Phase 2 Stream Geomorphic Assessment
Huntington River Watershed
Town of Huntington
Chittenden County, Vermont

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EXECUTIVE SUMMARY

- Arrowwood Environmental was retained by the Huntington Conservation Commission (CCC) and the National Wildlife Federation to conduct a Phase 2 Stream Geomorphic Assessment of 10 reaches of the Huntington River.

- The Phase 2 study focused on stream reaches on the main stem of the Huntington River, primarily within the town of Huntington, from the Huntington/Richmond town line downstream to Hanksville upstream.

- Protocols outlined in the Agency of Natural Resources, Stream Geomorphic Assessment, Phase 2 Handbook (Vermont Agency of Natural Resources 2004) were employed. The Phase 2 data were entered into the most current version of the Phase 2 database.

- ArcView shapefiles were constructed from the mapped field data for major parameters such as: bank erosion, grade control structures, bank revetments, beaver dams, debris jams, and depositional features.

- The Phase 1 geomorphic condition is compared to the Phase 2 geomorphic condition in this report. The Phase 1 geomorphic condition ranged from fair to good for the 10 reaches assessed under the Phase 2 Assessment. Of the 14 assessed stream segments under Phase 2, twelve were rated fair. Two segments were rated good.

- The Phase 2 Rapid Geomorphic Assessment (RGA) was used to evaluate the stage of channel evolution as part of the Schumm Evolution model. Of the 14 segments assessed, six segments were found to be in stage 2, five segments were in stage 3, and three segments were in stage 4. During stage 2, rivers exhibit loss of floodplain access and riffle erosion. Segments undergoing Stage 3 channel adjustment processes typically exhibit significant bank failure and sedimentation of riffles. The Phase 2 assessment confirmed bank erosion is present within much of the mainstem. Stream segments at Stage 4 evolution continue to exhibit some channel adjustment. Channel width begins to narrow through aggradation and the development of point bars. Erosion may be extreme in this stage.

- The Rapid Habitat Assessment (RHA) rating was generally the same as the RGA rating. Twelve of 14 segments resulted in a rating of fair for both the RHA and the RGA.

- Most of the assessed Phase 2 segments appear to be C channels. This channel type is depicted with riffles and pools, found typically in unconfined valleys, noted for its meandering nature, and uses floodplains to dissipate energy during flood events. Thus, protecting the river corridor to allow for meandering and floodplain access, buffer protection, and streamside plantings should be a high priority for restoration planning and design work.

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1.0 INTRODUCTION

A Phase 1 stream geomorphic assessment was completed in the summer of 2005 by Arrowwood Environmental. The Phase 1 report identified priority reaches for the Phase 2 assessment. The fieldwork for the Phase 2 assessment was conducted by Dori Barton of Arrowwood Environmental and Kari Dolan of the National Wildlife Federation. The assessment was completed in the fall of 2005.

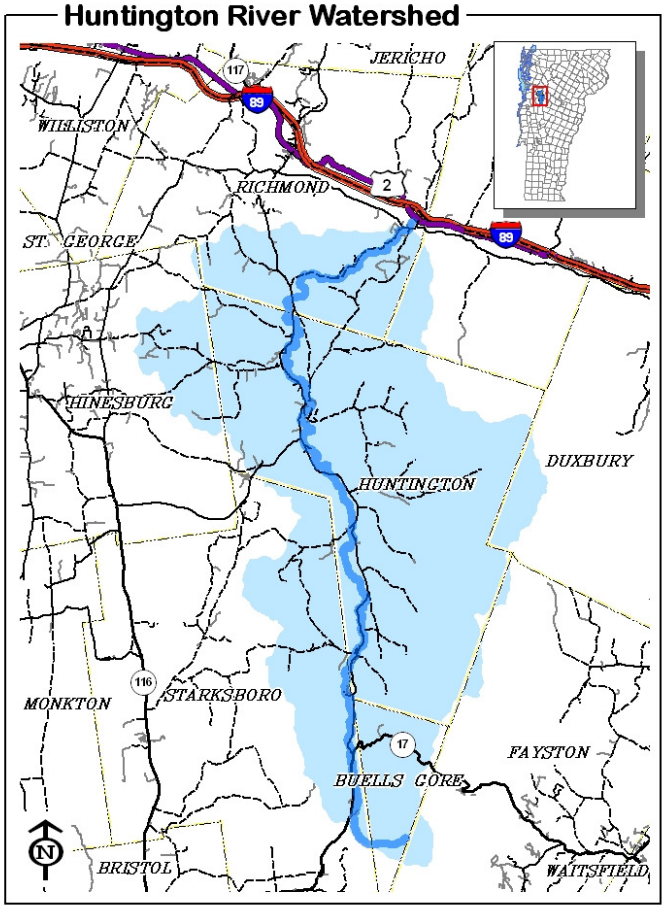

Figure 1: Watershed Location Map

The Huntington River Watershed has a watershed size of 66 square miles. The main stem of the Huntington River flows northerly for approximately 21 miles, from its headwaters in Camels Hump State Forest in Buels Gore and Starksboro, to its confluence with the Winooski River in Jonesville. The watershed drains land found in the town boundaries of Buels Gore, Duxbury, Fayston, Starksboro, Huntington, Richmond, Bolton and Hinesburg.

The Phase 2 study focused on stream reaches on the main stem of the Huntington River within the Town of Huntington, from the Richmond/Huntington town line downstream to Hanksville upstream (Reaches M06 through M15). The combined length of the stream reaches assessed is approximately 8 miles. Watershed and reach location maps are included for reference.

