: M02 x-section (tape slack)				Description: M02 x-section			
							
Segment ID: M02	Photo #: 95	Date: 9/25/08	View: US	Segment ID: M02	Photo #: 96	Date: 8/18/08	View: US
Description: M02 x-section				Description: Towards diagonal/mid-channel bar (near x-section site)			
							





Segment ID: M02	Photo #: 97	Date: 8/18/08	View: DS	Segment ID: M02	Photo #: 98	Date: 8/18/08	View: RB
Description: Below diagonal bar				Description: Right bank with berm in front of WWTF			
							
Segment ID: M02	Photo #: 99	Date: 8/18/08	View: LB	Segment ID: M02	Photo #: 100	Date: 8/18/08	View: US RB
Description: Typical forested left bank				Description: DS extent of berm (WWTF L & mass failure R in background)			
							





Segment ID: M02	Photo #: 101	Date: 8/18/08	View: DS RB	Segment ID: M02	Photo #: 102	Date: 8/18/08	View: RB
Description: Buffer <25' section below WWTF berm				Description: Carpet-like material on bank below buffer <25' section			
							
Segment ID: M02	Photo #: 103	Date: 8/18/08	View: RB	Segment ID: M02	Photo #: 104	Date: 8/18/08	View: US
Description: Carpet-like material on bank below buffer <25' section				Description: Bottom of reach M02			
							

Segment ID: M01	Photo #: 105	Date: 8/18/08	View: DS	Segment ID: M01	Photo #: 106	Date: 8/18/08	View: RB
Description: Top of reach M01 (tributary on R)				Description: Tributary just below M02/M01 reach break			
							
Segment ID: M01	Photo #: 107	Date: 8/18/08	View: US RB	Segment ID: M01	Photo #: 108	Date: 8/18/08	View: DS
Description: DS end of island/start of rip-rap				Description: Looking toward sharp bend (buffer <25'/rip-rap on R)			
							

Segment ID: M01	Photo #: 109	Date: 8/18/08	View: DS RB	Segment ID: M01	Photo #: 110	Date: 8/18/08	View: RB
Description: Buffer <25'/rip-rap on RB just above bend				Description: Buffer <25'/rip-rap on RB just above bend (note invasives)			
							
Segment ID: M01	Photo #: 111	Date: 8/18/08	View: US	Segment ID: M01	Photo #: 112	Date: 8/18/08	View: DS
Description: Just US of sharp bend				Description: Toward sharp bend and area of sedimentation			
							

Segment ID: M01	Photo #: 113	Date: 8/18/08	View:	Segment ID: M01	Photo #: 114	Date: 7/29/08	View: US
Description: DS of sharp bend				Description: From LB at sharp bend (sedimentation in foreground)			
							
Segment ID: M01	Photo #: 115	Date: 9/25/08	View: DS LB	Segment ID: M01	Photo #: 116	Date: 9/25/08	View:
Description: M01 x-section (RL side)				Description: M01 x-section (RR side)			
							

Segment ID: M01	Photo #: 117	Date: 9/25/08	View: LB	Segment ID: M01	Photo #: 118	Date: 9/25/08	View: RB
Description: M01 x-section				Description: M01 x-section			
							
Segment ID: M01	Photo #: 119	Date: 9/25/08	View: US RB	Segment ID: M01	Photo #: 120	Date: 9/25/08	View: US RL
Description: M01 x-section (RR side)				Description: M01 x-section (RL side)			
							

Segment ID: M01	Photo #: 121	Date: 8/18/08	View: DS	Segment ID: M01	Photo #: 122	Date: 8/18/08	View: DS
Description: Toward Route 346 bridge				Description: Toward Route 346 bridge (railroad bridge in background)			
							
Segment ID: M01	Photo #: 123	Date: 8/18/08	View: US	Segment ID: M01	Photo #: 124	Date: 8/18/08	View: DS
Description: US from under Route 346 bridge				Description: DS from under Route 346 bridge (railroad bridge in background)			
							

Segment ID: M01	Photo #: 125	Date: 6/25/08	View: US	Segment ID: M01	Photo #: 126	Date: 6/25/08	View: DS
Description: US from deck of Route 346 bridge				Description: DS from deck of Route 346 bridge (railroad bridge in background)			



Segment ID: M01	Photo #: 127	Date: 7/30/08	View: US RB
Description: Outlet of Route 346 bridge			



APPENDIX F
Standard Database Reports

Stream Geometry Data

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Reach	Phase 2 Stream Type				Phase 1 Data			Phase 2 Channel Data										RGA				
	Seg- ment	Stream Type	Bed Material	Bed Bedform	Subcl. Slope	Sub Rch?	Channel Slope	Channel width	Bankfull width	Max. depth	Mean depth	Floodpr. width	Abandn FldPln	W/D Ratio	Entrench- ment	Incision Ratio	Stage Evol.	Cond Model.	RHA Cond.	QC Stf	Aut	
M01	0	B	Gravel	Riffle-Pool	c	No	0.08	133.81	180.0	6.72	4.98	296.0	13.95	36.14	1.64	2.08	IV	F	Fair	Good	F	P
M02	0	F	Gravel	Riffle-Pool	None	No	0.17	131.55	139.0	8.5	6.39	183.0	8.55	21.75	1.32	1.01	III	F	Fair	Good	F	F
M03	A	B	Cobble	Riffle-Pool	c	No	0.31	131.18	169.0	8.35	5.24	356.0	15.25	32.25	2.11	1.83	IV	F	Fair	Good	F	P
M03	B	C	Sand	Plane Bed	None	No	0.31	131.18											Fair		F	F
M04	A	C	Sand	Plane Bed	None	No	0.05	129.25	158.0	6.6	5.39	591.0	9.35	29.31	3.74	1.42	IV	F	Fair	Good	F	P
M04	B	C	Gravel	Riffle-Pool	None	No	0.05	129.25	136.0	9.43	5.79	802.0	11.6	23.49	5.90	1.23	IV	F	Fair	Good	F	P
M05	0	C	Cobble	Riffle-Pool	None	No	0.02	128.15	127.0	7.88	6.12	474.5	13.39	20.75	3.74	1.70	IV	F	Fair	Good	F	P
M06	0	F	Cobble	Riffle-Pool	None	No	0.04	125.63	134.0	7.39	5.68	172.0	16.85	23.59	1.28	2.28	III	F	Fair	Good	F	P

Rapid Geomorphic Assessment

Hoosic

Reach	Seg- ment	Sub- Rch?	Degradation			Aggradation			Widening		Planform		Geo. Score	Geo. Condition	Evol. Stage	Confin- ement Type	Sens- itivity	QC	
			Score	STD	Historic	Score	STD	Historic	Score	Historic	Score	Historic						Stf	Aut
M01	0	No	5	C to B	Yes	12	None	No	10	Yes	13	No	0.50	Fair	IV	NW	Very	F	P
M02	0	No	4	C to F	Yes	14	None	No	10	No	13	No	0.51	Fair	III	NW	Extreme	F	F
M03	A	No	8	C to B	Yes	13	None	No	10	Yes	13	No	0.55	Fair	IV	SC	High	F	P
M03	B	No											0.00	Fair				F	F
M04	A	No	12	None	Yes	5	None	No	15	No	15	No	0.59	Fair	IV	NW	Very	F	P
M04	B	No	11	None	Yes	14	None	No	13	Yes	13	No	0.64	Fair	IV	BD	Very	F	P
M05	0	No	9	None	Yes	13	None	No	14	Yes	14	No	0.63	Fair	IV	BD	High	F	P
M06	0	No	5	C to F	Yes	14	None	No	10	No	12	No	0.51	Fair	III	BD	Extreme	F	P

