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Phase I Stream Geomorphic Assessment
Neshobe River
Town of Goshen
Addison County, Vermont

DRAFT

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Summary, Conclusions, and Recommendations

- A Phase I Stream Geomorphic Assessment of the Neshobe River and main tributaries within the Town of Goshen was completed by Bear Creek Environmental during spring 2004. The study included the main stem of the Neshobe, the North Branch of the Neshobe and Gould Brook. The watershed was divided into 15 reaches based on confinement, slope, and soils. Of these 15 reaches, a full Phase I Stream Geomorphic Assessment was conducted on 13 reaches. With the exception of one reach, all of the stream reaches were Rosgen type A or B systems.
- 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 Addison County Regional Planning Commission, the Vermont Mapping Program, Vermont Center for Geographic Information, and the windshield survey.
- The dominant surficial geology of the Neshobe basin consists of glacial till and ice contact deposits. These soils are infrequently flooded; however they have severe to very severe erodibility due to the loose structure of unsorted materials formed during glacial movement. Evidence of soil instability or its impacts on the study streams were not observed in the field.
- The Neshobe watershed in the Town of Goshen is relatively undeveloped. Forest was the dominant land use type within the watershed. Forest or residential were generally the dominant river corridor land use. Although roads run parallel to the river in much of the watershed, generally, either the right or the left bank had a riparian buffer of easter than 100 feet.
- The primary instream channel modification identified within the watershed was windrowing and possible dredging as part of flood mitigation work conducted a few decades ago.
- Berms and roads were identified as the predominant factor potentially contributing to floodplain modification and planform changes. Seven of the thirteen reaches were given a rating of high impact for this parameter. This is a result of roads paralleling the river corridor in the lower portion of this watershed (near the town center).
- Based on the windshield survey, bank erosion was noted to be low and was only observed in three of the thirteen reaches. Eight of the thirteen reaches contained at least one structure that provided some risk of ice/debris jam potential.
- A reach condition was assigned based on professional judgment. Seven of the reaches were rated in good geomorphic condition, while six were rated in reference condition. The within watershed condition generated from the Phase I database was generally

similar to the reach condition. The largest difference was noted for reaches, which were rated in poor or fair condition by the database.

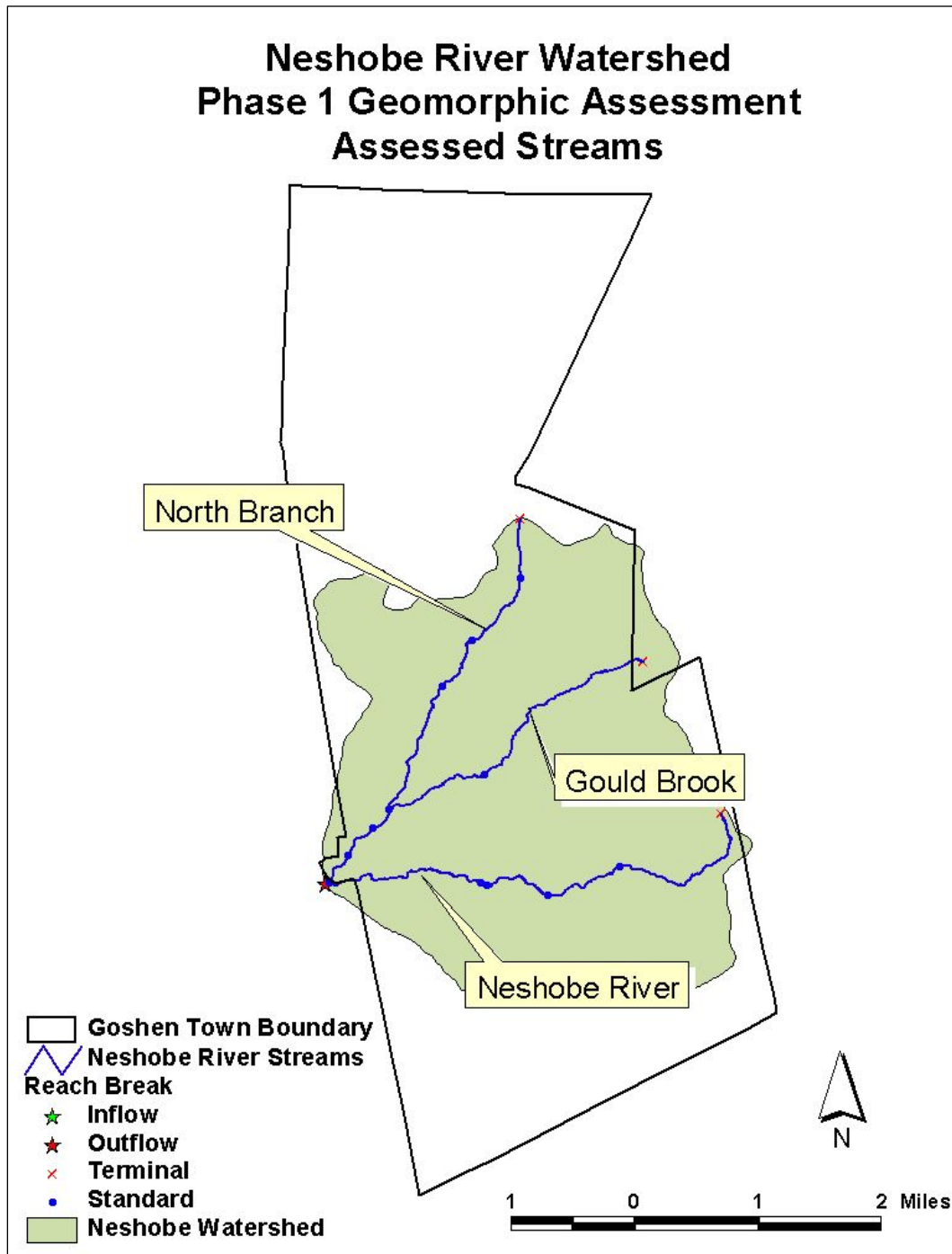
- The Phase I database predicted four of the reaches had undergone or were undergoing one or more adjustment process.
- Recommendations for watershed planning and follow-up work are provided in Section 6 of this report (Conclusions and Recommendations)