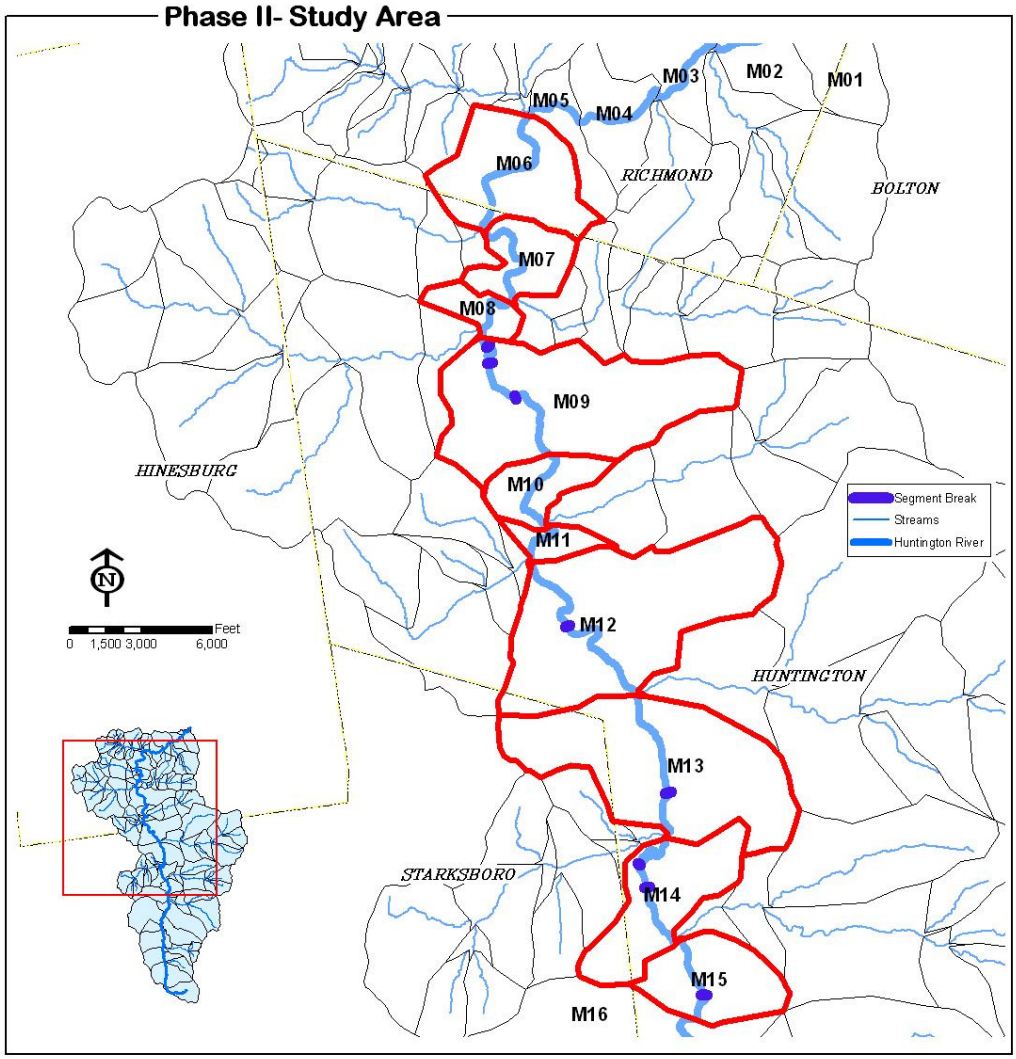

Figure 2. Reach Location Map

2.0 METHODOLOGY

The Phase 2 assessment followed procedures specified in the Vermont Stream Geomorphic Assessment Handbook Phase 2 (Vermont Agency of Natural Resources 2004). All assessment data were recorded on the Agency of Natural Resources (ANR) Phase 2 data sheets, and were entered in to the most current version (version 4) of the ANR Phase 1 _2 database. The Phase 1 database was updated using the field data from the Phase 2 assessment.

2.1 Field Protocols

The ANR's Phase 2 stream geomorphic assessment protocol includes seven steps. These steps are as follows:

1. Valley and River Corridor
2. Stream Channel
3. Riparian Banks, Buffers and Corridor
4. Flow Modifiers
5. Channel, Bed and Planform Changes
6. Rapid Habitat Assessment (RHA)
7. Rapid Geomorphic Assessment (RGA)

The parameters and protocols used for undertaking each of the above steps are outlined in the Phase 2 Handbook (ANR 2004). The length of each Phase 2 reach was walked to determine segment breaks. Bank erosion, grade control structures, bank revetments, beaver dams, debris jams, depositional features, and other important features were mapped within all segments. Phase 2 field sheets were not completed for some segments because landowner permission was denied to access the property.

2.2 QA Review

The Phase 2 – Quality Assurance Worksheet was completed by Arrowwood Environmental to document the tools used to collect the Phase 2 data, the confidence level in the data, the date the assessment was completed, and the date each Phase 2 step was checked by the local QA team. The QA worksheets are included in Appendix B, pages 3-12. The RGA QC report from the Microsoft Access Phase 2 database is provided in table form in Appendix B, pages 1-2. The Microsoft Access Phase 2 database and field forms were submitted to the ANR for a QA review in December 2005. Photos were taken at each study cross-section and problem areas. A photo log is included as Appendix C. Photos are digitally provided on the attached CD.

2.3 Reach Locations

As described in the Phase 1 Final Report (Arrowwood Environmental and National Wildlife Federation, dated December 16, 2005), the stream reaches M06 through M15 were recommended for inclusion in the Phase 2 study. These reaches were identified as unconfined, riffle-pool systems in the Phase 1 study, with the exception of M14, which was identified as braided. The reach condition from the Phase 1 study for the proposed Phase 2 Assessment reaches range from fair to good, as shown below in Table 1.

Table 1. Reaches Recommended for Inclusion in the Phase 2 Assessment

Reach No.	Channel Length (Miles)	Confinement Type	Channel Slope	Stream Type/ Bed form	Reach Condition	Reach Sensitivity
M06	1.3	VB	0.85	C3/Riffle-pool	Fair	High
M07	1.0	VB	0.12	C4/Riffle-pool	Good	Moderate
M08	0.5	BD	0.50	C3/Riffle-pool	Good	Moderate
M09	1.3	VB	0.34	C3/Riffle-pool	Fair	Moderate
M10	0.8	VB	0.46	C3/Riffle-pool	Good	Moderate
M11	0.5	VB	0.31	C3/ Riffle-pool	Good	Moderate
M12	1.8	VB	0.60	C3/Riffle-pool	Fair	Moderate
M13	1.3	VB	0.62	C3/Riffle-pool	Fair	Moderate
M14	1.3	VB	0.27	D3/ Braided	Good	Extreme
M15	0.7	VB	1.44	C3/Riffle-pool	Good	Moderate

3.0 BANKFULL DISCHARGE – CHANNEL DIMENSIONS

Measurements of channel dimensions were made using a depth rod, a measuring tape, a hand-held tape ruler, and a hand level. We measured channel dimensions at cross over (riffle) locations, and conducted at least one cross-section per stream segment. The cross section data was entered in the Vermont Agency of Natural Resources, Phase 2 Stream Geomorphic Assessment Database. The stream geometry data are summarized on page 2 of Appendix A.

The cross-sectional area calculated from the field measurements was compared to the Vermont Regional Hydraulic Geometry Curves (Vermont Water Quality Division, 2001) and presented in Table 2 below. Of the 14 segment locations, twelve of the cross sections had a cross-sectional area within 75 percent of the value predicted from the regional curves. Of those 12 cross-sections, five had cross sectional areas which essentially matched the regional curves, and two of the cross sections were approximately 55 percent of the predicted value. This inconsistency in bankfull cross-sectional area is likely attributed to the difficulty in finding reliable bankfull indicators due to the considerable amount of bank erosion and rock revetment noted in almost all the segments.

Table 2. Comparison of Measured and Predicted Bankfull Cross-sectional Area

Segment Number	Measured Bankfull Cross-sectional Area (Sq. Feet)	Predicted Bankfull Cross-sectional Area (Sq. Feet)	Percentage of Predicted Value
M06	190	251	76
M07	255	242	105
M08	230	239	96
M09-A	233	218	107
M09-C	226	218	104
M09-D	179	218	82
M10	223	212	105
M11	235	201	117
M12-B	266	194	137
M13-A	178	151	118
M13-B	173	151	115
M14-A	192	132	145
M14-B	147	132	112
M15-B	129	111	117

Predicted value form Vermont Regional Hydraulic Geometry Curves (2001)

Table 3 summarizes entrenchment ratio, width/depth ratio, sinuosity, sediment storage types and stream types for the study reaches.

Table 3: Stream Type					
Segment ID	**Entrenchment Ratio**	**Width/Depth Ratio**	**Sinuosity**	**Sediment Storage Types**	**Stream Type**
M06	4.4	30.4	Moderate	Mid channel, point, side, and diagonal bars	C4
M07	3.3	32.5	Moderate	Mid channel, point, side and diagonal bars	C4
M08	3.7	39.9	Moderate	Mid channel, point, side, and diagonal bars	C4
M09-A	4.6	40.4	Low	Side bars	C4
M9-C	1.8	22.1	Low	Side bars	B4
M9-D	4.0	17.5	Low	Side bars	C4
M10	2.3	26.5	Moderate	Side bars	C4
M11	3.8	21.6	High	Mid channel, and point bars	C4
M12-B	5.8	29.5	Low	Point and side bars	C4
M13-A	2.2	33.4	Low	Mid channel, side, and diagonal bars	C4
M13-B	4.9	14.8	Low	Side bars	C4
M14-A	3.6	47.8	High	Mid channel, point, side and diagonal bars	D4
M14-B	5.9	25.6	High	Point and side bars	C4
M15-B	1.7	26.7	Low	Single bars	B3

4.0 PHASE 2 RESULTS BY REACH

The results of the Phase 2 study are summarized below by reach number, and individual reach summary reports from the Phase 2 database are included on pages 4-39 of Appendix A.