Project: **Hoosic**
 Stream: **Hoosic River**
 Organization: **Bennington County RPC**
 Segment Length (ft): **6,666**

Phase 2 Segment Summary page 1 of 2
 Reach # **M01** Segment: **0**
 Observers: **Jill Winton, Jason George,** Why Not assessed:
 Segment Location: **Between WWTF & Route 346 Bridge**

January 15, 2009 SGAT Version: 4.56
 Completion Date: **September 25, 2008**
 Rain: **Yes**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	1,961	0
height	15	0
Railroads	2,322	0
height	15	0
Improved Paths	0	0
height	0	0
Development	1,718	0

1.4 Adjacent Side Left Right

Hillside Slope **Very Steep** **Very Steep**

Continuous w/ **Sometimes** **Never**

W/in 1 Bankfill **Sometimes** **Never**

Texture **Mixed** **Mixed**

1.5 Valley Features

Valley Width (ft) **890**

Width Determination **Estimated**

Confinement Type **Narrow**

Rock Gorge? **No**

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width **180**

2.2 Max Depth (ft) **6.72**

2.3 Mean Depth (ft) **4.98**

2.4 Floodprone Width (ft) **296**

Notes:
 Reach M01 flows from the downstream extent of the wastewater treatment facility to the VT/NY border where it flows under the Route 346 bridge. Its naturally very broad valley is artificially confined by the railroad and Route 346 on the right. Near the

Provisional Step 2. (Contued)

2.5 Aband. Floodpln **13.95** ft.

Human Elev Floodpln **0.00** ft.

2.6 Width/Depth Ratio **36.14**

2.7 Entrenchment Ratio **1.64**

2.8 Incision Ratio **2.08**

Human Elevated Inc Rat **0.00**

2.9 Sinuosity **Moderate**

2.10 Riffles Type **Complete**

2.11 Riffle/Step Spacing (ft) **580**

2.12 Substrate Composition

Bedrock	0%
Boulder	1%
Cobble	32%
Coarse Gravel	41%
Fine Gravel	16%
Sand	7%
Silt and smaller	3%

Silt/Clay Present? **No**

Detritus **2 %**

Large Woody **57**

2.13 Average Largest Particle on

Bed	8.0	inches
Bar	5.0	inches

2.14 Stream Type

Stream Type: **B**

Bed Material: **Gravel**

Subclass Slope: **c**

Bed Form: **Riffle-Pool**

Field Measured Slope:

2.15 Reference Stream Type
 (if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture Left Right

Upper

Material Type **Silt** **Silt**

Consistency **Cohesive** **Cohesive**

Lower

Material Type **Gravel** **Silt**

Consistency **Non-cohesive** **Cohesive**

Bank Erosion Left Right

Erosion Length (ft) **0** **0**

Erosion Height (ft) **0.00** **0.00**

Revetmt. Type **Rip-Rap** **Rip-Rap**

Revetmt. Length (ft) **159** **1,821**

Near Bank Veg. Type Left Right

Dominant **Deciduous Shrubs/Saplin**

Sub-dominant **Shrubs/Saplin** **Invasives**

Bank Canopy Left Right

Canopy % **51-75** **26-50**

Mid-Channel Canopy **Open**

3.2 Riparian Buffer

Buffer Width Left Right

Dominant **>100** **26-50**

Sub-dominant **None** **0-25**

W less than 25 **0** **1,581**

Buffer Veg. Type Left Right

Dominant **Mixed Trees Shrubs/Saplin**

Sub-dominant **Coniferous** **Herbaceous**

3.3 Riparian Corridor

Corridor Land Left Right

Dominant **Forest** **Crop**

Sub-dominant **Residential Shrubs/Saplin**

Mass Failures **0** **0**

Height **0** **0**

Gullies **0** **0**

Height **0** **0**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **Minimal**

4.2 Adjacent Wetlands **Minimal**

4.3 Flow Status **High**

4.4 # of Debris Jams **0**

4.5 Flow Regulation Type **None**

Flow Regulation Use

Impoundments

Impoundmt. Location

4.6 Up/Down strm flow reg **None**
 (old) Upstrm Flow Reg

4.7 StormwaterInputs

Field Ditch	0	Road Ditch	0
Other	0	Tile Drain	0
Overland Flow	0	Urb Strm Wtr Pipe	0

4.9 # of Beaver Dams **0**

Affected Length (ft) **0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
4	0	2
Diagonal	Delta	Island
0	0	3

5.2 Other Features Braiding

Flood	Neck Cutoff	Avulsion	
1	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal **No**

5.5 Straightening **Straightening**

Straightening Length: **598**

5.5 Dredging **None**

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: **Hoosic**
 Stream: **Hoosic River**
 Organization: **Bennington County RPC**
 Segment Length (ft): **6,666**

Phase 2 Segment Summary page 2 of 2
 Reach # **M01** Segment: **0**
 Observers: **Jill Winton, Jason George, Jeremy**
 Segment Location: **Between WWTF & Route 346 Bridge**

January 15, 2009
 Completion Date: **September 25,**
 Rain: **Yes**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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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	12	None	No
7.3 Widening Channel	10		Yes
7.4 Change in Planform	13		No

Total Score **40**

Geomorphic Rating **0.5**

Channel Evolution Model **F**

Channel Evolution Stage **IV**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	200.	Yes	Yes	No	Yes
	Problem	None			

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	12
6.2 Embeddedness	13
6.3 Velocity/Depth Patterns	19
6.4 Sediment Deposition	6
6.5 Channel Flow Status	19
6.6 Channel Alteration	11
6.7 Frequency of Riffles/Steps	16
6.8 Bank Stability	Left: 10 Right: 9
6.9 Bank Vegetation Protection	Left: 9 Right: 7
6.10 Riparian Vegetation Zone Width	Left: 9 Right: 3

Total Score **143**

Habitat Rating **0.715**

Habitat Stream Condition **Good**

Narrative:

This reach has experienced historic degradation & widening and is now forming a new floodplain through aggradation, as evidenced by many depositional features. Planform is also adjusting, as evidenced by flood chutes, transverse bars, & erosion.

Project: **Hoosic**
 Stream: **Hoosic River**
 Organization: **Bennington County RPC**
 Segment Length (ft): **3,011**

Phase 2 Segment Summary page 1 of 2
 Reach # **M02** Segment: **0**
 Observers: **Jill Winton, Jason George,** Why Not assessed:
 Segment Location: **Waste Water Treatment Facility**

January 15, 2009 SGAT Version: 4.56
 Completion Date: **September 25, 2008**
 Rain: **Yes**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	2,253	0
height	15	0
Roads	0	665
height	0	15
Railroads	3,011	0
height	15	0
Improved Paths	0	0
height	0	0
Development	0	896

1.4 Adjacent Side Left Right

Hillside Slope **Very Steep** **Very Steep**

Continuous w/ **Sometimes** **Never**

W/in 1 Bankfill **Always** **Never**

Texture **Mixed** **Mixed**

1.5 Valley Features

Valley Width (ft) **737**

Width Determination **Estimated**

Confinement Type **Narrow**

Rock Gorge? **No**

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width **139**

2.2 Max Depth (ft) **8.50**

2.3 Mean Depth (ft) **6.39**

2.4 Floodprone Width (ft) **183**

Notes:
 Reach M02 is fairly short and is confined by almost its entire length by a berm on the right. The berm serves to protect a former EPA superfund site which has been redeveloped into a new wastewater treatment plant. This encroachment has pushed the river up

Provisional Step 2. (Contued)

2.5 Aband. Floodpln **8.55** ft.

Human Elev Floodpln **18.67** ft.

