

**Phase I Stream Geomorphic Assessment
Huntington River Watershed
Town of Huntington
Chittenden, Addison, & Washington Counties, VT**

Prepared by:

Dori Barton
Principal/Wetlands Ecologist
Arrowwood Environmental

and

Kari Dolan
Restoration Manager
National Wildlife Federation

Prepared for:

Town of Huntington, and
Vermont Agency of Natural Resources

December 16, 2005



Northeastern Natural Resource Center
58 State Street
Montpelier VT 05602
802-229-0650
www.nwf.org



ARROWWOOD ENVIRONMENTAL

950 BERT WHITE ROAD
HUNTINGTON, VT 05462
(802) 434-7276 FAX: (802) 434-2102

**Phase I Stream Geomorphic
Assessment**

Huntington River Watershed, Town of Huntington Chittenden, Addison, & Washington Counties, Vermont

TABLE OF CONTENTS

1.0 INTRODUCTION	1
2.0 BACKGROUND	1
3.0 METHODOLOGY	3
3.1 PARAMETERS	4
3.2 QA REVIEW	4
4.0 RESULTS	5
4.1 REACH LOCATIONS	5
4.2 STREAM TYPING	7
4.3 BASIN GEOLOGY AND SOILS	9
4.4 LAND COVER – REACH HYDROLOGY	10
4.5 HISTORIC CHANNEL MODIFICATIONS	11
4.6 FLOODPLAIN MODIFICATIONS	15
4.7 BED AND BANK WINDSHIELD SURVEY.....	18
5.0 DATA ANALYSIS.....	18
5.1 IMPACT SCORES.....	18
5.2 ADJUSTMENT PROCESSES	22
5.3 REACH SENSITIVITY	22
6.0 RECOMMENDATIONS FOR PHASE 2	22
REFERENCES	24

Phase I Stream Geomorphic Assessment Huntington River Watershed, Town of Huntington Chittenden, Addison, & Washington Counties, Vermont

LIST OF APPENDICES

PROJECT METADATA	1
BACKGROUND INFORMATION	2
STEP 1. REACH LOCATIONS	3-7
STEP 2. PRELIMINARY REFERENCE STREAM TYPE	8-10
STEP 3. BASIN CHARACTERISTICS: GEOLOGY	11-13
STEP 3. BASIN CHARACTERISTICS: SOILS	14-16
STEP 4. LAND COVER REACH HYDROLOGY	17-19
STEP 4. RIPARIAN CONDITION SUMMARY	20-22
STEP 5. INSTREAM CHANNEL MODIFICATION	23-25
STEP 6. FLOODPLAIN MODIFICATION AND PLANFORM CHANGES	26-28
STEP 7. BED AND BANK WINDSHIELD SURVEY	29-31
STEP 7. CHANNELIZATION REPORT	32-34
STEP 8. STREAM AND WATERSHED IMPACT RATING	35-37
STEP 8. SUMMARY OF CATEGORICAL IMPACTS	38-40
STEP 9. ADJUSTMENT PROCESS AND REACH CONDITION	41-44

Phase I Stream Geomorphic Assessment Huntington River Watershed, Town of Huntington Chittenden, Addison, & Washington Counties, Vermont

EXECUTIVE SUMMARY

- A Phase I Stream Geomorphic Assessment of the Huntington River and major tributaries within the towns of Buels Gore, Duxbury, Fayston, Starksboro, Huntington, Richmond, Bolton and Hinesburg was completed by Arrowwood Environmental during the winter and spring of 2005. The study included the main stem of the Huntington River and major tributaries. The watershed was divided into 118 reaches based on confinement, slope, soils, and tributary influence.
- The study followed the Phase I assessment protocol developed by the Vermont Agency of Natural Resources. Information from the study came from the Vermont Department of Environmental Conservation, the Vermont Fish and Wildlife Department, the Vermont Mapping Program, the Vermont Center for Geographic Information, and the windshield survey.
- The dominant surficial geology of the Upper Winooski River consists of alluvium, glacial till, and ice contact deposits. The reaches are generally characterized as C channels with alluvium as the dominant geologic material. These soils are frequently flooded. However, they are only slight to moderately erodible. The majority of the A and B type channels have till and ice contact deposits as the dominant geologic materials. These soils are rarely flooded and have very severe erodibility.
- Of the four impact categories measured during the Phase I Assessment, Land Cover/Land Use was the primary category identified as being at risk of causing channel adjustments. Nineteen (19) percent of the reaches resulted in a watershed/land use impact rating of high, while fifty (50) percent of the reaches resulted in a river corridor land cover/land use impact rating of high. Eleven (11) percent of the reaches received a high impact rating for riparian corridor, due to over seventy-five (75) percent of the reach having little or no buffer on one or more banks.
- The meander migration, meander width ratio, and meander wavelength indicate undergoing channel adjustment. Nineteen of the unconfined reaches fell outside the range of expected meander width ratio, and 23 reaches fell outside of the range of expected meander wavelength ratio. Based on the review of current and historical orthophotos, meander migration was evident on the main stem of the Huntington River from reach M6 to M22 downstream. Migration, or movement of the channel by eroding its outer bank on meander bends, appeared to be the primary mechanism for lateral migration of the channel.

- The watershed condition generated from the Phase I database was generally similar to the reach condition based on professional judgment and observations during the Phase I windshield survey.
- Reaches in fair condition include the main stem reaches (M1, M5, M6, M9, M10, M13, M16, M17), and the tributaries of Texas Hill Brook, Fargo Brook, Hollow Brook, Johns Brook and Owls Head Brook. The majority of the unconfined stream reaches were in the fair category, while two confined stream reaches resulted in a reach condition of fair. Fifteen of the confined reaches were placed in the good category based on professional judgment and the output from the Phase I database. The stream reaches in good condition were generally located in the middle of the watershed (i.e. not in the headwaters and not near the lower end). Streams identified as reference are generally located in headwater areas that were not assessed.
- The evaluation team recommends that the main stem reaches, from M06 to M15, of the Huntington River be selected for the upcoming Phase 2 Assessment fieldwork.