4.1 Reaches

Reach M06

Reach M06 is on the Richmond/Huntington border, near the Mayo Road/Huntington Road intersection. Reach M06 is a riffle-pool system, dominated by gravels. This segment was classified as a C4 channel based on the channel cross section and the pebble count. The confinement is very broad. Sediment storage bars are extensive, including mid channel, point, side, diagonal, delta, and point bars, as well as islands. The incision ratio was calculated to be 1.6, suggesting the river has only fair access to the floodplain within this segment.

Erosion was prevalent in this section. Hay fields and pasture were noted to be the dominant land use within the riparian corridor. The buffer is narrow on the right bank (<25 feet in width) and

has herbaceous vegetation as the dominant vegetation type. Invasive plant species are present on both banks.

The stream channel is located close to the valley wall in the lower section of the reach. This location of the stream in relation to the valley wall, in addition to evidence of historic channel straightening and armoring, provides evidence that the channel was altered.

Figure 3: Rock revetment and lack of buffer at Reach M06's left bank

Evidence of a stabilization project was found on the lower section of the reach. A tree revetment was located on the right bank, a rock revetment on the left bank, log weirs, also on the left bank, and livestock fencing. It did not appear that the log vanes were functioning as designed, partly due to the angle of the weir, its angle of departure from the bank, and placement in relation to planform. The stream could also have migrated, since the left bank is unstable.

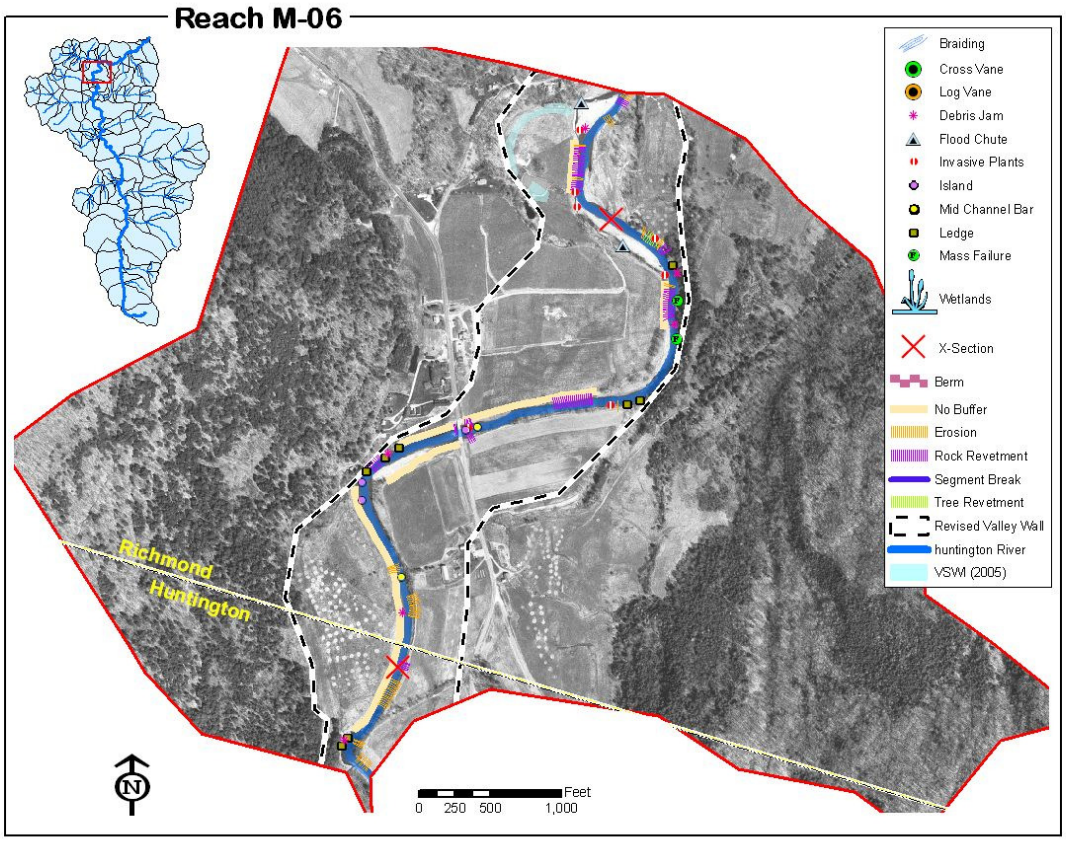

Figure 4. Reach M06 Inventory Map

Reach M07

The downstream portion of Reach M07 is at the Audubon Center. Reach M07 is classified as having a broad valley, due to the influence of Main Road on the valley width. Based on the cross-section and pebble count data, this segment is a Rosgen C4 channel. The incision ratio was calculated to be 1.6, suggesting the river has only fair access to the floodplain within this segment.

Segment M07 has some erosion on both banks. Forest and hay fields were observed as the primary land uses within the riparian corridor. The buffer width is fair (greater than 26 feet) and consists of mixed trees. Invasives, particularly honey suckle, are extensive. Sediment storage bars include mid, point, side, diagonal, and delta bars and an island. The river in this reach also appears to have been relocated against the right valley wall and straightened in some locations.

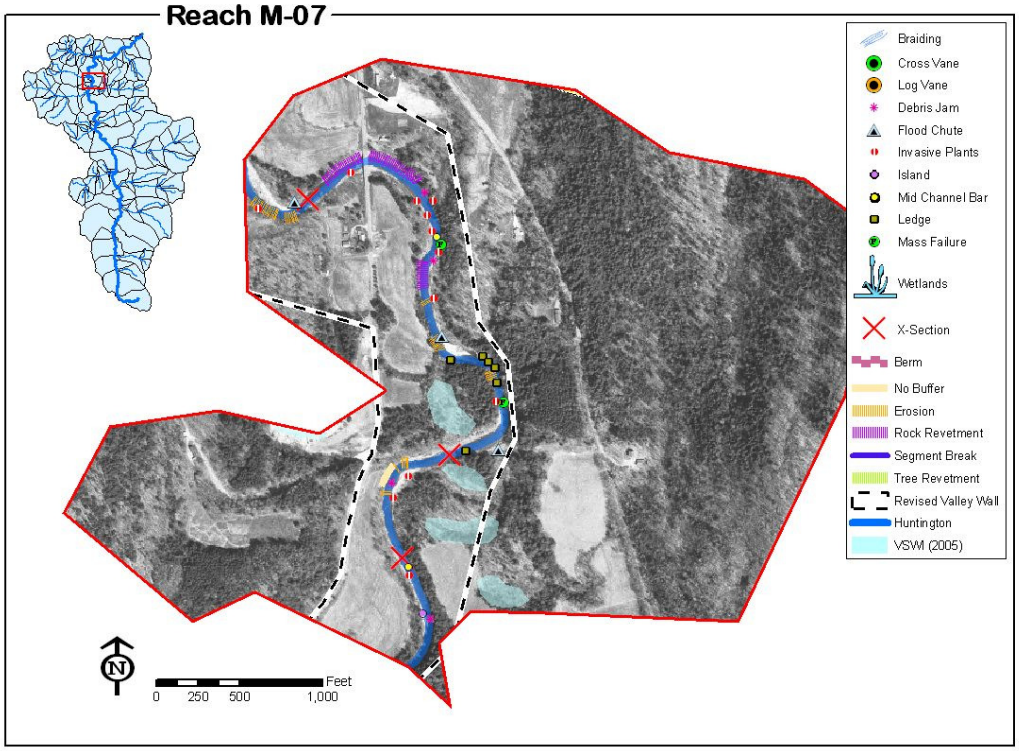

Figure 5. Reach M07 Inventory Map

Reach M08

Reach M08 includes the popular swimming hole Horseshoe Bend. Its upstream end is where Texas Brook meets the Huntington River. Reach M08 is classified with a broad valley, due to the influence of the Main Road. Development is also prevalent within the river corridor. The incision ratio of 1.3 suggests some access to flood plain. The cross section information indicates that this reach is a C4 stream type, depicted by riffles and pools.