2.6 Width/Depth Ratio **21.75**

2.7 Entrenchment Ratio **1.32**

2.8 Incision Ratio **1.01**

Human Elevated Inc Rat **2.20**

2.9 Sinuosity **Low**

2.10 Riffles Type **Complete**

2.11 Riffle/Step Spacing (ft) **700**

2.12 Substrate Composition

Bedrock	19%
Boulder	4%
Cobble	27%
Coarse Gravel	30%
Fine Gravel	9%
Sand	1%
Silt and smaller	10%

Silt/Clay Present? **No**

Detritus **7 %**

Large Woody **35**

2.13 Average Largest Particle on

Bed	10.0	inches
Bar	N/A	inches

2.14 Stream Type

Stream Type: **F**

Bed Material: **Gravel**

Subclass Slope: **None**

Bed Form: **Riffle-Pool**

Field Measured Slope:

2.15 Reference Stream Type
 (if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	One	50.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture Left Right

Upper

Material Type **Silt** **Silt**

Consistency **Cohesive** **Cohesive**

Lower

Material Type **Mix** **Silt**

Consistency **Cohesive** **Cohesive**

Bank Erosion Left Right

Erosion Length (ft) **0** **0**

Erosion Height (ft) **0.00** **0.00**

Revetmt. Type **None** **None**

Revetmt. Length (ft) **0** **0**

Near Bank Veg. Type Left Right

Dominant **Coniferous Shrubs/Saplin**

Sub-dominant **Deciduous** **Invasives**

Bank Canopy Left Right

Canopy % **51-75** **26-50**

Mid-Channel Canopy **Open**

3.2 Riparian Buffer

Buffer Width Left Right

Dominant **>100** **26-50**

Sub-dominant **None** **0-25**

W less than 25 **0** **170**

Buffer Veg. Type Left Right

Dominant **Coniferous Shrubs/Saplin**

Sub-dominant **Mixed Trees** **Herbaceous**

3.3 Riparian Corridor

Corridor Land Left Right

Dominant **Forest** **Industrial**

Sub-dominant **None** **Crop**

Mass Failures **379** **0**

Height **50** **0**

Gullies **0** **0**

Height **0** **0**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **None**

4.2 Adjacent Wetlands **None**

4.3 Flow Status **High**

4.4 # of Debris Jams **0**

4.5 Flow Regulation Type **None**

Flow Regulation Use

Impoundments

Impoundmt. Location

4.6 Up/Down strm flow reg **None**

(old) Upstrm Flow Reg

4.7 StormwaterInputs

Field Ditch	0	Road Ditch	0
Other	0	Tile Drain	0
Overland Flow	0	Urb Strm Wtr Pipe	0

4.9 # of Beaver Dams **0**

Affected Length (ft) **0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	0	0
Diagonal	Delta	Island
1	0	0

5.2 Other Features Braiding

Flood	Neck Cutoff	Avulsion
0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal **No**

5.5 Straightening **Straightening**

Straightening Length: **2,431**

5.5 Dredging **None**

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: **Hoosic**
 Stream: **Hoosic River**
 Organization: **Bennington County RPC**
 Segment Length (ft): **3,011**

Phase 2 Segment Summary page 2 of 2
 Reach # **M02** Segment: **0**
 Observers: **Jill Winton, Jason George, Jeremy**
 Segment Location: **Waste Water Treatment Facility**

January 15, 2009
 Completion Date: **September 25,**
 Rain: **Yes**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Unconfined**

	Score	STD	Historic
7.1 Channel Degradation	4	C to F	Yes
7.2 Channel Aggradation	14	None	No
7.3 Widening Channel	10		No
7.4 Change in Planform	13		No

Total Score **41**

Geomorphic Rating **0.5125**

Channel Evolution Model **F**

Channel Evolution Stage **III**

Geomorphic Condition **Fair**

Stream Sensitivity **Extreme**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	12
6.2 Embeddedness	12
6.3 Velocity/Depth Patterns	19
6.4 Sediment Deposition	15
6.5 Channel Flow Status	19
6.6 Channel Alteration	11
6.7 Frequency of Riffles/Steps	16
6.8 Bank Stability	Left: 7 Right: 9
6.9 Bank Vegetation Protection	Left: 9 Right: 7
6.10 Riparian Vegetation Zone Width	Left: 9 Right: 5

Total Score 150

Habitat Rating 0.75

Habitat Stream Condition **Good**

Narrative:

This reach has experienced historic degradation & floodplain build-up when it was bermed on the right. It is now attempting to widen as evidenced by a substantial mass failure, but is somewhat confined by bedrock, steep valley wall, and the berm.

Project: **Hoosic**
 Stream: **Hoosic River**
 Organization: **Bennington County RPC**
 Segment Length (ft): **1,419**

Phase 2 Segment Summary page 1 of 2
 Reach # **M03** Segment: **A**
 Observers: **Jill Winton, Jason George,** Why Not assessed:
 Segment Location: **Downstream of dam**

January 15, 2009 SGAT Version: 4.56
 Completion Date: **September 25, 2008**
 Rain: **Yes**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	Grade Controls	
1.2 Alluvial Fan	None	
1.3 Corridor Encroachments		
	<u>Length (ft)</u>	<u>One</u> <u>Both</u>
Berms	0	0
height	0	0
Roads	452	954
height	15	15
Railroads	1,409	0
height	15	0
Improved Paths	0	0
height	0	0
Development	0	1,409
1.4 Adjacent Side	<u>Left</u>	<u>Right</u>
Hillside Slope	Hilly	Very Steep
Continuous w/	Sometimes	Never
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Mixed	Mixed
1.5 Valley Features		
Valley Width (ft)	386	
Width Determination	Estimated	
Confinement Type	Semi-confined	
Rock Gorge?	No	
Human-caused Change?	Yes	
Step 2. Stream Channel		
2.1 Bankfull Width	169	
2.2 Max Depth (ft)	8.35	
2.3 Mean Depth (ft)	5.24	
2.4 Floodprone Width (ft)	356	

Notes:
 Reach M03 is broken into two segments due to the Pownal Dam which serves as a grade control. The upper segment, M03-B, was not assessed because it is impounded. Segment M03-A below the dam, although short, has a lot going on. The segment is essential split in