Phase I Stream Geomorphic Assessment Huntington River Watershed, Town of Huntington Chittenden, Addison, & Washington Counties, Vermont

1.0 INTRODUCTION

Arrowwood Environmental was retained by the Huntington Conservation Commission (HCC) and the National Wildlife Federation to conduct a Phase I Stream Geomorphic Assessment of the Huntington River and Major Tributaries.¹ The assessment was conducted on the main stem of the Huntington River and the major tributaries of the Huntington River (Figure 1 and 1b). The primary objective of the study was to provide an overview of the general physical characteristics of the Huntington River watershed and determine which reaches may be in adjustment. A secondary objective of the study was to select reaches to be included in a Phase 2 Assessment. The Phase 2 Assessment would then be used to provide the Town of Huntington with information that can be used for watershed planning and restoration activities.

Data and information for the Huntington River Watershed within the Town of Huntington was obtained from the Vermont Department of Environmental Conservation (VDEC), the Vermont Fish and Wildlife Department (VF&W), the Vermont Center for Geographic Information (VCGI), and the Huntington Conservation Commission. Windshield surveys of the watershed were conducted on April 27th, May 5th and July 14th, 2005. A Project metadata summary is provided in the Appendix, page 1.

2.0 BACKGROUND

The Huntington River Watershed has a watershed size of 66 square miles. This Phase I study included stream reaches on the Huntington River located within the towns of Huntington, Richmond, Buels Gore, Duxbury, Fayston, Starksboro, Bolton and Hinesburg.

¹ Per the ANR protocols major tributaries constitute ten percent or more of the watershed area at the confluence with the main stem.

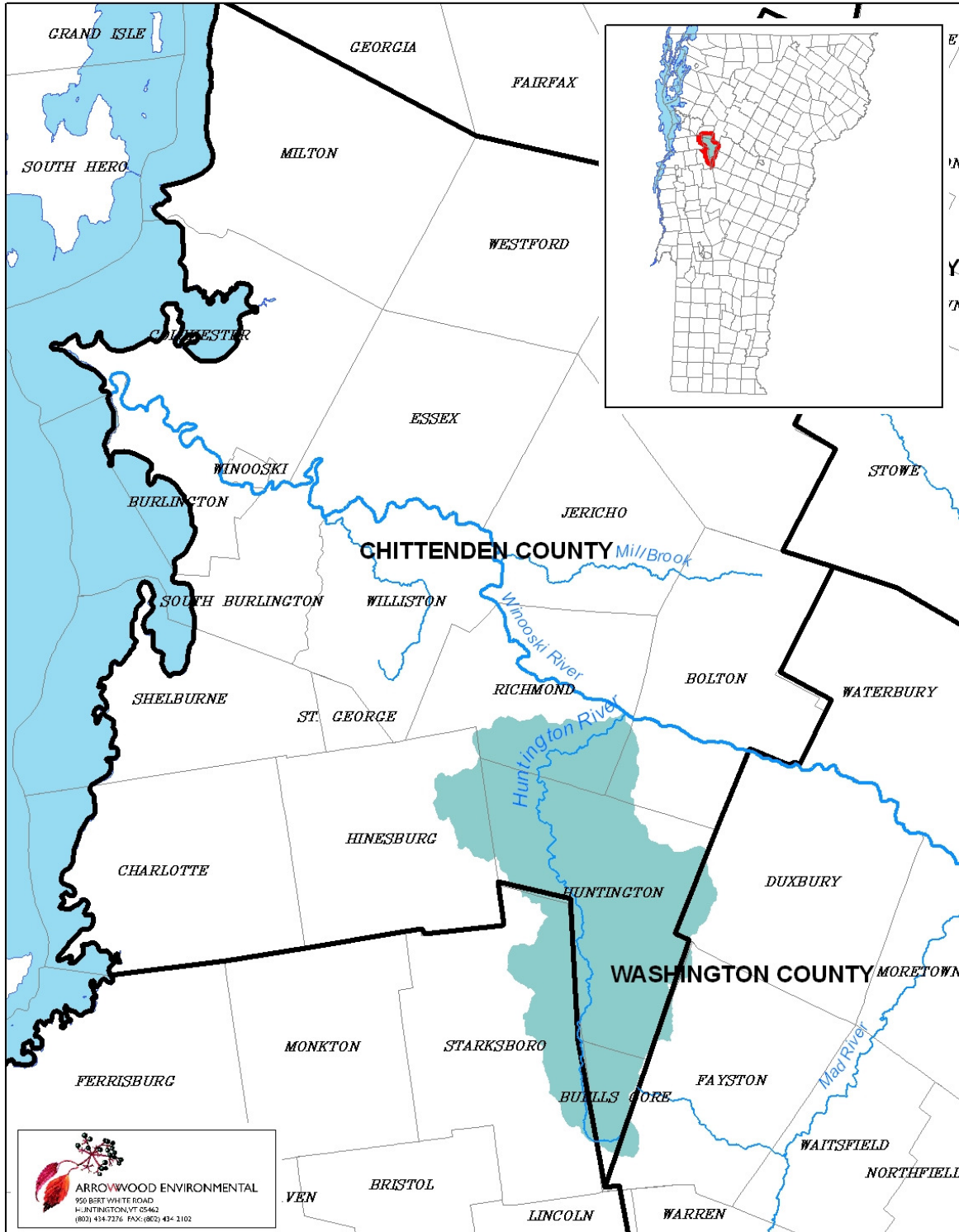


Figure 1. Project Location Map for the Phase I Assessment



Figure 1b. Huntington River Watershed

3.0 METHODOLOGY

The Phase I assessment followed procedures specified in the Vermont Stream Geomorphic Assessment Handbook Phase I (Vermont Agency of Natural Resources 2004), and used version 3.01 of the Stream Geomorphic Assessment Tool (SGAT) GIS extension. All assessment data were recorded on the Agency of Natural Resources (ANR) Phase I data sheets or in GIS database files, and were entered in to the most current version of the ANR Phase I database. Arrowwood Environmental also provided the reach and subwatershed delineations and ran SGAT.

3.1 Parameters

During the Phase I Assessment, each parameter in Table I was rated according to the following menu options (NS – not significant, low impact, high impact or No info –no information). A zero was scored for options NS and No info, a one for low impact and a two for high impact.