This reach has also experienced significant historic channel straightening, with the stream relocated close to the valley wall. Bank erosion is found on both banks. The buffer width is less than 25 feet on the left bank, made up of primarily of mixed tree and herbaceous species. Invasive plants were found on both banks. Hay fields and residential development are the primary landuses in the riparian corridor. Sediment storage bars include mid, point, side, diagonal, and delta bars.

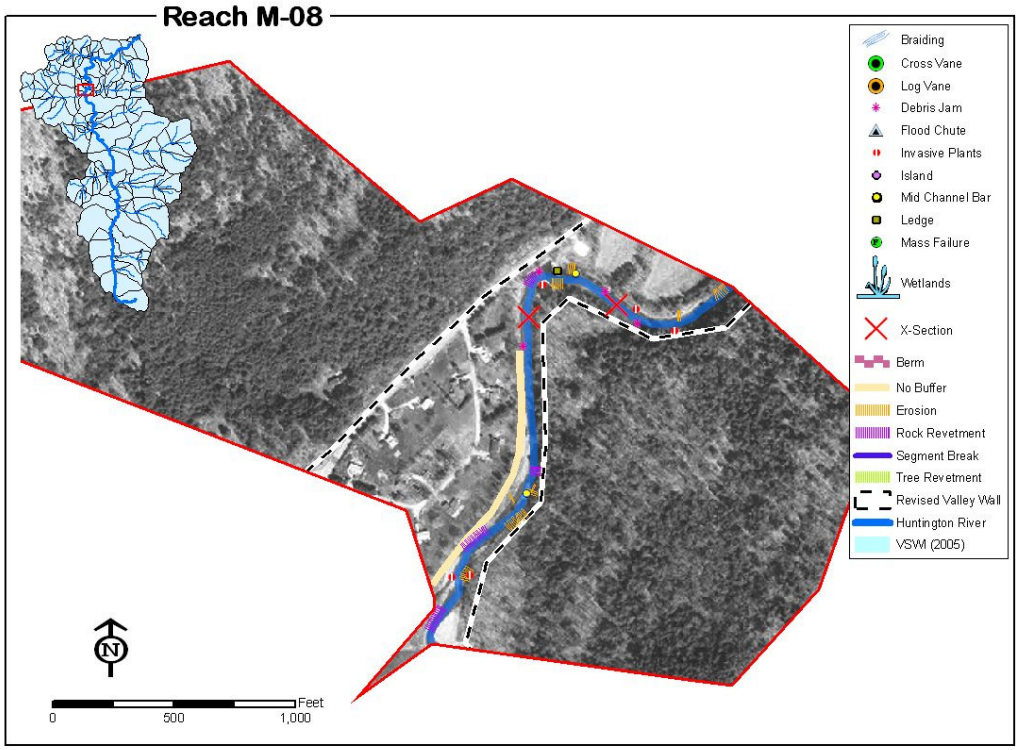

Figure 6. Reach M08 Inventory Map

Reach M09

Reach M09's upstream end is the Bridge Street Bridge. The gravel-dominated Reach M09 was segmented into four segments based on differences in stream type. Segment M09-A is classified as a Rosgen C-4 riffle-pool channel type. Segment M09-B was not assessed; however, cursory evaluation from walking the reach indicates that it is a braided stream segment. Segment M09-C's entrenched condition denotes a B-4 stream type, whereas Segment M09-D's entrenchment ratio of nearly 4.0 indicates a C-4 stream type.

This reach has experienced historic straightening, and has a low overall sinuosity.

Segment M09-A

Segment M09-A's confinement is broad, due to the influence of the road on the valley width. Its incision ratio of 1.2 suggests some access to floodplain. The segment is very wide, with a width-to-depth ratio of over 40. This reach has also experienced significant historic channel straightening and gravel extraction. Bank erosion is extensive on the left bank where the stream bends.

Figure 7. Left bank at a cross-section along Reach M09

The buffer width is poor, averaging less than 25 feet, vegetated primarily with deciduous and herbaceous species. Invasive plants were found on both banks. Sediment storage bars include side and diagonal bars. A flood chute and a steep riffle were noted.

Segment M09-B

Segment M09-B was not assessed. However, future assessments should include this stream segment. The segment is highly unstable. It is experiencing significant bank erosion and contains multiple channels, steep riffles, and numerous debris jams.

Segment M09-C

Segment M09-C's confinement is also influenced by the road, but the influence is not enough to change valley type. This reach's confinement remains very broad. This segment has an entrenchment ratio of 1.8, categorizing this reach as a B-4 stream type. The stream shows signs of being straightened.

The right bank riparian corridor is dominated by a hay field. The buffer width is less than 25 feet, and herbaceous and deciduous species are the primary vegetation types on both banks. Sediment storage consists of mid, point and side bars.

Segment M09-D

Segment M09-D's confinement is classified as broad due to the road's encroachment on the river corridor. This segment is only slightly entrenched, with an entrenchment ratio of almost 4.0. However, its incision ratio, measured at 1.2, implies some reduction in floodplain access. The sinuosity of this segment is low, showing evidence of historic straightening.

A hay field dominates the left riparian corridor, while forest and residential housing are present on the right corridor. The buffer is narrow on both banks (<25 feet in width) and has herbaceous vegetation as the dominant vegetation type. Sediment storage bars include point, side, diagonal, and delta bars. Multiple flood chutes and a steep riffle were noted.

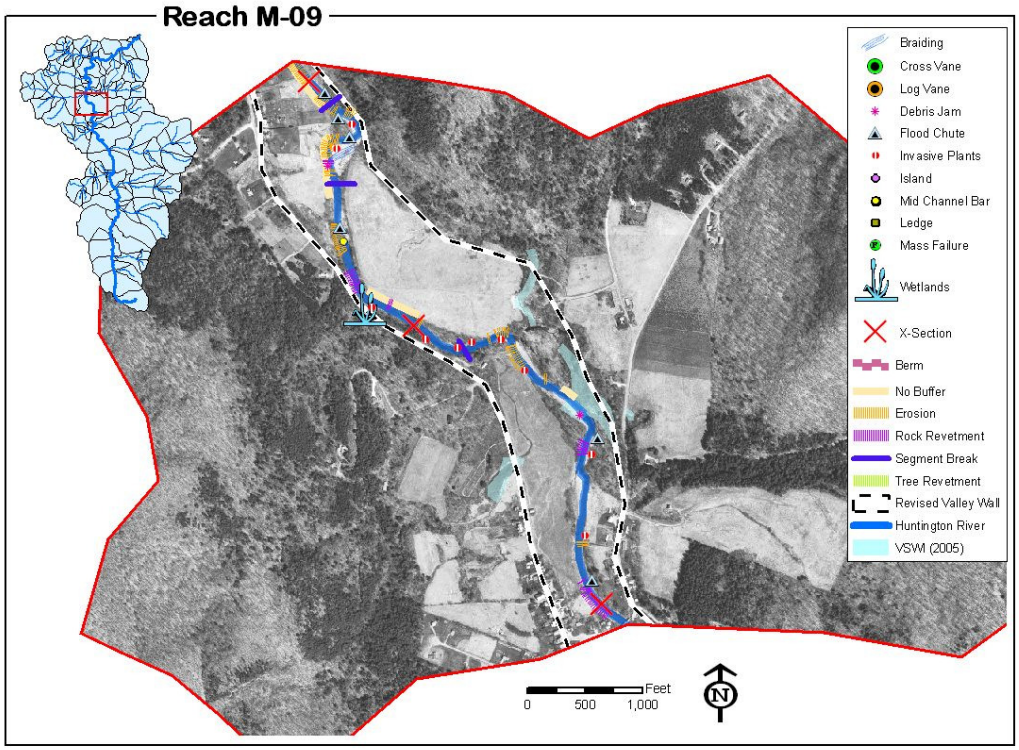

Figure 8. Reach M09 Inventory Map

Reach M10

Reach M10 is adjacent to Huntington Village and flows under the East Street Bridge. The upstream end of the reach is behind Liberty Head Post and Beam. Reach M10 is another riffle-pool system with gravel substrate and a very broad valley. The incision ratio is 1.5, showing limited access to floodplain. Sediment storage consists of multiple side bars, with a mid, point, delta bar and an island. Hay field and residential development are the primary land use on the right riparian corridor and forest was found on the left. The buffer is narrow on the right bank (<25 feet in width) with decidous and herbaceous species as the major vegetation type. Invasive plant species are present on both banks. The segment's planform indicates historic channel straightening. The width/depth ratio is high, and erosion was present on both banks, indicating that some widening is taking place.