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	15.25	ft.
Human Elev Floodpln	0.00	ft.
2.6 Width/Depth Ratio	32.25	
2.7 Entrenchment Ratio	2.11	
2.8 Incision Ratio	1.83	
Human Elevated Inc Rat	0.00	
2.9 Sinuosity	Low	
2.10 Riffles Type	Eroded	
2.11 Riffle/Step Spacing (ft)	500	
2.12 Substrate Composition		
Bedrock	0%	
Boulder	4%	
Cobble	50%	
Coarse Gravel	22%	
Fine Gravel	10%	
Sand	14%	
Silt and smaller	0%	
Silt/Clay Present?	No	
Detritus	5 %	
# Large Woody	30	
2.13 Average Largest Particle on		
Bed	10.0	inches
Bar	6.0	inches
2.14 Stream Type		
Stream Type:	B	
Bed Material:	Cobble	
Subclass Slope:	c	
Bed Form:	Riffle-Pool	
Field Measured Slope:		
2.15 Reference Stream Type		
(if different from Phase 1)		
3.3 old	<u>Amount</u>	<u>Mean Height</u>
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Moderate	
Bank Texture	<u>Left</u>	<u>Right</u>
Upper		
Material Type	Sand	Sand
Consistency	Cohesive	Cohesive
Lower		
Material Type	Silt	Silt
Consistency	Cohesive	Cohesive
Bank Erosion	<u>Left</u>	<u>Right</u>
Erosion Length (ft)	0	0
Erosion Height (ft)	0.00	0.00
Revetmt. Type	Rip-Rap	Other
Revetmt. Length (ft)	121	425
Near Bank Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Deciduous	Deciduous
Sub-dominant	Herbaceous Shrubs/Saplin	
Bank Canopy	<u>Left</u>	<u>Right</u>
Canopy %	26-50	26-50
Mid-Channel Canopy	Open	
3.2 Riparian Buffer		
Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	26-50	26-50
Sub-dominant	51-100	51-100
W less than 25	0	0
Buffer Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Mixed Trees	Mixed Trees
Sub-dominant	Herbaceous Shrubs/Saplin	
3.3 Riparian Corridor		
Corridor Land	<u>Left</u>	<u>Right</u>
Dominant	Forest	Industrial
Sub-dominant	Residential Shrubs/Saplin	
Mass Failures	0	0
Height	0	0
Gullies	0	0
Height	0	0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	None
4.2 Adjacent Wetlands	None
4.3 Flow Status	High
4.4 # of Debris Jams	0
4.5 Flow Regulation Type	None
Flow Regulation Use	
Impoundments	Small
Impoundmt. Location	Upstream
4.6 Up/Down strm flow reg	None
(old) Upstrm Flow Reg	Run-of-river
4.7 StormwaterInputs	
Field Ditch	0
Road Ditch	0
Other	0
Tile Drain	0
Overland Flow	0
Urb Strm Wtr Pipe	0
4.9 # of Beaver Dams	0
Affected Length (ft)	0

Step 5. Channel Bed and Planform Changes

5.1 Bar Types			
	<u>Mid</u>	<u>Point</u>	<u>Side</u>
	2	0	1
	<u>Diagonal</u>	<u>Delta</u>	<u>Island</u>
	0	0	1
5.2 Other Features			<u>Braiding</u>
Flood	<u>Neck Cutoff</u>	<u>Avulsion</u>	0
1	0	0	
5.3 Steep Riffles and Head Cuts			
Steep Riffles	<u>Head Cuts</u>	<u>Trib Rejuv.</u>	
0	0	No	
5.4 Stream Ford or Animal			No
5.5 Straightening			Straightening
Straightening Length:			1,412
5.5 Dredging			None
Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.			

Project: **Hoosic**
 Stream: **Hoosic River**
 Organization: **Bennington County RPC**
 Segment Length (ft): **1,419**

Phase 2 Segment Summary page 2 of 2
 Reach # **M03** Segment: **A**
 Observers: **Jill Winton, Jason George, Jeremy**
 Segment Location: **Downstream of dam**

January 15, 2009
 Completion Date: **September 25,**
 Rain: **Yes**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Unconfined**

	Score	STD	Historic
7.1 Channel Degradation	8	C to B	Yes
7.2 Channel Aggradation	13	None	No
7.3 Widening Channel	10		Yes
7.4 Change in Planform	13		No
Total Score		44	
Geomorphic Rating		0.55	
Channel Evolution Model	F		
Channel Evolution Stage	IV		
Geomorphic Condition	Fair		
Stream Sensitivity	High		

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	260.	Yes	Yes	No	Yes
Problem Deposition Above, Deposition Below					

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score	
6.1 Epifaunal Substrate - Available Cover	14	
6.2 Embeddedness	11	
6.3 Velocity/Depth Patterns	18	
6.4 Sediment Deposition	10	
6.5 Channel Flow Status	16	
6.6 Channel Alteration	10	
6.7 Frequency of Riffles/Steps	16	
6.8 Bank Stability	Left: 9 Right: 9	
6.9 Bank Vegetation Protection	Left: 6 Right: 7	
6.10 Riparian Vegetation Zone Width	Left: 5 Right: 5	
Total Score		136
Habitat Rating		0.68
Habitat Stream Condition		Good

Narrative:

This segment has experienced historic degradation, & floodplain build-up (especially on the right). It has become over-widened, in part due to the effects of old, temporary, & new bridges, and is now developing new bar features.

Project: **Hoosic**
 Stream: **Hoosic River**
 Organization: **Bennington County RPC**
 Segment Length (ft): **3,445**

Phase 2 Segment Summary
 Reach # **M03**
 Observers: **Jill Winton, Jason George,**
 Segment Location: **Upstream of dam**

page 1 of 2
 Segment: **B**
 Why Not assessed: **impounded**

January 15, 2009 SGAT Version: 4.56
 Completion Date: **September 25, 2008**
 Rain: **Yes**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation		
1.2 Alluvial Fan	None	
1.3 Corridor Encroachments		
<u>Length (ft)</u>	<u>One</u>	<u>Both</u>
Berms	0	0
height	0	0
Roads	3,047	0
height	15	0
Railroads	3,446	0
height	15	0
Improved Paths	0	0
height	0	0
Development	0	1,253
1.4 Adjacent Side	<u>Left</u>	<u>Right</u>
Hillside Slope		
Continuous w/ W/in 1 Bankfill		
Texture		
1.5 Valley Features		
Valley Width (ft)	0	
Width Determination		
Confinement Type		
Rock Gorge?		
Human-caused Change?		
Step 2. Stream Channel		
2.1 Bankfull Width	0	
2.2 Max Depth (ft)	0.00	
2.3 Mean Depth (ft)	0.00	
2.4 Floodprone Width (ft)	0	

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	0.00	ft.
Human Elev Floodpln	0.00	ft.
2.6 Width/Depth Ratio	0.00	
2.7 Entrenchment Ratio	0.00	
2.8 Incision Ratio	0.00	
Human Elevated Inc Rat	0.00	
2.9 Sinuosity		
2.10 Riffles Type		
2.11 Riffle/Step Spacing (ft)	0	
<u>2.12 Substrate Composition</u>		
Silt/Clay Present?		
Detritus	0	%
# Large Woody	0	
<u>2.13 Average Largest Particle on</u>		
Bed	0.0	
Bar	0.0	
<u>2.14 Stream Type</u>		
Stream Type:	C	
Bed Material:	Sand	
Subclass Slope:	None	
Bed Form:	Plane Bed	
Field Measured Slope:		
<u>2.15 Reference Stream Type</u>		
(if different from Phase 1)		
<u>3.3 old</u>	<u>Amount</u>	<u>Mean Height</u>
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