Step #	Parameter
4.1	Watershed Land Cover/ Land Use
4.2	Corridor Land Cover/ Land Use
4.3	Riparian Buffer Width
5.1	Flow Regulations and Water Withdrawals
5.2	Bridges and Culverts
5.3	Bank Armoring and Revetments
5.4	Channel Modifications
5.5	Dredging and Gravel Mining History
6.1	Berms and Roads
6.2	River Corridor Development
6.3	Depositional Features
6.4	Meander Migration / Channel Avulsion
6.5	Meander Width Ratio
6.6	Wavelength Ratio
7.2	Bank Erosion – Relative Magnitude
7.3	Ice and Debris Jam Potential

3.2

QA Review

Arrowwood Environmental completed the Phase I – Quality Assurance Worksheet to document: (a) the tools used to collect the Phase I data, (b) the confidence level in the data, (c) the date the assessment was completed, and (d) the date each Phase I step was

checked by the local and state QA teams (see page 2 of the Appendix). Arrowwood Environmental then rated the confidence level in the Phase I data from moderate to high. A few of the reaches could not be accessed due to poor accessibility or lack of landowner permission. For these reasons, the quality of the data was rated as moderate to high rather than high. In addition, some of the historic instream and floodplain modifications were not known.

The ArcView Shapefiles for the Huntington River Phase I study were submitted to Peter Spatz and Shayne Jacquith of the VTANR, River Management Division. SGAT generated data and database entries were made to the Online Geomorphic Assessment Database for a QA review from approximately November 2004 to May 2005. Some revisions to stream type classifications were made by ANR staff during the QA review.

4.0 RESULTS

4.1 Reach Locations

The Huntington River Watershed was divided into 118 reaches for the Phase I Assessment. Phase I– Step 1. Reach Locations Report on page(s) 3-7 of the Appendix provides the reach locations including reach description, town where the reach is located, and latitude and longitude generated from SGAT. Figure 2 shows the location of study reaches used in the Phase I Assessment. Each point represents the downstream end of the reach.

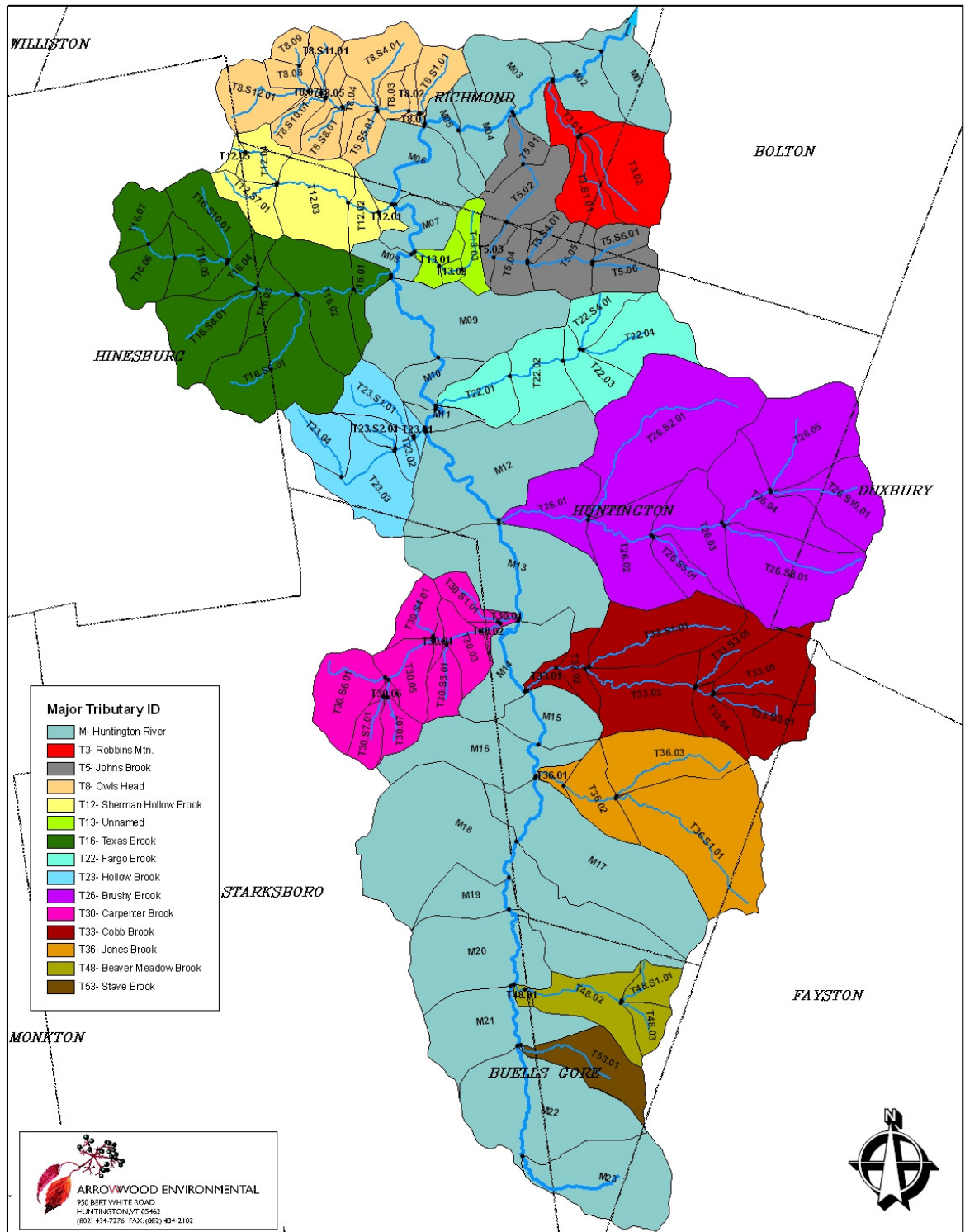


Figure 2. Reach Location Map for the Phase I Geomorphic Assessment

4.2 Stream Typing

Reference stream types are defined as stream channel forms and processes that would exist in the absence of human-related changes to the channel, floodplain, and/or watershed. Stream and valley characteristics including valley confinement, and slope determined through remote sensing were used to ascertain the stream type. The reference reach characteristics were later refined during the windshield survey. Reference reach typing was based on both the Rosgen (1996) and the Montgomery and Buffington (1996) classification systems.

Phase I-Step 2. Preliminary Reference Stream Type Report on page(s) 8-10 of the Appendix provides a complete listing of reference stream types for each reach within the project area. The reference stream types, based on the Phase I Geomorphic Assessment are shown in Figure 3. The majority of the stream reaches fall within the A stream type (see Table 2). A few of the reaches in the upper part of the watershed were not easily accessible and were not visited during the windshield survey. Best professional judgment was used to assign a bed form (eg. step-pool, plane bed) to these reaches that were not visited during the windshield survey.