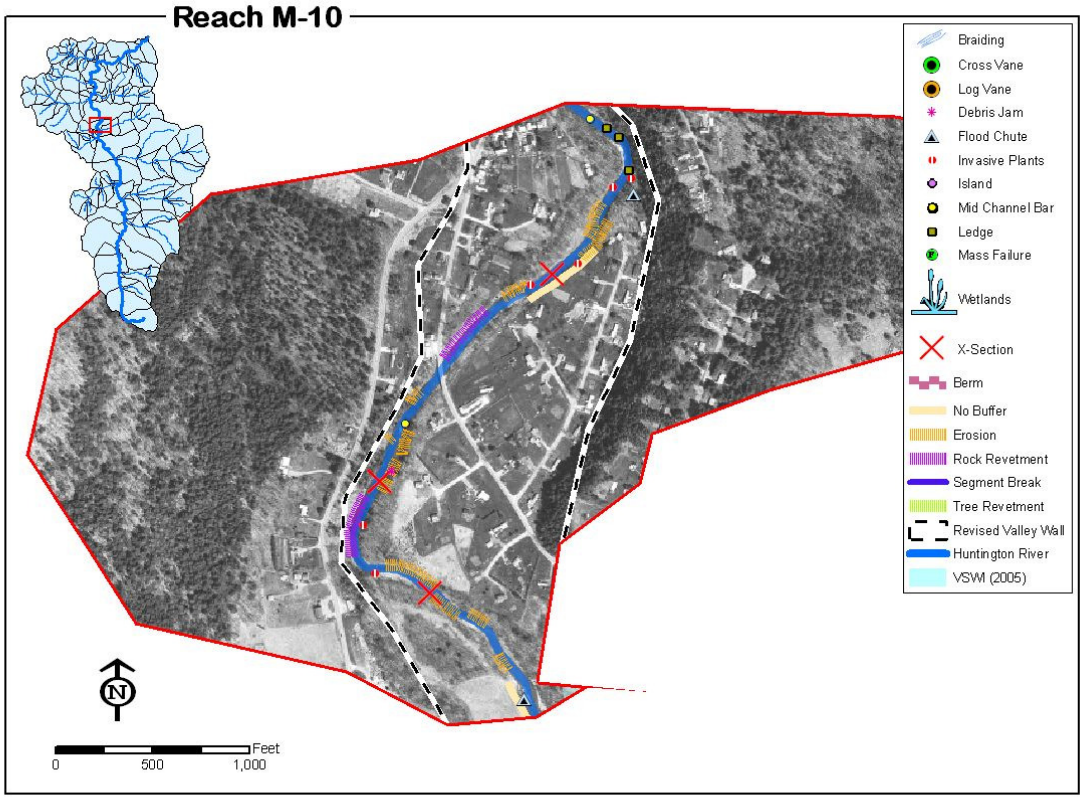

Figure 9. Reach M10 Inventory Map

Reach M11

Reach M11 is upstream (or south) of Huntington Village (upstream of Liberty Head Post and Beam), and downstream of the Spence Bridge. Reach M11 is a riffle-pool, gravel-dominated segment. Confinement was determined to be very broad. Sediment storage consists of mid, point, and side bars. A hay field is the dominate land use on the left corridor. The buffer is poor (<5 feet in width on the left bank and <25 feet on the right bank) with herbaceous species as the dominant vegetation type on both banks. Invasive plant species are present on both banks. Lack of vegetation is the likely cause of significant bank erosion on the left bank. The segment's planform indicates some historic channel straightening. The segment is experiencing aggradation.

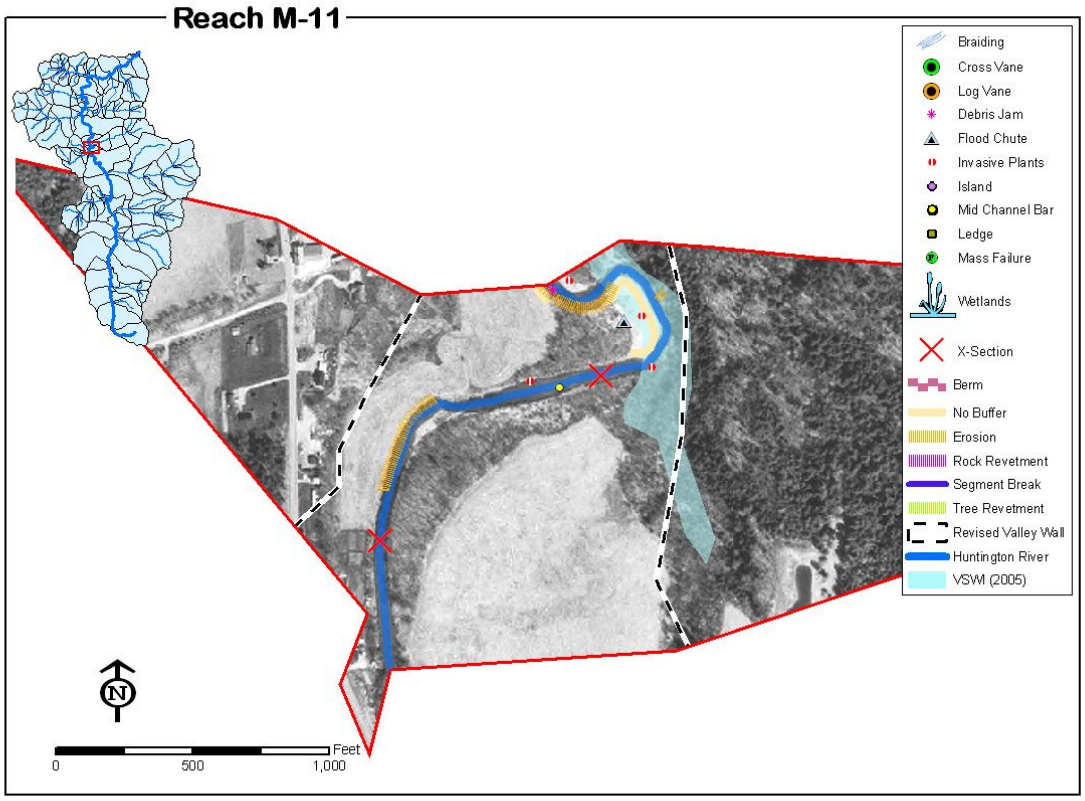

Figure 10. Reach M11 Inventory Map

Reach M12

Reach M12 is just north of Huntington Center. Its upstream end is Brushy Brook's confluence with the Huntington River. Reach M12 was segmented into two segments based on landowner access. Future study of Segment M12-A is recommended.