<u>3.1 Stream Banks</u>		
Typical Bank Slope		
Bank Texture	<u>Left</u>	<u>Right</u>
Upper		
Material Type		
Consistency		
Lower		
Material Type		
Consistency		
Bank Erosion	<u>Left</u>	<u>Right</u>
Erosion Length (ft)	0	0
Erosion Height (ft)	0.00	0.00
Revetmt. Type	None	Rip-Rap
Revetmt. Length (ft)	0	2,581
Near Bank Veg. Type	<u>Left</u>	<u>Right</u>
Dominant		
Sub-dominant		
Bank Canopy	<u>Left</u>	<u>Right</u>
Canopy %		
Mid-Channel Canopy		
<u>3.2 Riparian Buffer</u>		
Buffer Width	<u>Left</u>	<u>Right</u>
Dominant		
Sub-dominant		
W less than 25	0	2,374
Buffer Veg. Type	<u>Left</u>	<u>Right</u>
Dominant		
Sub-dominant		
<u>3.3 Riparian Corridor</u>		
Corridor Land	<u>Left</u>	<u>Right</u>
Dominant		
Sub-dominant		
Mass Failures	0	0
Height	0	0
Gullies	0	0
Height	0	0

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 Regulation Use			
Impoundments			
Impoundmt. Location			
4.6 Up/Down strm flow reg	None		
(old) Upstrm Flow Reg			
4.7 StormwaterInputs			
Field Ditch	0	Road Ditch	0
Other	0	Tile Drain	0
Overland Flow	0	Urb Strm Wtr Pipe	0
4.9 # of Beaver Dams	0		
Affected Length (ft) 0			

Step 5. Channel Bed and Planform Changes

<u>5.1 Bar Types</u>		
<u>Mid</u>	<u>Point</u>	<u>Side</u>
0	0	0
<u>Diagonal</u>	<u>Delta</u>	<u>Island</u>
0	0	0
<u>5.2 Other Features</u>		
		<u>Braiding</u>
<u>Flood</u>	<u>Neck Cutoff</u>	<u>Avulsion</u>
0	0	0
<u>5.3 Steep Riffles and Head Cuts</u>		
<u>Steep Riffles</u>	<u>Head Cuts</u>	<u>Trib Rejuv.</u>
0	0	
5.4 Stream Ford or Animal No		
5.5 Straightening Straightening		
Straightening Length: 2,840		
5.5 Dredging None		

Notes:

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: **Hoosic**
 Stream: **Hoosic River**
 Organization: **Bennington County RPC**
 Segment Length (ft): **3,445**

Phase 2 Segment Summary
 Reach # **M03**
 Observers: **Jill Winton, Jason George, Jeremy**
 Segment: **B**
 Segment Location: **Upstream of dam**

January 15, 2009
 Completion Date: **September 25,**
 Rain: **Yes**

1.6 Grade Controls

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
Dam	Mid-segment	25.00	15.00	Yes	

Step 7. Rapid Geomorphic Assessment Data

Confinement Type

Channel Evolution Model
 Channel Evolution Stage
 Geomorphic Condition
 Stream Sensitivity

Fair

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type

Habitat Stream Condition

Narrative:

Project: **Hoosic**
 Stream: **Hoosic River**
 Organization: **Bennington County RPC**
 Segment Length (ft): **1,500**

Phase 2 Segment Summary page 1 of 2
 Reach # **M04** Segment: **A**
 Observers: **Jill Winton, Jason George,** Why Not assessed:
 Segment Location: **Riverine impounded segment upstream of dam impoundment**

January 15, 2009 SGAT Version: 4.56
 Completion Date: **September 25, 2008**
 Rain: **Yes**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **Planform and Scope**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	1,373	0
height	15	0
Improved Paths	0	0
height	0	0
Development	0	0
1.4 Adjacent Side	Left	Right
Hillside Slope	Very Steep	Very Steep
Continuous w/	Never	Never
W/in 1 Bankfill	Always	Never
Texture	Mixed	Mixed

1.5 Valley Features

Valley Width (ft)	802
Width Determination	Estimated
Confinement Type	Narrow
Rock Gorge?	No

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width	158
2.2 Max Depth (ft)	6.60
2.3 Mean Depth (ft)	5.39
2.4 Floodprone Width (ft)	591

Notes:

Segment M04-A was separated from M04-B because it is still somewhat impounded due to the Pownal Dam downstream. This segment is essentially a featureless plane bed with very low gradient and velocity. Its naturally broad valley is artificially confined by

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	9.35 ft.
Human Elev Floodpln	0.00 ft.
2.6 Width/Depth Ratio	29.31
2.7 Entrenchment Ratio	3.74
2.8 Incision Ratio	1.42
Human Elevated Inc Rat	0.00
2.9 Sinuosity	Low
2.10 Riffles Type	Not Applicable
2.11 Riffle/Step Spacing (ft)	0
2.12 Substrate Composition	
Bedrock	0%
Boulder	0%
Cobble	0%
Coarse Gravel	0%
Fine Gravel	5%
Sand	90%
Silt and smaller	5%

Silt/Clay Present?	Yes
Detritus	5 %
# Large Woody	20

2.13 Average Largest Particle on

Bed	N/A
Bar	N/A

2.14 Stream Type

Stream Type:	C
Bed Material:	Sand
Subclass Slope:	None
Bed Form:	Plane Bed

Field Measured Slope:

2.15 Reference Stream Type
 (if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	<u>Left</u>	<u>Right</u>
Upper		
Material Type	Silt	Silt
Consistency	Cohesive	Cohesive
Lower		
Material Type	Clay	Silt
Consistency	Cohesive	Cohesive
Bank Erosion	<u>Left</u>	<u>Right</u>
Erosion Length (ft)	0	0
Erosion Height (ft)	0.00	0.00
Revetmt. Type	None	None
Revetmt. Length (ft)	0	0
Near Bank Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Herbaceous	Herbaceous
Sub-dominant	Deciduous Shrubs/Saplin	
Bank Canopy	<u>Left</u>	<u>Right</u>
Canopy %	26-50	1-25
Mid-Channel Canopy		Open
3.2 Riparian Buffer		
Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	>100	>100
Sub-dominant	None	None
W less than 25	0	0
Buffer Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Mixed Trees	Herbaceous
Sub-dominant	Herbaceous Shrubs/Saplin	
3.3 Riparian Corridor		
Corridor Land	<u>Left</u>	<u>Right</u>
Dominant	Forest Shrubs/Saplin	
Sub-dominant	None	None
Mass Failures	0	0
Height	0	0
Gullies	0	0
Height	0	0

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps	Minimal		
4.2 Adjacent Wetlands	Abundant		
4.3 Flow Status	High		
4.4 # of Debris Jams	0		
4.5 Flow Regulation Type	None		
Flow Regulation Use			
Impoundments	None		
Impoundmt. Location			
4.6 Up/Down strm flow reg (old) Upstrm Flow Reg	None		
4.7 StormwaterInputs			
Field Ditch	0	Road Ditch	0
Other	0	Tile Drain	0
Overland Flow	0	Urb Strm Wtr Pipe	0
4.9 # of Beaver Dams	0		
Affected Length (ft)	0		