I. Introduction

Bear Creek Environmental was retained by the Addison County Regional Planning Commission (ACRPC) to conduct a Phase I Stream Geomorphic Assessment of the Neshobe River and Major Tributaries¹ limited to the Town of Goshen, Vermont. The assessment was conducted on the main stem of the Neshobe River, the North Branch of the Neshobe River, and Gould Brook (Figure 1). The objective of the study was to provide an overview of the general physical characteristics of the Neshobe watershed and determine which reaches may be in adjustment outside the natural range of variability. Specifically, the Phase I study will be used to identify stream reaches which are at risk of being an erosion hazard.

Available data for the Neshobe River within the Town of Goshen was obtained from the Vermont Department of Environmental Conservation (VDEC), the Vermont Geographic Information Center (VCGI), and the Addison County Regional Planning Commission. A windshield survey of the watershed was conducted by Mary Nealon and Michael Blazewicz of Bear Creek Environmental and Shayne Jaquith (VDEC) on May 7, 2004.

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



Streams in the Neshobe Watershed

Figure 1. Phase I Geomorphic Assessment

2.0 Background

The Neshobe River has a watershed size of 9.85 square miles at the confluence of the main Branch and the North Branch of the Neshobe River near the town boundaries of Goshen and Brandon. This Phase I study included stream reaches on the Neshobe River within the confines of the Town of Goshen and Addison County. The Neshobe River is one of several smaller watersheds which comprise the Otter Creek Basin. The Otter Creek drains northward to Lake Champlain and into the St. Lawrence River Basin (Figure 2).