Segment M12-B

Segment M12-B is a Rosgen C-4 stream, denoted by a riffle-pool system with gravel substrate. The segment's confinement is broad, due to the influence of Main Road. This location of the stream in relation to the valley wall, its straightened condition, as described by its sinuosity, and history of gravel extraction provide evidence that the channel had been altered. A natural channel design restoration project was recently implemented in the downstream portion of this segment, which is intact.

Hay fields were observed on both banks, and the right bank also contains crop field. The buffer width is poor to fair, noting that the right bank has less than 25 feet of buffer. The buffer on both banks consists of deciduous and herbaceous species. Invasives are present on both banks. Sediment storage bars include multiple side bars, some point bars, and a mid channel bar.

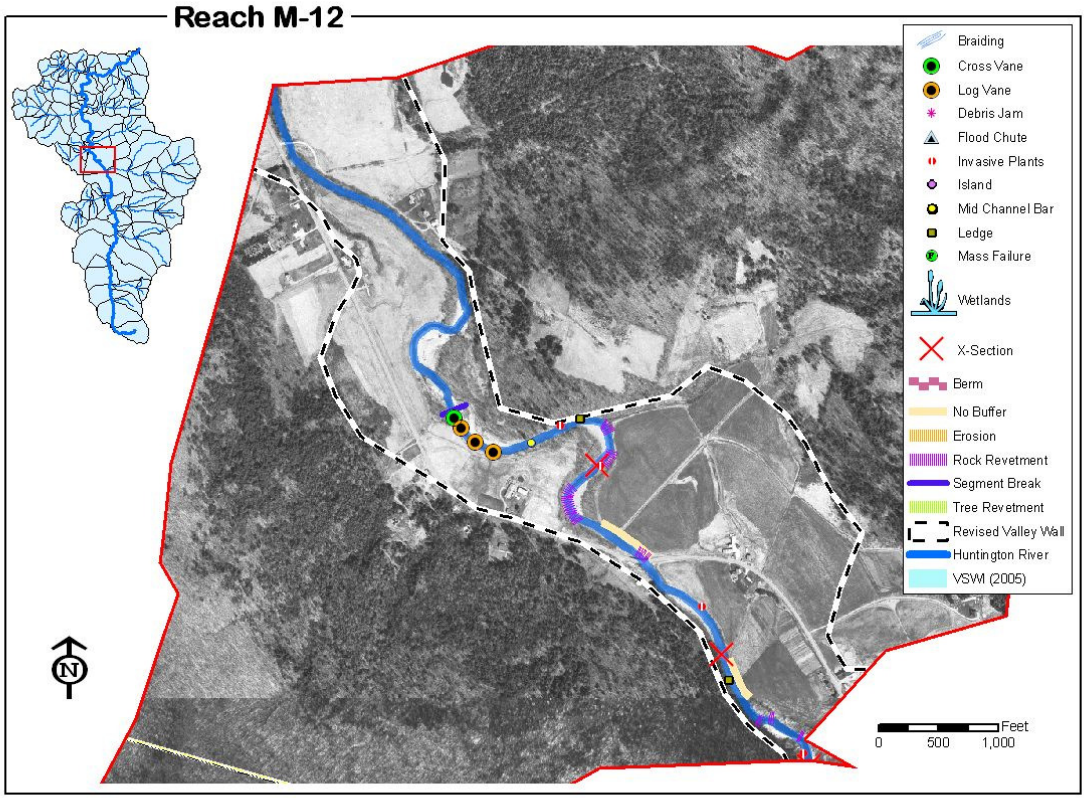

Figure 11. Reach M12 Inventory Map

Reach M13

Reach M13 flows through Huntington Center. Its downstream end is above the confluence of Brushy Brook. Its upstream end is south of the Shaker Mountain Road bridge crossing at a point where Carpenter Brook meets the Huntington River. Based on the cross-section and pebble count data, this reach is classified as a Rosgen C4 channel. It is a riffle-pool stream with gravel substrate and a very broad valley. This location of the stream in relation to the valley wall, evidence of historic channel straightening with a low sinuosity, and extensive armoring demonstrate that this channel reach was altered.

Segment M13-A

This segment is downstream of the Shaker Mountain Road bridge crossing and flows through Huntington Center. The incision ratio for this segment was calculated to be 1.4, suggesting the river has only fair access to the floodplain within this segment. Bank erosion is present on the right bank. Hay fields dominate the riparian corridor. The buffer contains a mix of trees and herbaceous species. The width of the buffer on the left bank – the valley wall – is in reference condition, however, the buffer width on the right bank is fair (<50 ft). Invasive plant species are present on both banks. Sediment storage bars include multiple mid, side and diagonal bars with steep riffles. The river segment is pushed against the left valley wall and straightened.

Segment M13-B

Reach M13-B is located upstream of the Shaker Mountain Road bridge crossing. The incision ratio for this segment is at 1.8, and has a greatly reduced width/depth ratio of 15, demonstrating greater channel incision and reduced floodplain access than Segment M13-A.

The riparian corridor is dominated by crop and hay on the left bank and residential development on the right. The buffer is poor (<25 feet), made up of predominately deciduous and herbaceous plant species. Sediment storage bars include multiple side bars and a delta bar.

Figure 12. Minimal buffer and sediment storage bars within Segment M13-B

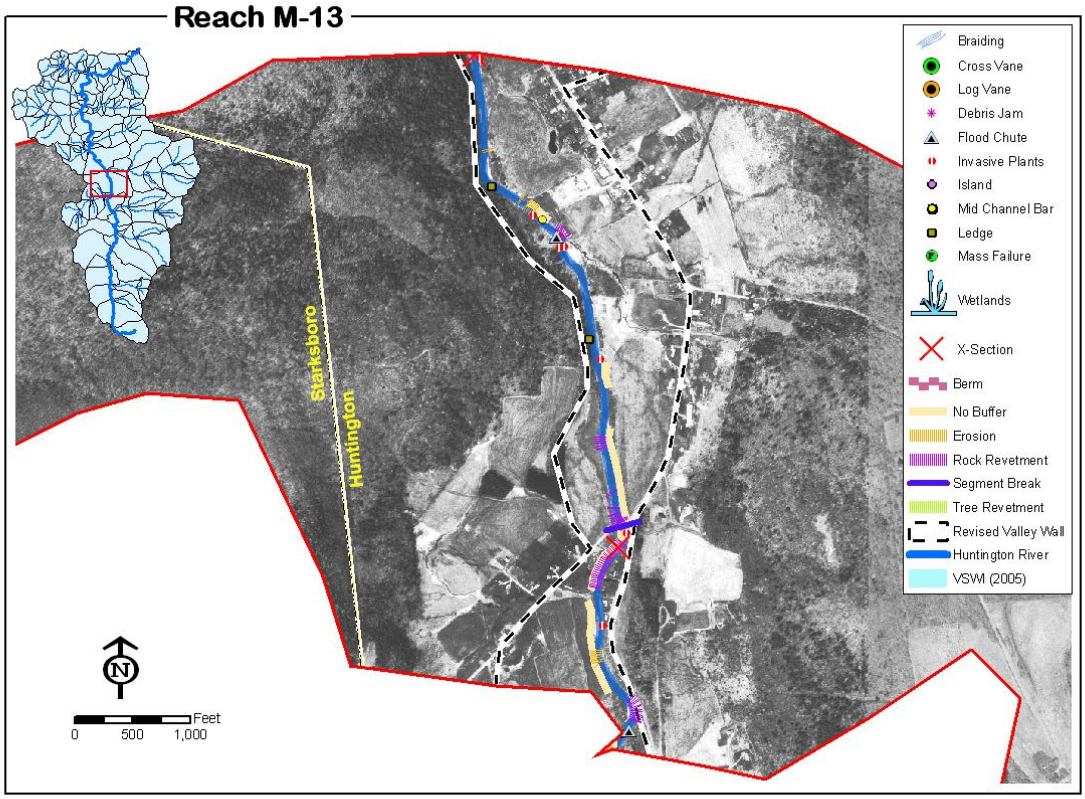

Figure 13. Reach M13 Inventory Map

Reach M14

Reach M14 is on the west side Main Road, south (or upstream) of Huntington Center. Its downstream end is just above the confluence with Carpenter Brook, and its upstream (southern) end is just downstream of Cobb Brook. The reach was segmented based on confinement, stream type, and access (pertaining to M14-C).