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	0	0
Diagonal	Delta	Island
0	0	0

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal

	No
5.5 Straightening	None
Straightening Length:	0

5.5 Dredging **None**

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: **Hoosic**
 Stream: **Hoosic River**
 Organization: **Bennington County RPC**
 Segment Length (ft): **1,500**

Phase 2 Segment Summary
 Reach # **M04**
 Observers: **Jill Winton, Jason George, Jeremy**
 Segment Location: **Riverine impounded segment upstream of dam impoundment**

page 2 of 2
 Segment: **A**

January 15, 2009
 Completion Date: **September 25,**
 Rain: **Yes**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Unconfined**

	Score	STD	Historic
7.1 Channel Degradation	12	None	Yes
7.2 Channel Aggradation	5	None	No
7.3 Widening Channel	15		No
7.4 Change in Planform	15		No

Total Score **47**

Geomorphic Rating **0.5875**

Channel Evolution Model **F**

Channel Evolution Stage **IV**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **Low**

	Score
6.1 Epifaunal Substrate - Available Cover	5
6.2 Pool Substrate	11
6.3 Pool Variability	11
6.4 Sediment Deposition	16
6.5 Channel Flow Status	16
6.6 Channel Alteration	17
6.7 Channel Sinuosity	6
6.8 Bank Stability	Left: 8 Right: 7
6.9 Bank Vegetation Protection	Left: 9 Right: 8
6.10 Riparian Vegetation Zone Width	Left: 10 Right: 9

Total Score 133

Habitat Rating 0.665

Habitat Stream Condition **Good**

Narrative:

This segment has experienced significant historic aggradation due to sediment settling out above the dam downstream in reach M03. It is essentially a featureless plane bed with little evidence of adjustment, except for the ongoing aggradation.

Project: **Hoosic**
 Stream: **Hoosic River**
 Organization: **Bennington County RPC**
 Segment Length (ft): **7,802**

Phase 2 Segment Summary page 1 of 2
 Reach # **M04** Segment: **B**
 Observers: **Jill Winton, Jason George,** Why Not assessed:
 Segment Location: **Between impoundment and Mack Plant**

January 15, 2009 SGAT Version: 4.56
 Completion Date: **September 25, 2008**
 Rain: **Yes**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms	0	0
height	0	0
Roads	0	0
height	0	0
Railroads	4,425	0
height	15	0
Improved Paths	0	0
height	0	0
Development	1,403	0

1.4 Adjacent Side Left Right

Hillside Slope **Very Steep** **Very Steep**

Continuous w/ **Sometimes** **Never**

W/in 1 Bankfill **Sometimes** **Never**

Texture **Mixed** **Mixed**

1.5 Valley Features

Valley Width (ft) **1,284**

Width Determination **Estimated**

Confinement Type **Broad**

Rock Gorge? **No**

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width **136**

2.2 Max Depth (ft) **9.43**

2.3 Mean Depth (ft) **5.79**

2.4 Floodprone Width (ft) **802**

Notes:
 Reach M04 flows from the Mack plant on river right downstream to the impoundment above Pownal Dam. The lower 1500-foot section of the reach is somewhat impounded by the dam, so was broken out into a separate segment (M04-A). M04-B is the

Provisional Step 2. (Contued)

2.5 Aband. Floodpln **11.60** ft.

Human Elev Floodpln **0.00** ft.

2.6 Width/Depth Ratio **23.49**

2.7 Entrenchment Ratio **5.90**

2.8 Incision Ratio **1.23**

Human Elevated Inc Rat **0.00**

2.9 Sinuosity **Moderate**

2.10 Riffles Type **Sedimented**

2.11 Riffle/Step Spacing (ft) **1,344**

2.12 Substrate Composition

Bedrock	0%
Boulder	1%
Cobble	33%
Coarse Gravel	45%
Fine Gravel	1%
Sand	20%
Silt and smaller	0%

Silt/Clay Present? **No**

Detritus **2 %**

Large Woody **125**

2.13 Average Largest Particle on

Bed	7.0	inches
Bar	6.0	inches

2.14 Stream Type

Stream Type: **C**

Bed Material: **Gravel**

Subclass Slope: **None**

Bed Form: **Riffle-Pool**

Field Measured Slope:

2.15 Reference Stream Type (if different from Phase 1)

3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture Left Right

Upper

Material Type **Silt** **Silt**

Consistency **Cohesive** **Cohesive**

Lower

Material Type **Silt** **Silt**

Consistency **Cohesive** **Cohesive**

Bank Erosion Left Right

Erosion Length (ft) **732** **203**

Erosion Height (ft) **4.70** **6.00**

Revetmt. Type **Rip-Rap** **Rip-Rap**

Revetmt. Length (ft) **35** **464**

Near Bank Veg. Type Left Right

Dominant **Invasives** **Deciduous**

Sub-dominant **Deciduous Shrubs/Saplin**

Bank Canopy Left Right

Canopy % **26-50** **51-75**

Mid-Channel Canopy **Open**

3.2 Riparian Buffer

Buffer Width Left Right

Dominant **>100** **26-50**

Sub-dominant **26-50** **>100**

W less than 25 **164** **1,119**

Buffer Veg. Type Left Right

Dominant **Deciduous** **Deciduous**

Sub-dominant **Herbaceous Shrubs/Saplin**

3.3 Riparian Corridor

Corridor Land Left Right

Dominant **Forest** **Crop**

Sub-dominant **Crop** **Industrial**

Mass Failures **0** **0**

Height **0** **0**

Gullies **0** **0**

Height **0** **0**

Step 4. Flow & Flow Modifiers

4.1 Springs / Seeps **Abundant**

4.2 Adjacent Wetlands **Minimal**

4.3 Flow Status **High**

4.4 # of Debris Jams **0**

4.5 Flow Regulation Type **None**

Flow Regulation Use

Impoundments **None**

Impoundmt. Location

4.6 Up/Down strm flow reg **None**

(old) Upstrm Flow Reg

4.7 StormwaterInputs

Field Ditch	0	Road Ditch	0
Other	0	Tile Drain	0
Overland Flow	0	Urb Strm Wtr Pipe	0

4.9 # of Beaver Dams **0**

Affected Length (ft) **0**

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
0	3	2
Diagonal	Delta	Island
2	0	1

5.2 Other Features Braiding

Flood	Neck Cutoff	Avulsion	
4	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal **No**

5.5 Straightening **Straightening**

Straightening Length: **983**

5.5 Dredging **None**

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: **Hoosic**
 Stream: **Hoosic River**
 Organization: **Bennington County RPC**
 Segment Length (ft): **7,802**

Phase 2 Segment Summary
 Reach # **M04**
 Observers: **Jill Winton, Jason George, Jeremy**
 Segment Location: **Between impoundment and Mack Plant**

page 2 of 2
 Segment: **B**
 Completion Date: **September 25,**
 Rain: **Yes**

January 15, 2009

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Unconfined**

	Score	STD	Historic
7.1 Channel Degradation	11	None	Yes
7.2 Channel Aggradation	14	None	No
7.3 Widening Channel	13		Yes
7.4 Change in Planform	13		No

Total Score **51**

Geomorphic Rating **0.6375**

Channel Evolution Model **F**

Channel Evolution Stage **IV**

Geomorphic Condition **Fair**

Stream Sensitivity **Very High**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	14
6.2 Embeddedness	12
6.3 Velocity/Depth Patterns	19
6.4 Sediment Deposition	9
6.5 Channel Flow Status	16
6.6 Channel Alteration	15
6.7 Frequency of Riffles/Steps	15
6.8 Bank Stability	Left: 6 Right: 7
6.9 Bank Vegetation Protection	Left: 7 Right: 8
6.10 Riparian Vegetation Zone Width	Left: 7 Right: 5

Total Score 140

Habitat Rating 0.7

Habitat Stream Condition **Good**

Narrative:

This reach has experienced historic degradation and is now narrowing to form a new floodplain through aggradation and development of bar features. Planform is also adjusting, as evidenced by several transverse bars/riffles, floodchutes, and erosion.