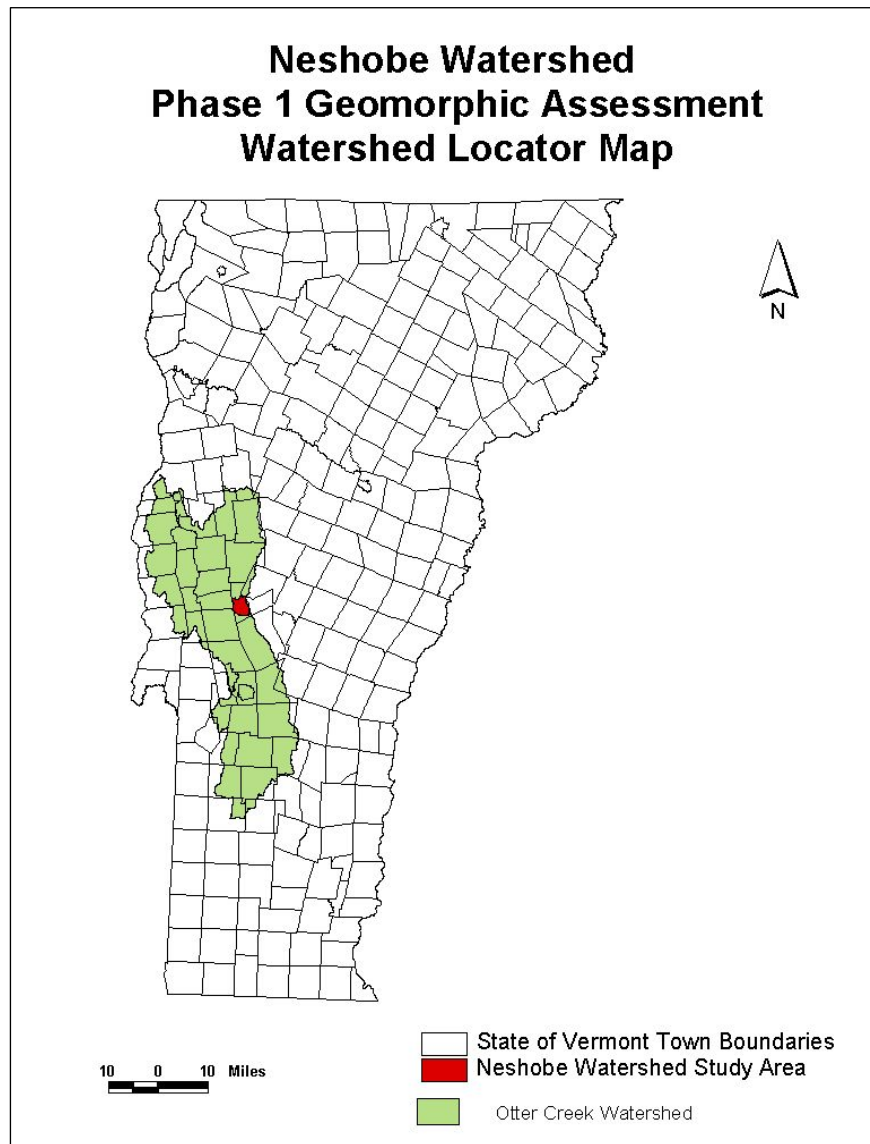


Figure 2. Watershed Locator Map for the Phase I Assessment

There are no known stream gages within the Neshobe watershed. A long term U.S. Department of the Interior, U.S. Geological Survey (USGS) gage on Otter Creek in Middlebury, VT (gage #04282500) was used to provide an understanding of the flood history within the watershed. Although the drainage area at the Middlebury gage is considerably larger (626 sq. miles) than the Neshobe watershed, it does provide some useful information about when large flood events occurred. Eighty-seven years of record are available for the Otter

Creek gage at Middlebury. The gage provides nearly a continuous record of flow from 1904 through the present, with the exception of water years 1907-1910 and 1920-1927. The long term record shows peak discharges between a ten year and 25 year recurrence interval occurred during water years 1948, 1958, 1960, 1977, and 1987. Floods with recurrence intervals less frequent than the 25 year discharge occurred during water years 1913, 1928, and 1936.

3.0 Methodology

The Phase I assessment followed procedures specified in the Vermont Stream Geomorphic Assessment Handbook Phase I, dated April 2004 and used version 3 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, and were entered in to the most current version of the ANR Phase I database. 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.

Table I. Parameters Included in Impact Scores	
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
Table I. Parameters Included in Impact Scores	
Step #	Parameter
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

4.0 Results

4.1 Reach Locations

The Neshobe River Watershed was divided into 15 reaches for the Phase I Assessment. Two of the 15 reaches did not receive a full assessment. Reach M01 was included for purposes of running SGAT, but was outside the Town of Goshen boundary. Reach M03 began at the 25 foot high concrete dam and included impounded water from the dam. A full assessment was not performed on this reach because the reach would not be considered free flowing water. Report Number 1 on pages 1 and 2 of the Appendix provides the reach locations including reach description, town where the reach is located, and latitude and longitude generated from SGAT.

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 calculate 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.

Most of the reaches within the main stem of the Neshobe River and major tributaries of the Neshobe River within the Town of Goshen were found to be high gradient, semi-confined or narrower systems. Report 2 on page 3 and 4 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 fell within the B/ Step-pool category (see Table 2). The B/ Step-pool channels were semi confined with steep channel slopes (generally 4 to 6.5 percent) and had cobble dominated bed material. Reach TI.S1.02 appeared to be a B/Step-pool system based on the section visited during the windshield survey, but had an overall reach slope of 12%, which is more characteristic of an A stream type. It is recommended that if a Phase 2 Stream Geomorphic Assessment of Gould Brook were to be undertaken that this stream reach possibly be broken into sub reaches.