Segment M14-A

Segment M14-A's valley confinement is broad, due to the presence of a terrace. The cross-section data, pebble count data, and channel bed and planform changes indicate that this segment is a Rosgen D4 channel with gravel substrate. There are multiple flood chutes, channel avulsions, and some braiding.

Sediment storage bars include multiple mid, point, side bars, and islands. The riparian corridor is dominated by pasture on the left bank and cropland on the right. The buffer is made up of predominately deciduous plants on the left bank and herbaceous plant species on the right bank.

Segment M14-B

Segment M14-B's valley confinement is very broad. This segment is a Rosgen C-4 stream, denoted by a riffle-pool system with gravel substrate. The riparian corridor is dominated by crop on the right bank and forest on the left bank. The right bank buffer is poor (<25 feet), made up of predominately herbaceous plant species. A berm follows the right bank. Sediment storage bars include multiple point and side bars. The segment contains a large mass failure with an average height of 25 feet, located at a 90 degree bend of the river. It is apparent that the mass failure is caused by a combination of a berm, which forces flood flows to remain in the channel, and the highly straightened condition of M14-B and M14-C, just upstream.

Figure 14. Mass failure within Segment M14

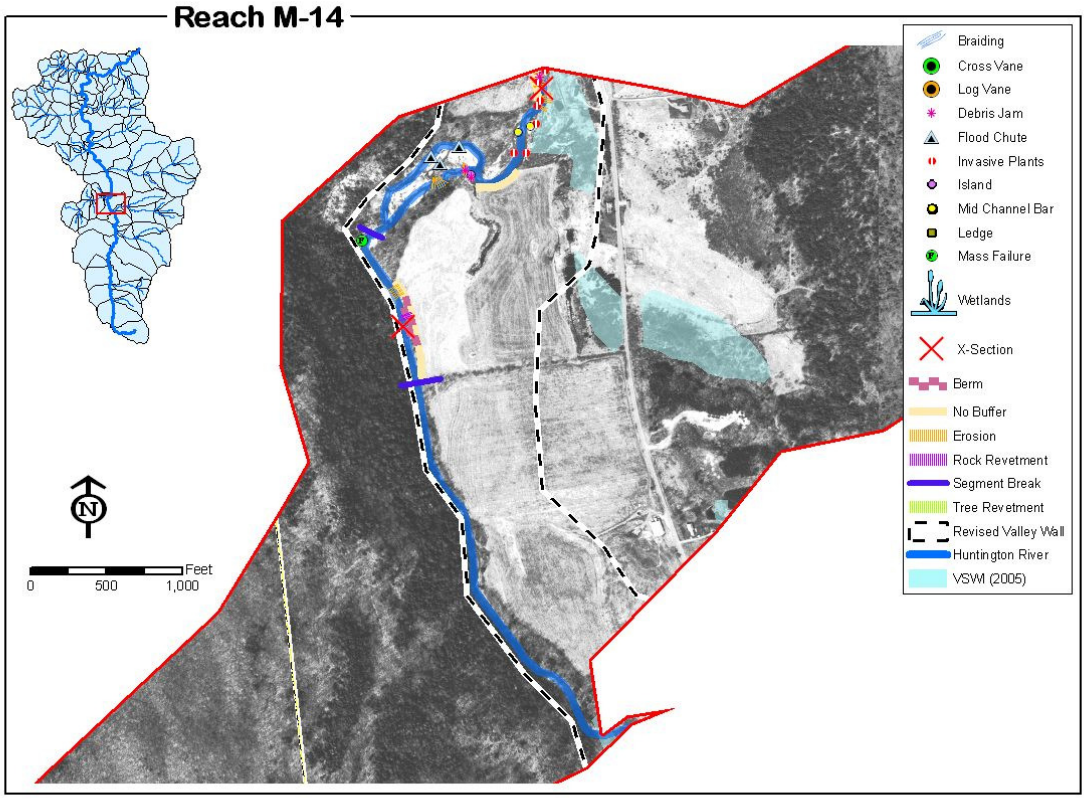

Figure 15. Reach M14 Inventory Map

Segment M15-B

Reach M15 is found upstream and downstream of the King Bridge, on the northern edge of the village of Huntington called Hanksville. The Reach was segmented based on access and stream type. A Phase 2 analysis of M15-A is recommended for future study.

Segment M15-B is a narrowly confined segment. Development also evident on the left side of the river corridor. The incision ratio of 1.6 and entrenchment ratio of 1.7 indicate that there is limited access to flood plain. The cross-section and pebble count information indicates that this reach is a B3 stream type, a riffle and pool stream with cobble bed material.

Rock revetments are found on both banks. The left bank's buffer width is poor (less than 25 feet), made up of primarily herbaceous and deciduous plant species. Invasive plants were found on the left bank. The left bank's riparian corridor consists primarily of forest and residential development; the right bank's corridor consists of pasture and forest. Sediment storage bars include a single mid, point, side, and delta bar and an island. There are also multiple flood chutes present.