Project: **Hoosic**
 Stream: **Hoosic River**
 Organization: **Bennington County RPC**
 Segment Length (ft): **11,062**

Phase 2 Segment Summary page 1 of 2
 Reach # **M05** Segment: **0**
 Observers: **Jill Winton, Jason George,** Why Not assessed:
 Segment Location: **From Mack Plant through racetrack**

January 15, 2009 SGAT Version: 4.56
 Completion Date: **September 25, 2008**
 Rain: **Yes**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation **None**

1.2 Alluvial Fan **None**

1.3 Corridor Encroachments

Length (ft)	One	Both
Berms height	0	0
Roads height	842	2,678
Railroads height	241	0
Improved Paths height	1,200	0
Development	7,382	1,627

1.4 Adjacent Side Left Right

Hillside Slope **Very Steep** **Very Steep**

Continuous w/ **Sometimes** **Never**

W/in 1 Bankfill **Sometimes** **Sometimes**

Texture **Mixed** **Mixed**

1.5 Valley Features

Valley Width (ft) **1,257**

Width Determination **Estimated**

Confinement Type **Broad**

Rock Gorge? **No**

Human-caused Change? **Yes**

Step 2. Stream Channel

2.1 Bankfull Width **127**

2.2 Max Depth (ft) **7.88**

2.3 Mean Depth (ft) **6.12**

2.4 Floodprone Width (ft) **475**

Notes:
 Reach M05 begins near the upstream extent of the racetrack property and flows downstream to just above the Mack plant on river right. It generally flows near or at the left edge of its naturally very broad valley, which has been artificially confined by a railroad,

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	13.39	ft.
Human Elev Floodpln	0.00	ft.
2.6 Width/Depth Ratio	20.75	
2.7 Entrenchment Ratio	3.74	
2.8 Incision Ratio	1.70	
Human Elevated Inc Rat	0.00	
2.9 Sinuosity	Low	
2.10 Riffles Type	Sedimented	
2.11 Riffle/Step Spacing (ft)	1,000	
2.12 Substrate Composition		
Bedrock	0%	
Boulder	3%	
Cobble	60%	
Coarse Gravel	19%	
Fine Gravel	4%	
Sand	14%	
Silt and smaller	0%	
Silt/Clay Present?	No	
Detritus	5 %	
# Large Woody	33	
2.13 Average Largest Particle on		
Bed	18.0	inches
Bar	12.0	inches
2.14 Stream Type		
Stream Type:	C	
Bed Material:	Cobble	
Subclass Slope:	None	
Bed Form:	Riffle-Pool	
Field Measured Slope:		
2.15 Reference Stream Type		
(if different from Phase 1)		
3.3 old	Amount	Mean Height
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks

Typical Bank Slope **Steep**

Bank Texture Left Right

Upper

Material Type **Silt** **Silt**

Consistency **Cohesive** **Cohesive**

Lower

Material Type **Boulder/Cobbl** **Boulder/Cobbl**

Consistency **Non-cohesive** **Non-cohesive**

Bank Erosion Left Right

Erosion Length (ft) **0** **289**

Erosion Height (ft) **0.00** **12.00**

Revetmt. Type **Rip-Rap** **Rip-Rap**

Revetmt. Length (ft) **1,229** **55**

Near Bank Veg. Type Left Right

Dominant **Deciduous** **Herbaceous**

Sub-dominant **Herbaceous** **Deciduous**

Bank Canopy Left Right

Canopy % **51-75** **26-50**

Mid-Channel Canopy **Open**

3.2 Riparian Buffer

Buffer Width Left Right

Dominant **>100** **26-50**

Sub-dominant **26-50** **>100**

W less than 25 **397** **0**

Buffer Veg. Type Left Right

Dominant **Mixed Trees** **Herbaceous**

Sub-dominant **Shrubs/Saplin** **Deciduous**

3.3 Riparian Corridor

Corridor Land Left Right

Dominant **Forest** **Commercial**

Sub-dominant **Crop** **Residential**

Mass Failures **0** **0**

Height **0** **0**

Gullies **0** **0**

Height **0** **0**

Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types

Mid	Point	Side
1	2	2
Diagonal	Delta	Island
1	0	1

5.2 Other Features

Flood	Neck Cutoff	Avulsion	Braiding
0	0	0	0

5.3 Steep Riffles and Head Cuts

Steep Riffles	Head Cuts	Trib Rejuv.
0	0	No

5.4 Stream Ford or Animal **No**

5.5 Straightening **Straightening**

Straightening Length: **7,353**

5.5 Dredging **None**

Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.

Project: **Hoosic**
 Stream: **Hoosic River**
 Organization: **Bennington County RPC**
 Segment Length (ft): **11,062**

Phase 2 Segment Summary page 2 of 2
 Reach # **M05** Segment: **0**
 Observers: **Jill Winton, Jason George, Jeremy**
 Segment Location: **From Mack Plant through racetrack**

January 15, 2009
 Completion Date: **September 25,**
 Rain: **Yes**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Unconfined**

	Score	STD	Historic
7.1 Channel Degradation	9	None	Yes
7.2 Channel Aggradation	13	None	No
7.3 Widening Channel	14		Yes
7.4 Change in Planform	14		No

Total Score **50**

Geomorphic Rating **0.625**

Channel Evolution Model **F**

Channel Evolution Stage **IV**

Geomorphic Condition **Fair**

Stream Sensitivity **High**

4.8 Channel Constrictions

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
Bridge	178. Problem	Yes	Yes	No	Yes

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	15
6.2 Embeddedness	15
6.3 Velocity/Depth Patterns	18
6.4 Sediment Deposition	15
6.5 Channel Flow Status	16
6.6 Channel Alteration	14
6.7 Frequency of Riffles/Steps	16
6.8 Bank Stability	Left: 8 Right: 8
6.9 Bank Vegetation Protection	Left: 7 Right: 6
6.10 Riparian Vegetation Zone Width	Left: 6 Right: 3

Total Score **147**

Habitat Rating **0.735**

Habitat Stream Condition **Good**

Narrative:

This reach appears to be approaching relative stability near the end of Stage IV. The channel is still incised, but has developed new bar features through aggradation. Little erosion was observed, mostly concentrated around the bridge & development.