Three reaches, comprising approximately 27 percent of the study area, by length, fell into the A/ Cascade stream type. The A/ Cascade systems were narrowly confined, very steep (channel slope greater than 6.5%), with boulder or cobble dominated bed material. Three of the reaches, comprising 19 percent of the study area by length fell with the B/ Plane Bed reference stream type. The Plane bed systems all had narrow confinement ratios, were moderate to steep and were cobble to gravel dominated. Only one stream reach, located in the head waters of the North Branch of the Neshobe River was classified as a C/Riffle-pool system. This reach of stream (TI.07) had a broad valley confinement, a moderate gradient, and was gravel dominated.

Figure 3. Stream Typing for Phase I Assessment Reaches

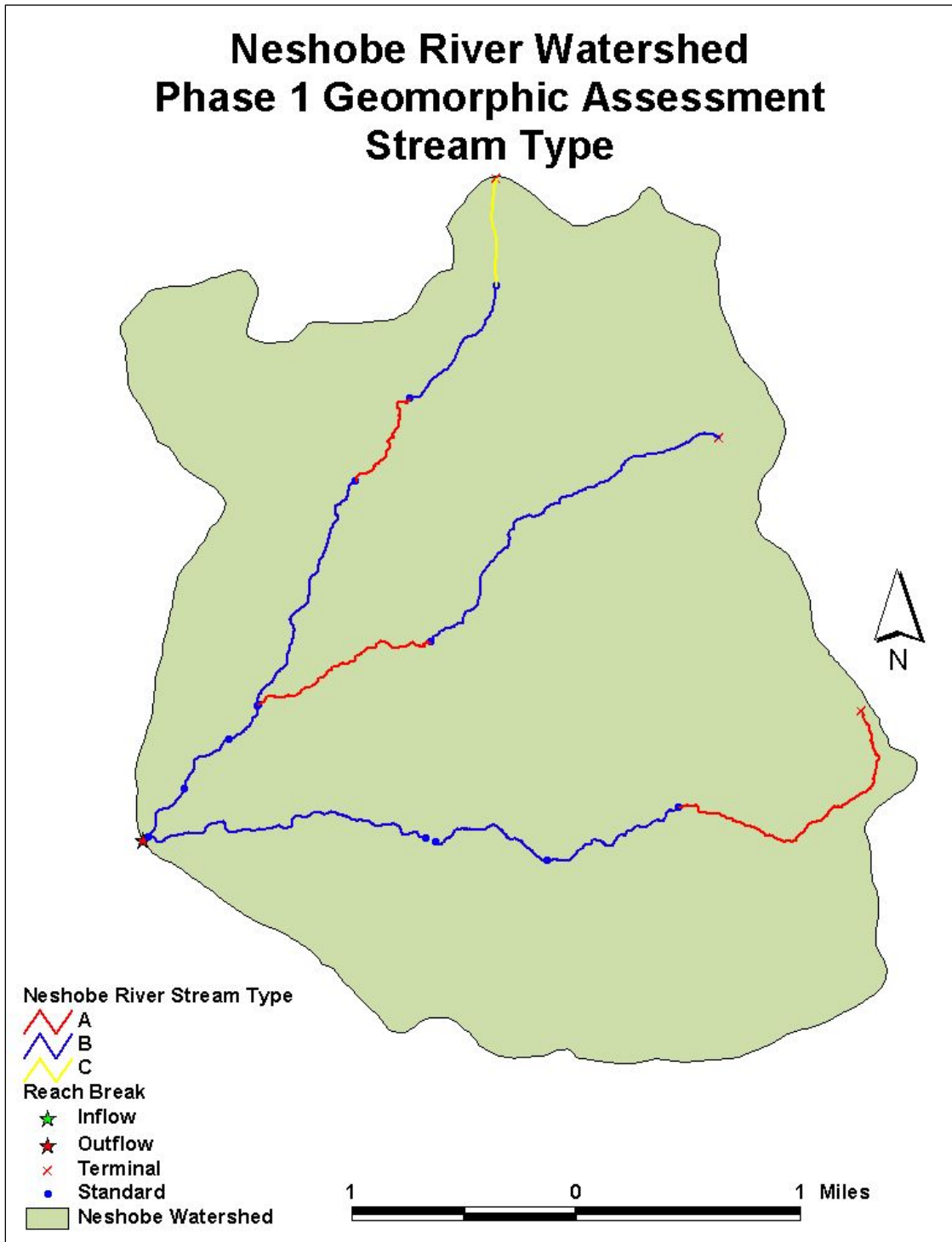


Table 2. Reference Stream Type				
Stream Type	Confinement	Channel Slope	Bed Material	% of Assessed Reaches
A/ Cascade	Narrowly confined	Very steep	Boulder	27
B/ Step-pool	Semi confined	Steep	Cobble	49
B/ Plane Bed	Narrow	Mod.- Steep	Cobble-gravel	19
C/ Riffle-pool	Broad	Mod.- gentle	Gravel	5

4.3 Basin Geology and Soils

The characteristics of the Neshobe basin were determined using a combination of soils data, review of topographic maps, and information acquired during the windshield survey. Report Number 3, located on page 5 and 6 of the Appendix, provides a summary of the basin characteristics. No alluvial fans were identified within the study reaches. Three grade control structures were noted during the windshield survey. Channel spanning ledge was noted in reach M02 and M06. The 25 foot high concrete dam in reach M03 also constitutes a grade control structure. 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 extremely steep side slopes dominated the watershed.

The dominant surficial geology of the Neshobe basin consists of glacial till and ice contact deposits. These soils are infrequently flooded; however they have severe to very severe erodibility due to the loose structure of unsorted materials formed during glacial movement. Evidence of soil instability or its impacts on the study streams were not observed in the field.

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 (ANR 2004).

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

The Phase I database considers urban to include residential, industrial, and commercial land use. The Neshobe watershed is relatively undeveloped and by including residential land use as part of the urban category, the database greatly overestimated the impact from urban development. Most of the residential development within the watershed was on large lots, which would not be considered urban land use. For this reason, the category urban was revised to exclude residential.

As provided in Report Number 4 (see appendix pages 7 and 8) the dominant watershed land cover/land use for within the Neshobe River watershed in Goshen was forest. All of the reaches resulted in a watershed/land use impact rating of not significant. This reflects the relatively undeveloped nature of the Neshobe watershed within the Town of Goshen. The dominant land cover/land use within the river corridor is also