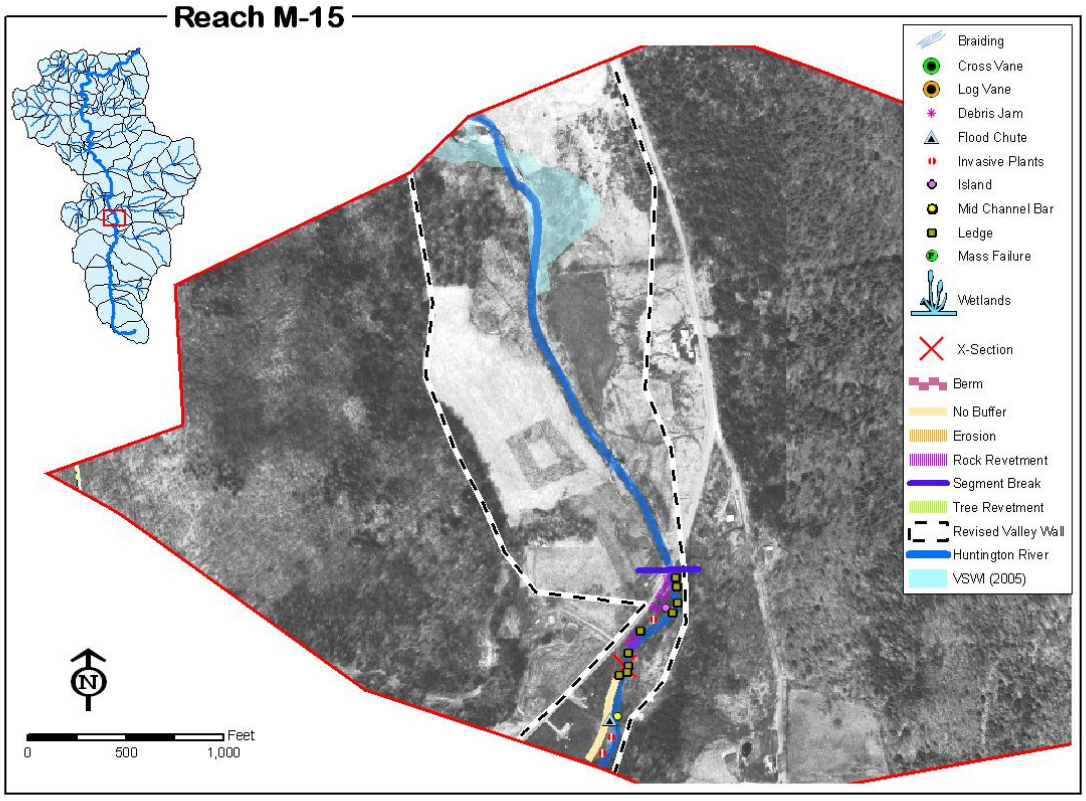

Figure 16. Reach M15 Inventory Map

5.0 RAPID GEOMORPHIC ASSESSMENT (RGA)

The Phase 1 and Phase 2 stream geomorphic assessment results are compared in Table 4 below, and are summarized on page 2 of Appendix A. The Phase 1 database predicted that most of the reaches along the mainstem, from reaches M06 to M15, are in good to fair condition. Based on the Phase 2 Rapid Geomorphic Assessment (RGA), all but segment M9-C were in fair condition. Some of the Phase 1 database results did not have significant differences in the adjustment process scores, reducing the level of confidence in which adjustment process was dominant. Based on the RGA, degradation, widening, and planform adjustment appear to be the primary adjustment processes for the mainstem reaches M-06 to M-15 on the Huntington River. These processes suggest that the river is incising, overwidening, and undergoing active lateral migration to rebuild the floodplain. The Phase 1 meander migration analysis confirms that lateral migration in reaches M06, M09, M12, M14, and M15 is occurring.

Table 4: Comparison of Phase 1 Data and Phase 2 (RGA) Stream Geomorphic Conditions								
Phase 1 Data						Phase 2 Data		
Reach/ Segment	**Total Impact**	**Confinement**	**Stream Type**	**Phase 1 Adjustment Process**	**Phase 1 Condition**	**Stream Type**	**Primary Phase 2 Adjustment Process**	**Phase 2 Condition**
M06	13	VB	C3	Degrading	Fair	C4	Incising	Fair
M07	7	VB	C4	Widening	Good	C4	Incising	Fair
M08	9	BD	C3	Widening	Good	C4	Incising	Fair
M09-A	14	VB	C3	Degrading/ Widening	Fair	C4	Planform/ Widening	Fair
M9-C	14	VB	C3	Degrading/ Widening	Fair	B4	Incising	Good
M9-D	14	VB	C3	Degrading/ Widening	Fair	C4	Planform	Fair
M10	15	VB	C3	Widening	Good	C4	Degrading/ Widening	Fair
M11	11	VB	C3	Degrading	Good	C4	Aggrading/ Planform	Fair
M12-B	12	VB	C3	Widening	Fair	C4	Aggrading/ Stable	Fair
M13-A	15	VB	C3	Widening	Fair	C4	Widening	Fair
M13-B	15	VB	C3	Widening	Fair	C4	Incising	Fair
M14-A	9	VB	D3	Degrading	Good	D4	Widening/ Planform	Fair
M14-B	9	VB	D3	Degrading	Good	C4	Widening	Fair
M15-B	11	VB	C3	Widening	Good	B3	Planform	Fair

Channel Evolution Model

The Phase 2 RGA was used to evaluate the stage of channel evolution. Schumm (1977 and 1984) has described five stages of channel evolution. These stages as described in the ANR Phase 2 manual (ANR 2004) are as follows:

I. Stable – in regime, reference to good condition. Insignificant to minimal adjustment; planform is moderate to highly sinuous.
II. Incision – Fair to poor condition, major to extreme channel degradation. High flow events are contained in the channel, and channel slope is typically increased.
III. Widening – Fair to poor condition, major to extreme widening and aggradation.
IV. Stabilizing – Fair to good condition, major reducing to minor aggradation, widening and planform adjustments
V. Stable – In regime, reference to good condition. Insignificant to minimal adjustment.

With respect to the Channel Evolution Model, the main stem of the Huntington River for reaches M06 to M15 generally appears to be at stage III in the channel evolution model (see page 3 of Appendix A). Many of the reaches show channel widening with depositional bar features developing. Bank erosion and placement of rock revetment to treat eroding banks are prevalent, especially at bends and along banks that lack adequate vegetated buffers. Many of the reaches experienced historic straightening, and thus, some of the reaches are undergoing active lateral adjustment. The presence of unvegetated mid-channel bars, point bars, and active flood chutes,

particularly in reaches M09, M11, M14, and M15, indicates lateral migration. Reaches M06, M07, M08, M10, and M13-B show some degree of incision taking place. Their incision ratios ranged from 1.3 to 1.8, demonstrating limited access to floodplain.

6.0 RAPID HABITAT ASSESSMENT (RHA)

The results of the Rapid Habitat Assessment (RHA) are provided on the reach summary sheets, pages 4-39 of Appendix B. Table 5 below shows a comparison of the habitat condition based on the RHA and the geomorphic condition based on the RGA. For twelve of the fourteen segments, both the RHA and the RGA resulted in ratings of fair.

Segment M9-C resulted in a rating of good for the RGA and fair for the RHA. The RHA scores were low due to channel alterations, bank instability, lack of bank vegetative protection and no riparian vegetative zone. The stream shows signs of being straightened. The right bank riparian corridor is dominated by a hay field. The buffer width is less than 25 feet, and herbaceous and deciduous species are the primary vegetation types on both banks. The RGA score was slightly higher than the RHA due to the lack of erosion on the banks.

Segment 15-B resulted in a rating of good for the RHA and a rating of fair for the RGA. The RGA scores were low due to historic channel straightening within this segment. The RHA was slightly higher due to the presence of vegetation on the banks and the riparian zone.

Table 5: Comparison of RHA and RGA for Phase 2 Reaches

Segment ID	Rating RHA	Rating RGA
M06	Fair	Fair
M07	Fair	Fair
M08	Fair	Fair
M09-A	Fair	Fair
M9-C	Fair	Good
M9-D	Fair	Fair
M10	Fair	Fair
M11	Fair	Fair
M12-B	Fair	Fair
M13-A	Fair	Fair
M13-B	Fair	Fair
M14-A	Fair	Fair
M14-B	Fair	Fair
M15-B	Good	Fair

7.0 RECOMMENDATIONS

Based on the Phase 2 Assessment performed during 2005, Arrowwood Environmental recommends the following:

1. Flag the water surface elevation during near bankfull events to confirm the bankfull depth.
2. Perform a Phase 2 assessment of the mainstem at reach segments M9C, M12A, M14C, and M15A which were inaccessible for this study.
3. Perform a Phase 2 assessment of the mainstem below reach M06 to determine if these reaches are undergoing adjustment. This would provide additional information for restoration design and planning.
4. The reference stream type for much of the mainstem of the Huntington River between M06 and M14 appears to be C stream channels with riffle-pool system. These C streams are generally unconfined, have moderate to gentle slopes, and well established floodplains. The channel generally has an undulating bed that defines a sequence of riffles, runs, pools, and bars. Pools are generally spaced every 5 to 7 channel widths. Riparian buffers provide many benefits. Some of these benefits include water quality protection, shade, root structure to prevent bank erosion, and fish and wildlife habitat. Healthy buffers also prevent the spread of invasive plant species. For these reasons restoring floodplains and vegetative buffers and protecting river corridors should be priorities in restoration planning and design work.
5. The Huntington Conservation Commission should work with willing landowners (such as the Audubon Center) to develop a river corridor protection strategy. This strategy could include stream restoration projects, buffer plantings, and a river corridor protection plan to reduce erosion hazards and minimize landuse conflicts. The plan can also be used to determine the width of a river corridor which is needed to accommodate the Huntington River's meander geometry under healthy conditions.
6. The Huntington Conservation Commission can support the development of this river corridor protection strategy by applying for funding from the Agency of Natural Resources.

8.0 REFERENCES

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