Stream Type	Channel Slope	Bed Material	Percentage by channel length of Assessed Reaches
A/ Cascade	Very steep	Boulder	50%
B/Step-pool	Steep	Cobble	8%
B/ Plane Bed	Moderate to Steep	Cobble-gravel	4%
C/Riffle-pool	Moderate to gentle	Gravel or finer	17%

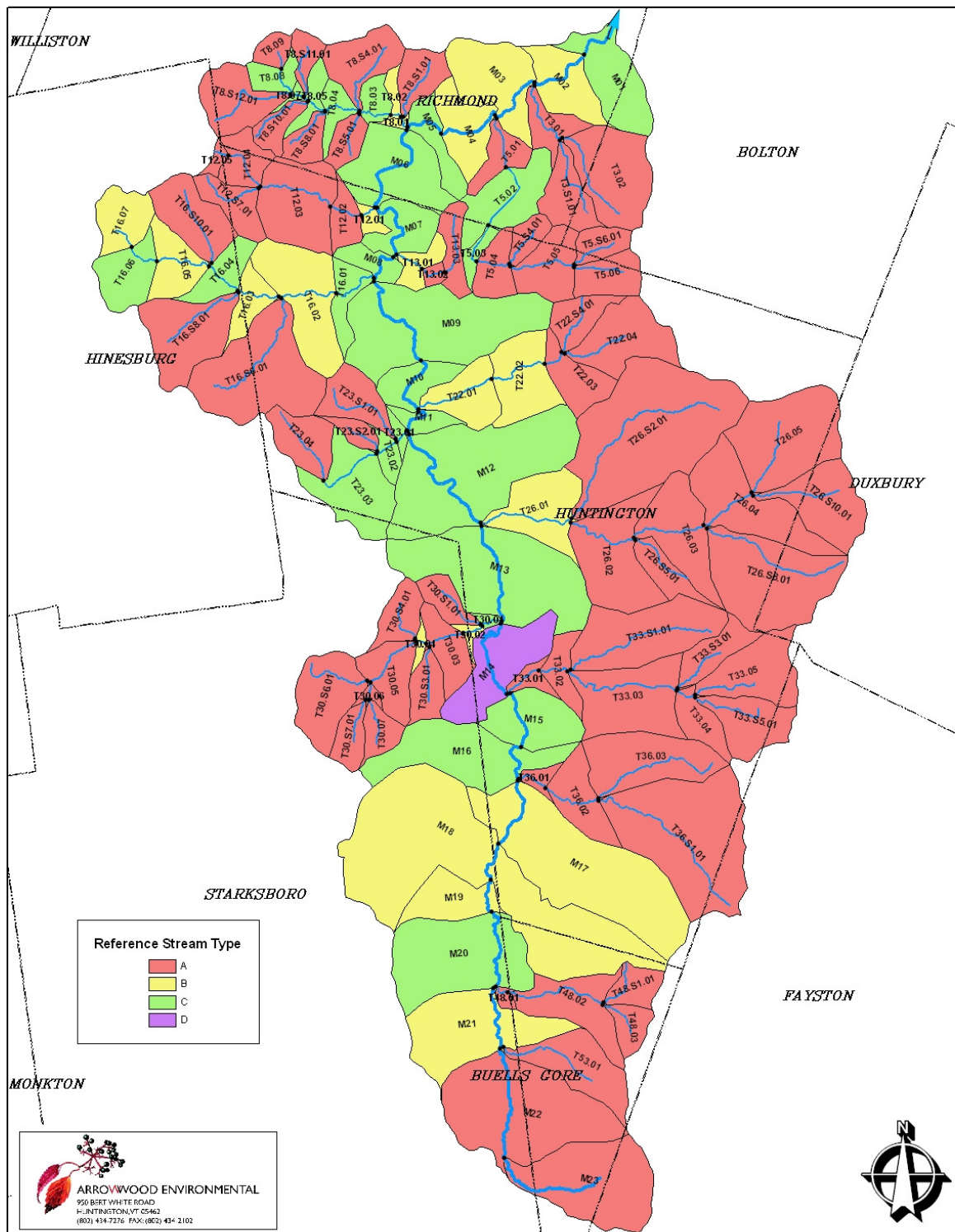


Figure 3. Stream Typing for Phase I Assessment Reaches

Forty-nine reaches, comprising approximately 50 percent of the study area, by length, falls into the A stream type and were noted to be cascade systems. Cascade systems

are narrowly confined, very steep (channel slope greater than 6.5%), with boulder or cobble dominated bed material.

Twenty-three of the 118 reaches (approximately 17 percent of the study area by stream length) fall within the C stream type and were noted to be riffle-pool systems. These C streams are unconfined, have moderate to gentle slopes, and gravel or finer bed material.

4.3 Basin Geology and Soils

The characteristics of the Huntington River watershed were determined using a combination of soils data, review of topographic maps, and information acquired during the windshield survey. Phase I-Step 3. Basin Characteristics: Geology Report, located on page(s) 11-13 of the Appendix, provides a summary of the basin characteristics, such as alluvial fans, grade control structures, geologic materials, valley side slopes, and soil characteristics.

Some alluvial fans were identified within the study reaches. Grade control structures such as ledge and dams were noted during the windshield survey. Channel spanning ledge was noted in 12 of the 118 reaches. Ledge acts as a grade control by keeping the base elevation of a river from being lowered, and prevents the river from incising in that location. Only one dam is located within the study area. This dam is located at the in reach T5.01 and T5.02 on the tributary, creating Gillett Pond.

The steepness of the valley side slopes was determined using a combination of a topographic map and the soils layer. The valley side slope steepness was variable, but overall steep to extremely steep side slopes dominated the watershed.

The dominant surficial geology of the Huntington River consists of alluvium, glacial till, and ice contact deposits. With few exception, the reaches characterized as C channels within the Huntington River watershed have alluvium as the dominant geologic material. These soils are frequently flooded, however are only slight to moderately erodable. The majority of the A and B type channels have till and ice contact deposits as the

dominant geologic materials. These soils are rarely flooded and have very severe erodibility.