summarized in Report Number 4. All the reaches with the exception of M02 resulted in an impact rating of not significant for river corridor land use/land cover.

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 Report Number 5 (see Appendix pages 9 and 10).

Flow Regulations

None of the stream reaches were found to be currently impacted by flow regulation. One dam at the downstream end of reach M3 was researched by contacting the Vermont Water Quality Division and the Facilities Engineering, Dam Safety Section, and is not believed to be used for water withdrawal or flow regulation.

Bridges and Culverts

Tim Bouton of the Addison Regional Planning Commission provided a bridge and culvert inventory that had been conducted for the Town of Goshen. This inventory includes structure type and condition, but does not provide information relating to the potential impact these structures have on the geomorphic condition of the stream. No information was available to cross reference structures identified by the Town of Goshen with those identified in the stream geomorphic assessment.

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. 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 reach M05 and reach T1.03, the impact from bridge and culverts on stream dimension, pattern or profile appeared to be not significant. A vegetated mid-channel bar was noted in reach M05 above an undersized culvert crossing a forest service road. In reach T1.03, above a bridge, a vegetated mid channel bar was noted.



Figure 4. Undersized culvert located in Reach M05.



Figure 5. Mid channel bar created as a result of the undersized culvert shown in Figure 4.

Bank Armoring

The amount of bank armoring within a watershed is often indicative of channel processes occurring resulting 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. However, stream alteration permits are only issued for drainage areas at or above 10 square miles. Due to the small drainage area of the Neshobe (9.85 sq. miles) at the confluence of the main branch and the North Branch, stream alteration permits were not a possible source of information. Therefore, bank armoring was identified during the Phase I windshield survey.

Rock riprap was the only type of revetment noted within the study area. The amount of revetment mapped from the Phase I windshield survey may be a slight underestimation of the total amount with the assessed reaches given the windshield surveys included a portion of each reach. Overall, the reaches were very accessible and much of the reach could be viewed from the road, so this underestimation is not of great concern. 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

All of the reaches assessed were found to have impact rating of NS for bank armoring, based on having less than 10 percent of the reach length being impacted. In fact, only four reach were found to have bank revetments and of these reaches less than 5

percent of the reach length was armored. This finding is not surprising given the very low amount of bank erosion noted (see Section 4.7 Bed and Bank Windshield Survey) and the natural bank armoring found in within these (B and A stream types). Figure 6 illustrates the natural bank armoring that was present in many of the assessment reaches.