Project: **Hoosic**
 Stream: **Hoosic River**
 Organization: **Bennington County RPC**
 Segment Length (ft): **5,571**

Phase 2 Segment Summary page 1 of 2
 Reach # **M06** Segment: **0**
 Observers: **Jill Winton, Jason George,** Why Not assessed:
 Segment Location: **Between racetrack & MA border**

January 15, 2009 SGAT Version: 4.56
 Completion Date: **September 25, 2008**
 Rain: **Yes**

QC Status - Staff: Provisional Cons

Step 1. Valley and Floodplain

1.1 Segmentation	None	
1.2 Alluvial Fan	None	
1.3 Corridor Encroachments		
	<u>Length (ft)</u>	<u>One</u> <u>Both</u>
Berms	0	0
height	0	0
Roads	2,702	0
height	15	0
Railroads	3,743	0
height	15	0
Improved Paths	506	0
height	15	0
Development	1,621	0
1.4 Adjacent Side	<u>Left</u>	<u>Right</u>
Hillside Slope	Very Steep	Steep
Continuous w/	Sometimes	Never
W/in 1 Bankfill	Sometimes	Sometimes
Texture	Mixed	Mixed
1.5 Valley Features		
Valley Width (ft)	890	
Width Determination	Estimated	
Confinement Type	Broad	
Rock Gorge?	No	
Human-caused Change?	Yes	
Step 2. Stream Channel		
2.1 Bankfull Width	134	
2.2 Max Depth (ft)	7.39	
2.3 Mean Depth (ft)	5.68	
2.4 Floodprone Width (ft)	172	

Notes:
 Reach M06 starts at the Massachusetts border and flows downstream approximately to the southern end of the racetrack access road. It's valley is naturally very broad but is artificially confined by a railroad and Route 7 in the right corridor. About halfway through

Provisional Step 2. (Contued)

2.5 Aband. Floodpln	16.85	ft.
Human Elev Floodpln	0.00	ft.
2.6 Width/Depth Ratio	23.59	
2.7 Entrenchment Ratio	1.28	
2.8 Incision Ratio	2.28	
Human Elevated Inc Rat	0.00	
2.9 Sinuosity	Moderate	
2.10 Riffles Type	Eroded	
2.11 Riffle/Step Spacing (ft)	1,060	
2.12 Substrate Composition		
Bedrock	0%	
Boulder	1%	
Cobble	67%	
Coarse Gravel	10%	
Fine Gravel	14%	
Sand	8%	
Silt and smaller	0%	
Silt/Clay Present?	No	
Detritus	3 %	
# Large Woody	29	
2.13 Average Largest Particle on		
Bed	12.0	inches
Bar	7.0	inches
2.14 Stream Type		
Stream Type:	F	
Bed Material:	Cobble	
Subclass Slope:	None	
Bed Form:	Riffle-Pool	
Field Measured Slope:		
2.15 Reference Stream Type		
(if different from Phase 1)		
3.3 old	<u>Amount</u>	<u>Mean Height</u>
Failures	None	0.00
Gullies	None	0.00

Step 3. Riparian Features

3.1 Stream Banks		
Typical Bank Slope	Steep	
Bank Texture	<u>Left</u>	<u>Right</u>
Upper		
Material Type	Silt	Silt
Consistency	Cohesive	Cohesive
Lower		
Material Type	Boulder/Cobbl	Boulder/Cobbl
Consistency	Non-cohesive	Non-cohesive
Bank Erosion	<u>Left</u>	<u>Right</u>
Erosion Length (ft)	761	719
Erosion Height (ft)	28.42	9.45
Revetmt. Type	None	Rip-Rap
Revetmt. Length (ft)	0	911
Near Bank Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Shrubs/Saplin	Shrubs/Saplin
Sub-dominant	Herbaceous	Herbaceous
Bank Canopy	<u>Left</u>	<u>Right</u>
Canopy %	51-75	51-75
Mid-Channel Canopy		Open
3.2 Riparian Buffer		
Buffer Width	<u>Left</u>	<u>Right</u>
Dominant	>100	>100
Sub-dominant	0-25	26-50
W less than 25	707	0
Buffer Veg. Type	<u>Left</u>	<u>Right</u>
Dominant	Deciduous	Deciduous
Sub-dominant	Herbaceous	Shrubs/Saplin
3.3 Riparian Corridor		
Corridor Land	<u>Left</u>	<u>Right</u>
Dominant	Forest	Forest
Sub-dominant	Crop	Commercial
Mass Failures	0	0
Height	0	0
Gullies	0	0
Height	0	0

Step 4. Flow & Flow Modifiers

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

Step 5. Channel Bed and Planform Changes

5.1 Bar Types			
	<u>Mid</u>	<u>Point</u>	<u>Side</u>
	0	2	3
	<u>Diagonal</u>	<u>Delta</u>	<u>Island</u>
	1	0	1
5.2 Other Features			<u>Braiding</u>
Flood	2	<u>Neck Cutoff</u>	0
		<u>Avulsion</u>	0
5.3 Steep Riffles and Head Cuts			
Steep Riffles	0	<u>Head Cuts</u>	<u>Trib Rejuv.</u>
		0	No
5.4 Stream Ford or Animal			No
5.5 Straightening			Straightening
Straightening Length:			1,216
5.5 Dredging			None
Note: Step 1.6 - Grade Controls and Step 4.8 - Channel Constrictions are on The second page of this report - with Steps 6 through 7.			

Project: **Hoosic**
 Stream: **Hoosic River**
 Organization: **Bennington County RPC**
 Segment Length (ft): **5,571**

Phase 2 Segment Summary page 2 of 2
 Reach # **M06** Segment: **0**
 Observers: **Jill Winton, Jason George, Jeremy**
 Segment Location: **Between racetrack & MA border**

January 15, 2009
 Completion Date: **September 25,**
 Rain: **Yes**

1.6 Grade Controls **None**

Type	Location	Total	Total Height Above Water	Photo Taken	GPSTaken
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4.8 Channel Constrictions **None**

Type	Width	Photo Taken?	GPS Taken?	Channel Constriction?	Floodprone Constriction?
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Step 7. Rapid Geomorphic Assessment Data

Confinement Type **Unconfined**

	Score	STD	Historic
7.1 Channel Degradation	5	C to F	Yes
7.2 Channel Aggradation	14	None	No
7.3 Widening Channel	10		No
7.4 Change in Planform	12		No

Total Score **41**

Geomorphic Rating **0.5125**

Channel Evolution Model **F**

Channel Evolution Stage **III**

Geomorphic Condition **Fair**

Stream Sensitivity **Extreme**

Step 6. Rapid Habitat Assessment Data

Stream Gradient Type **High**

	Score
6.1 Epifaunal Substrate - Available Cover	14
6.2 Embeddedness	15
6.3 Velocity/Depth Patterns	18
6.4 Sediment Deposition	11
6.5 Channel Flow Status	16
6.6 Channel Alteration	15
6.7 Frequency of Riffles/Steps	16
6.8 Bank Stability	Left: 5 Right: 6
6.9 Bank Vegetation Protection	Left: 6 Right: 8
6.10 Riparian Vegetation Zone Width	Left: 5 Right: 6

Total Score **141**

Habitat Rating **0.705**

Habitat Stream Condition **Good**

Narrative:

This reach has experienced historic degradation and floodplain build-up (particularly on the right), leading to an STD from C to F. It is still entrenched, attempting to widen & migrate laterally as evidenced by bank erosion & flood chutes.