4.4 Land Cover – Reach Hydrology

The land use within the watershed plays a role in the hydrology of the receiving waters. The percentage of urban and cropland development within the watershed are factors which change a watershed's response to precipitation. The most common effects of urban and cropland development is increasing peak discharges and runoff by reducing infiltration and travel time (United States Department of Agriculture 1986). The land use/land cover within the stream corridor itself is also an important parameter to evaluate. This land use/land cover plays an important role in the sediment deposition and erosion which occurs during annual flood events (Vermont Agency of Natural Resources 2004).

As outlined in the Phase I handbook, impact ratings were assigned for watershed land cover/land use and stream corridor land cover/land use as follow:

High – 10% or more is crop and/or urban

Low – Between 2 and 10 % is crop and/or urban

NS – Not Significant – Less than 2 % is crop and/or urban

As provided in Phase I-Step 4. Land Cover-Reach Hydrology Report (see Appendix page(s) 17-19), the dominant watershed land cover/land use within the Huntington River watershed is forest. Twenty-one of the reaches resulted in a watershed /land use impact rating of high.

The dominant land cover/land use within the river corridor is also summarized in Phase I-Step 4. Land Cover-Reach Hydrology Report. Fifty-nine of the reaches resulted in a high impact rating for corridor land cover/use.

Riparian buffers provide many benefits. Some of these benefits are protecting and enhancing water quality, providing fish and wildlife habitat, providing streamside shade,

and providing root structure to prevent bank erosion. Thirteen of the stream reaches had at least 75 percent of the reach with little or no buffer on one or more banks. These stream reaches which lack a high quality riparian buffer are a significantly higher risk of experiencing high rates of lateral erosion. Riparian buffer conditions are summarized in the Phase I-Step 4. Riparian Corridor Summary Report located in the Appendix, page (s) 21-22.

4.5 Historic Channel Modifications

Channel modifications may impact a stream reach by affecting the hydraulics and the sediment regime. Historic channel modifications were assessed in this Phase I study by evaluating flow regulations, bridges and culverts impacts, bank armoring, windrowing, straightening, and dredging. The percentage by length of reach impacted by one or more of these channel modifications was estimated and is summarized in Phase I-Step 5. Instream Channel Modification Report (see Appendix page(s) 23-25).

Flow Regulations

None of the stream reaches were found to be currently impacted by flow regulation. Although there is one dam on the upstream end of T5.01, the Facilities Engineering, Dam Safety Section, reported that it is not used for water withdrawal or flow regulation.

Bridges and Culverts

As part of the Phase I Stream Geomorphic Assessment, the number of bridges and culverts within the study reach were counted by identifying stream crossings on the topographic map and orthophotos. These stream crossings were confirmed during the windshield survey. The percentage of the reach impacted by stream crossing structures was estimated during the windshield survey and from orthophotos. Impact ratings for bridge and culverts were evaluated by determining the percentage of the reach length that is channelized, has split flow, or makes a sharp “S” bend upstream or downstream of bridges or culverts. With the exception of reaches M7, T16.04, and T23.03, the

impact from bridge and culverts on stream dimension, pattern or profile appears to be low or not significant.

Bank Armoring

The amount of bank armoring within a watershed is often indicative of the occurrence of channel processes, which result in bank erosion. Bank armoring, also called revetments, can be made of a variety of material including wooden cribs, gabions, logs, and rock riprap. The most common type of revetment in Vermont is rock riprap. Stream alteration permits can typically be used to identify bank revetments within a watershed of interest.

Rock riprap and tree revetments were the only type of revetment noted within the study area. The amount of revetment mapped from the Phase I windshield survey is likely an underestimation of the total amount of revetment, since the windshield surveys evaluated only a portion of the reaches. The following criterion was used to provide an impact rating for human placed bank armoring.

H	High – Greater than 30% of the reach length is armored
L	Low – Between 10 and 30% of the reach length is armored
NS	Not Significant – Less than 10% of the reach length is armored
No Info	Bank armoring has not been evaluated for the entire reach and impact at the reach level is unknown

During the windshield survey, rock riprap was noted in 12 of reaches. Of these reaches, riprap received an impact rating of low for 5 of the reaches.

Channel Modifications (Windrowing and Straightening)

During the windshield survey evidence of historic channelization projects were recorded. The total reach length (in feet) and the percentage of the reach length directly impacted by the channel modification were noted. Categories considered as part of the Step 5.4 (channel Modifications) included the following menu options:

- Windrowing – pushing gravel up from the stream bed onto the top of either bank

- Straightening – Dredging, windrowing, and bulldozing the stream into a straight course
- Multiple – Multiple channel modification, where neither windrowing nor straightening are the dominant channelization type
- None – No known modifications.

The only channel modification noted within the Huntington River was straightening. Channel straightening was identified by reviewing orthophotos and through field confirmation during the windshield survey. Portions of stream reaches that have been historically channelized or straightened are identified below in Figure 4.

Dredging History

We discussed the possibility of dredging and gravel mining in the Huntington River with local residents and Barry Cahoon of the Vermont Agency of Natural Resources. According to the residents and confirmed by Cahoon, the local communities did undertake significant gravel or sediment mining operations for the Huntington River watershed, particularly in the towns of Huntington and Richmond.