Figure 6. Looking downstream into reach M02 at large native boulders providing good bank armoring

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 for the stream bed to 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.

Because of the natural low sinuosity of the streams within the study area, it was difficult to identify channel straightening from orthorphotos. Fred Nicholson of the Vermont Agency of Natural Resources was also consulted about historical channelization projects within the watershed.

The windshield survey showed evidence of windrowing in two of the reaches within the village of Goshen (see Figure 7). The reaches where berms had been constructed along the channel were T1.04 and S1.01. These berms may have been constructed to protect farm land, roads or houses located adjacent to the North Branch of the Neshobe or Gould Brook within the Village of Goshen. According to Fred Nicholson, historic straightening and channelization dates back to the 1940s. Channel modification projects also occurred in southern Vermont following high flow events in the 1970s.



Figure 7. Historic berms along right bank of reach T1.04 (North Branch of the Neshobe River). The stream channel was over wide in this location and had some minor bank erosion along the right bank. The channel dredging which took place at the time the berms were constructed likely contributed to this wide channel. The channel appeared to be in the process of rebuilding its floodplain.

Dredging History

Fred Nicholson, DEC Stream Alteration Engineers was consulted about the dredging and gravel mining history within the Neshobe watershed. In areas where windrowing had occurred, Fred Nicholson suggested that channel dredging had occurred concurrently as part of the flood remediation work. Given this likelihood, stream reaches T1.04 and T1.S1.01 were assigned a high impact rating for dredging and gravel mining history.

4.6 Floodplain Modifications

In this step of the Phase I assessment, careful attention is played 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 Neshobe watershed, are discussed below: Report 6, which is included on page 11 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 were identified. The Neshobe watershed, in general, was very accessible for conducting a windshield survey because of the number of roads running parallel to the river. Seven of the thirteen reaches were rated as high impact as a result of having berms, roads, railroads, or improved paths along 20 percent or more of the reach length.

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. With the exception of two reaches, river corridor development was given an impact rating of not significant. Reach T1.03, located near the center of Goshen was the only reach with a river corridor development impact rating of high.

4.7 Bed and Bank Windshield Survey

The dominant bed form, dominant bank material, bank erosion/bank height, and ice jam potential were recorded during the windshield survey and these results are summarized in Report 7, on page 12 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. With the exception of a few isolated reaches, the magnitude of bank erosion within the watershed was rated as not significant. Some minor areas of bank erosion were observed along reaches T1.S1.01 and T1.04, where channel modifications (ie. windrowing and dredging) had historically occurred. The windrowing may have led to channel incision and increased sheer stress along the banks, resulting in bank erosion. A small section of bank erosion was also observed within reach T1.S1.02.

Ice Debris Jam Potential

Within approximately 60 percent of the reaches, at least one structure was observed that had the potential to result in ice and debris jams. For the most part, structures identified with debris jam potential appeared to be undersized culverts or bridges with spans less than the average channel width.

5.0 Data Analysis

5.1 Impact Scores

The total impact scores for the Phase I assessment are provided in Report 8, on page 13 of the Appendix and are mapped below in Figure 8. As shown in Table 3, the within 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. The largest difference was noted for reaches, which were rated in poor or fair condition by the database. Based on the windshield survey, none of the reaches were considered in fair or poor condition. 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. None of the reaches appeared to be undergoing active incision (i.e. headcutting), widening, or rapid lateral movement.

Seven of the thirteen reaches were placed in the good category based on professional judgment. 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 all had at least one parameter from the instream channel modifications or floodplain modifications that was rated as a high impact. These high impacts appeared to have occurred many decades ago and were associated with floodplain and channel modifications.