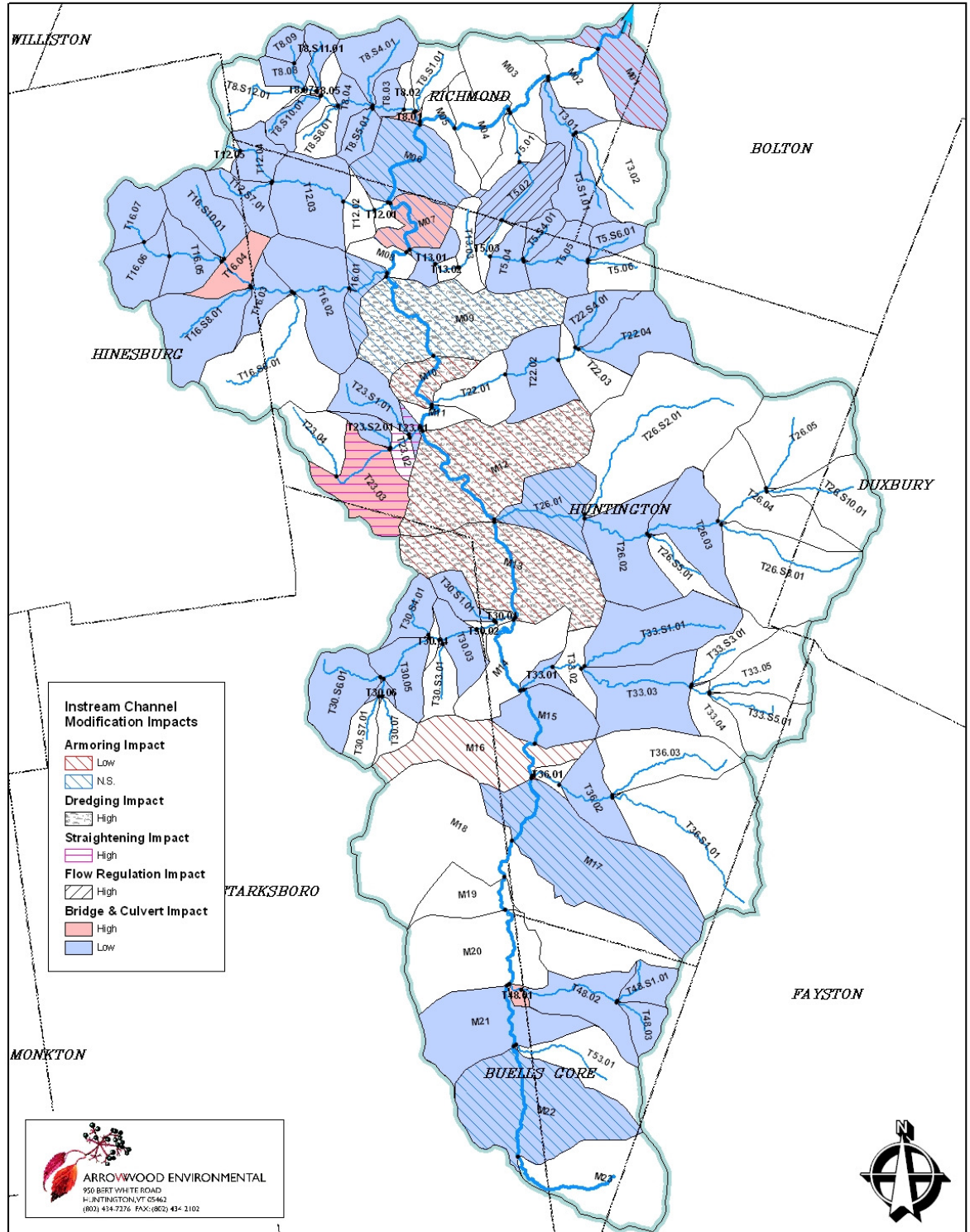


Figure 4. Instream Channel Modifications Identified for Phase I Reaches

4.6 Floodplain Modifications

In this step of the Phase I assessment, careful attention is paid to infrastructure and other development which restricts access to the floodplain, resulting in vertical or lateral confinement of flood flows. The parameters included in this step are: Berms and Roads, River Corridor Development, Depositional Features, Meander Migration/Channel Avulsion, Meander Width Ratio, and Wavelength Ratio. Some of the primary factors, which may influence floodplain function in the upper Winooski River, are discussed below. Phase I-Step 6. Floodplain Modification and Planform Changes Report, which is included on pages 26-28 of the Appendix, contains the Phase I information for Floodplain and Planform changes.

Berms and Roads

Using information from maps, orthophotos, and the windshield survey, the percentage of the river corridor length along which berms, roads, railroad, or improved paths run parallel to the stream was estimated. Reaches where berms, roads, railroads or improved paths were located along 20 percent or more of the river corridor were given impacted ratings of high. Main stem reaches (M04-M05, and M16-M17), two reaches of Sherman Hollow Brook (T12.04-T12.05), a reach of Texas Hill Brook (T16.05), and a reach of Beaver Meadow Brook (T48.02) received an impact rating of high primarily because of the presence of roads immediately adjacent to the stream.

River Corridor Development

The river corridor development parameter looks at whether developments within the river corridor are effectively decreasing the belt width. The percentage of the reach length with houses, fill, parking lots or other development within the river corridor was tabulated using maps, orthophotos, and knowledge from the windshield survey. Sixteen reaches had development of the corridor over 20 percent, and thus, were given an impact rating of high.

Channel Bars

The 1940s orthophotos series (1:5000) as well as results from the windshield survey were used to evaluate depositional features within the upper Winooski River

watershed. The presence of bars (mid channel or point bars) and deltas were noted in each of the study reaches. The ANR has included depositional features as a component of the Phase I analysis because these features are indicative of an increased sediment load and a high likelihood that the streambed is actively aggrading and/or undergoing lateral migration. An unvegetated bar indicates the bar has recently formed or is in the process of growing.

Multiple channel bars were the predominant depositional feature noted within the Huntington River watershed. Of the 24 reaches assessed, one reach (M14) had an impact rating of high for channel bars; 16 additional reaches had an impact rating of low for channel bars, while the other reaches were given ratings of not significant.

Meander Migration

Orthophotos were used to evaluate areas where the Huntington River has migrated, bifurcated, or avulsed². Current orthophotos from 1995 and 1999 and historic orthophotos from the 1940s were overlaid to compare the location of the river channel over time. The current and the historic orthophotos span a range of approximately 50 years. Seven reaches, all on the main stem of the Huntington River received an impact rating of high for meander migration, while nine reaches (5 on the main stem and the remaining on tributaries) received an impact rating of low. Migration, or movement of the channel by eroding its outer bank on meander bends, appeared to be the primary mechanism for lateral migration of the channel. Channel avulsions were noted for reach M14.

Meander Width and Wavelength

The 1990 series (1:5000) orthophotos in conjunction with topographic maps were used to determine the meander belt width and the meander wavelength for streams typed in Step 2.10 as C or E riffle-pool or ripple dune reference stream types (i.e. unconfined systems). The topographic maps were used to determine the valley direction, while the

² An avulsion is a change in planform resulting from a meander cut-off.

most current orthophoto series was used to provide the accurate location of channel meanders.

The meander belt width is the horizontal distance between two opposite, outside banks on fully developed meanders. The meander width ratio is calculated by dividing the average belt width for the reach by the bankfull width. The ANR Phase I protocol considers unconfined, gravel dominated streams with moderate to gentle gradients, which are in regime, to have belt widths in the range of 5 to 8 times the channel width. Nineteen of the unconfined reaches fell outside of the range expected for channels which are in regime. Ten of the study reaches were rated as high impact for meander width ratio, and nine reaches received an impact rating of low.

Twelve of the 19 stream reaches which resulted in a low or high impact rating had meander width ratios of less than 5. Five of them had a meander width ratio of one. These low values may indicate the stream has become straighter and steeper, possibly resulting in degradation and loss of access to its floodplain. Field observations confirm the finding that the Huntington River has lost access to its floodplain in many locations, primarily due to road development. Stream channel incision was particularly evident within reaches M02, M03, M05, M06 and M07 on the main stem.

The meander wavelength consists of two bendways. The wavelength ratio is calculated by dividing the average wavelength by the bankfull channel width. Leopold 1994 and Williams 1985 (cited in Vermont Agency of Natural Resources, 2004a) have shown unconfined, gravel dominated streams in shallow-sloped valleys to have wavelengths in the range of 10 to 12 times the channel width. Twenty-three of the reaches fell outside the range of expected meander wavelength ratio: six of the reaches resulted in a low impact rating and seventeen of the stream reaches received an impact rating of high for wavelength ratio. The wavelength ratio was equal to one in five reaches, indicating a straightened condition. The wavelength ratio was less than 8 for three other reaches (but greater than 1.0), suggesting the stream is starting to aggrade and become more sinuous. This has resulted in a decrease in channel slope as the stream migrates

laterally. The degree of meander migration and bank erosion noted on the main stem supports the finding that the Huntington River is aggrading.

4.7 Bed and Bank Windshield Survey

The dominant bed form, dominant bank material, bank erosion/bank height, and debris/ice jam potential were recorded during the windshield survey, and these results are summarized in Phase I-Step 7. Bed and Bank Windshield Survey Report, on pages 29-31 of the Appendix. The dominant bed form and dominant bank material were previously discussed under Section 4.2, Stream Typing. The amount of bank erosion observed along a reach and the bank height were evaluated in conjunction with each other to provide a bank erosion impact rating. Bank erosion was rated as low or high impact for 19 reaches of the 32 reaches evaluated. Bank heights were not evaluated.

Debris/Ice Jam Potential

Undersized culverts or bridges with spans less than the average channel width or bridges with piers in the middle of the channel were the primary factors identified as potential for ice and debris jams. These structures, which are likely to cause constrictions during high flow events may result in lateral erosion or channel avulsions or may even endanger infrastructure. Four reaches of 46 reaches evaluated received an impact rating of low for debris/ice jam potential, none of the reaches resulted in an impact rating of high.

5.0 DATA ANALYSIS

5.1 Impact Scores

The Phase I evaluates parameters that may cause channel adjustment. These parameters are grouped into four major categories: land use, instream modifications, floodplain modifications, and bed and bank windshield survey. For each parameter, the maximum impact score for the entire watershed is 236 (118 reaches times impact score of 2). As shown below in Figure 6, all impact scores were less than 150 out of the possible 236. All three parameters in the land use category received high impact ratings for the watershed. The parameters berms and roads and bank erosion also resulted in high scores.

Figure 5 shows the watershed impact ratings for the channel adjustment parameters.

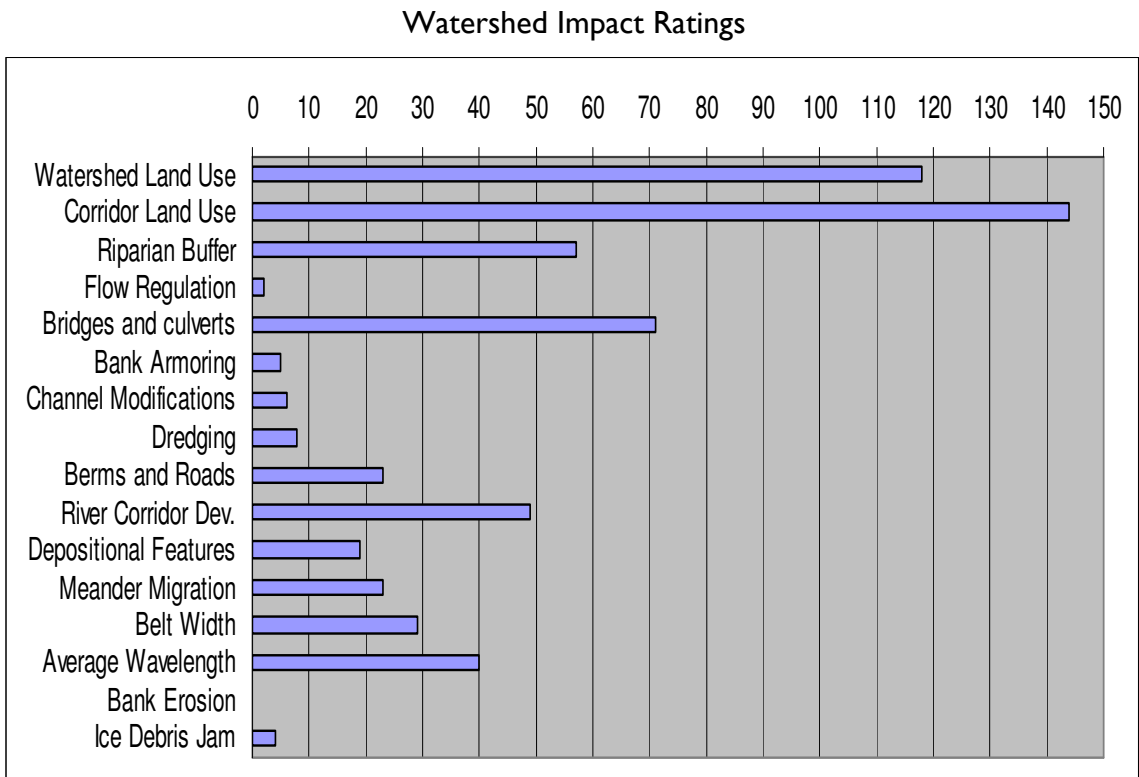


Figure 5: Watershed Impact Rating Scores

The total impact scores for the Phase I assessment are provided in Phase I-Step 8. Stream and Watershed Impact Rating Report, on pages 35-37 of the Appendix and are mapped below in Figure 6.

}

Reaches in fair condition include the main stem reaches (M1, M5, M6, M9, M10, M13, M16, M17), and the tributaries of Texas Hill Brook (T16.01, T16.04-T16.07), Fargo Brook (T22.01, T22.02), Hollow Brook (T23.01-T23.03), Johns Brook (T5.02) and Owls Head Brook (T8.01, T8.03-T8.04, T8.06, T8.08).