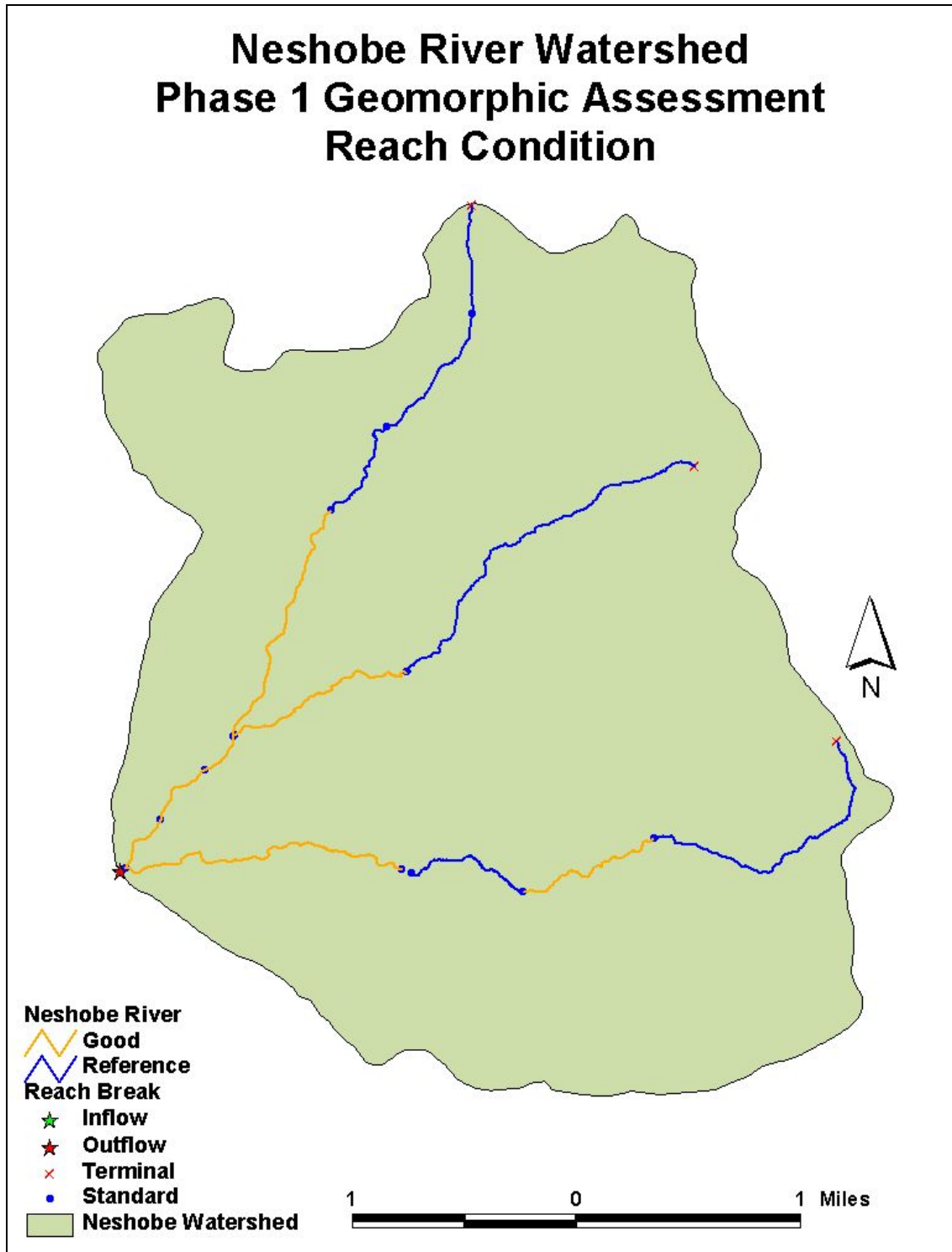


Figure 9. Reach Condition

Table 3. Reach Impact Scores for Neshobe Watershed Within the Town of Goshen				
Reach Number	Stream Name	Total Impact Score	Within Watershed Condition (from Phase I Database)	Reach Condition (based on Professional Judgment)
TI.04*	North Branch	8	Fair	Good
TI.SI.01*	Gould Brook	8	Fair	Good
M02	Neshobe River	8	Good	Good
TI.03	North Branch	7	Poor	Good
M05	Neshobe River	6	Good	Good
TI.02	North Branch	4	Good	Good
TI.01	North Branch	3	Good	Good
TI.05	North Branch	1	Good	Reference
TI.06	North Branch	1	Reference	Reference
M04	Neshobe River	1	Reference	Reference
M06	Neshobe River	1	Reference	Reference
TI.SI.02	Gould Brook	1	Reference	Reference
TI.07	North Branch	0	Reference	Reference

As shown in Figure 10 below, the primary floodplain modification is encroachment from berms and roads. Seven of the 13 reaches received a high impact score in the berms and roads category. River corridor development was rated as a low or high impact for five of the reaches. Instream modifications identified as possibly having a significant impact included channel modifications such as windrowing. It is likely that dredging and channel straightening occurred at the same time as the berms were constructed along the banks.