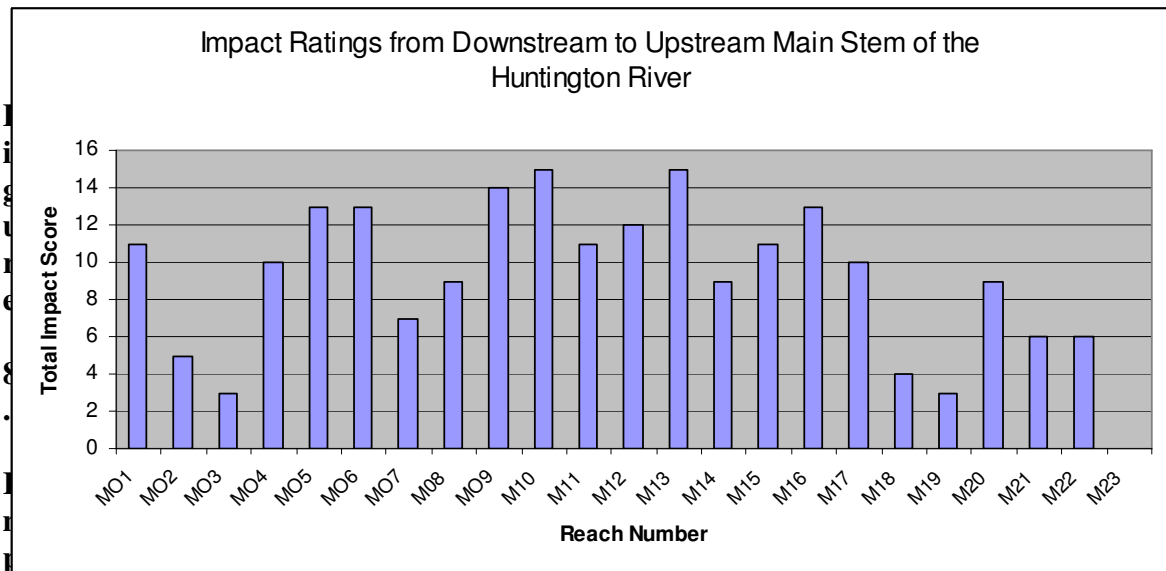
The majority of the unconfined stream reaches were in the fair category, while only two confined stream reaches (T8.01 and T16.05) resulted in a reach condition of fair. These reaches had undergone channel and floodplain modifications which may have resulted in a change in planform, profile, and dimension such that the stream is no longer in balance with the flow and sediment regime of its watershed.

Streams in fair condition are fully in adjustment and are experiencing major and rapid changes due to recent floodplain and channel modifications, land cover changes, and/or loss of riparian buffer. The majority of the unconfined stream reaches were in the fair category,

15 of the confined reaches were placed in the good category based on professional judgment and the output from the Phase I database. The streams in the good category had experienced some degree of human-induced change to their watershed, floodplain and/or channel and appeared to be undergoing only minor adjustments. The stream reaches in good condition were generally located in the middle of the watershed (i.e. not in the headwaters and not near the lower end).

A reference reach has no significant channel or floodplain modifications and has a forested buffer, adjacent to the channel. These reaches are close to the natural condition. Streams identified as reference are generally located in headwater areas that were not assessed.

Figure 8 shows impact ratings from downstream on the main stem to the headwaters.



a

Figure 8: Ratings from downstream to upstream on the main stem of the Huntington River

5.2 Adjustment Processes

Phase I-Step 9. Adjustment Process and Reach Condition Report, on pages 41-43 of the Appendix, provides a summary of the primary adjustment processes that were predicted based on the Phase I Stream Geomorphic Assessment. The Phase I data suggest that most of the assessed stream reaches are experiencing more than one type of channel adjustment process.

5.3 Reach Sensitivity

The Phase 2 Handbook (Vermont Agency of Natural Resources, 2004b) was used to assign a stream sensitivity based on existing stream type and condition. Highly sensitive reaches are more likely to be in adjustment, and are very sensitive to land use changes within the watershed. The reach sensitivity is summarized in Phase I-Step 9. Adjustment Process and Reach Condition Report, on pages 41-43. There was one unconfined stream reach (M14) with a stream sensitivity rating of extreme. There were 9 unconfined stream reaches (M6, T16.04, T16.06, T23.01, T23.03, T5.02, T8.03, T8.04, and T8.08) with a stream sensitivity rating of high. There were 17 confined reaches with a stream sensitivity rating of high.

6.0 RECOMMENDATIONS FOR PHASE 2

The Phase I results are valuable for providing recommendations for reaches to select for the Phase 2 Assessment. Phase 2 Assessment work in the Huntington River watershed took place in late summer, 2005. The fieldwork included M06 through M015 on the main stem. The combined length of the stream reaches is about 10 miles. The unconfined channels along the main branch (Reference stream Type C) were given highest priority in conducting the Phase 2 Assessment. The reach condition and reach sensitivity ratings from the Phase I study for the proposed Phase 2 Assessment reaches are summarized in Table 5.

Table 5. Reaches Recommended for Inclusion in the Phase 2 Assessment to be Completed During Late Summer/Early Fall 2005						
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	Good	Moderate
M07	1.0	VB	0.12	C4 Riffle- pool	Reference	High
M08	0.5	BD	0.50	C3 Riffle- pool	Reference	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	Good	Moderate
M13	1.3	VB	0.62	C3 Riffle- pool	Fair	Moderate
M14	1.3	VB	0.27	D3 Braided	Reference	Extreme
M15	0.7	VB	1.44	C3 Riffle- pool	Reference	Moderate

REFERENCES

United States Department of Agriculture. 1986. Urban Hydrology for Small Watersheds. Soil Conservation Service, Engineering Division, Technical Release 55. Washington, D.C.

Vermont Agency of Natural Resources. 2004a. Vermont Stream Geomorphic Assessment Phase I Handbook. Watershed Assessment Using Maps, Existing Data, and Windshield Surveys. Waterbury, Vermont

Vermont Agency of Natural Resources. 2004b. Vermont Stream Geomorphic Assessment Phase 2 Handbook. Rapid Stream Assessment, Field Protocols. Waterbury, Vermont