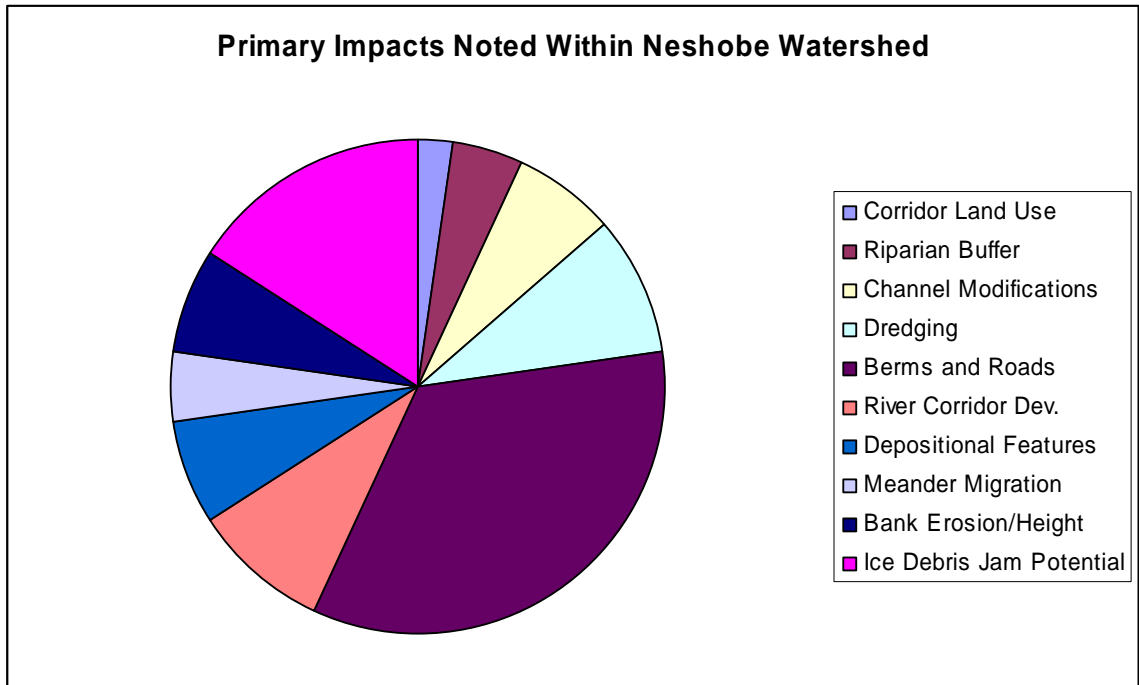


Figure 10. Impacts identified as part of remote sensing and the windshield survey

5.2 Adjustment Processes

Report Number 9, on page 14 of the Appendix, provides a summary of the primary adjustment processes that were predicted based on the Phase I Stream Geomorphic Assessment. For nine of the reaches, no adjustment process is indicated. As summarized in Table 4, the Phase I data suggest that four of the reaches (T1.S1.01, M02, T1.03, and T1.04) are likely experiencing some channel adjustment process. It is likely that the historical channel and land management practices in the Neshobe watershed in Goshen resulted in vertical and lateral channel adjustment. The predictions from the Phase I study suggest that different channel adjustment processes are occurring concurrently.

Based on observations of the watershed during the windshield survey, the four reaches presented below in Table 4 appeared to be fairly stable and appear to be undergoing only minor adjustments. It is likely that these four reaches have historically undergone major adjustments related to human induced changes to the watershed, floodplain, and or channel.

The most noteworthy of these human induced impacts within the Neshobe watershed in Goshen include: windrowing, possible dredging for flood control purposes, and berms and roads located parallel to the stream channel. These stream reaches, which had been impacted by historical instream channel modification or floodplain modifications appear to have undergone substantial adjustments (i.e. channel incision followed by widening and aggradation) and are now entering stage V of the Schumm channel evolution process. Three out of four of these reaches were rated as having low sensitivity to reach and watershed modifications, while the fourth reach (T1.03) was rated as moderate sensitivity. This may in part explain why extensive channel adjustment processes were not observed in the field.

Table 4. Predicted Adjustment Process for Phase I Stream Geomorphic Assessment			
Reach Number	Stream Name	Predicted Adjustment Process	
		Adjustment	Concurrent Adjustment
T1.S1.02	Gould Brook	Degradation	Planform
M02	Neshobe River	Planform	Multiple
T1.03	North Branch	Planform	Multiple
T1.04	North Branch	Degradation	Planform

6.0 Conclusions and Recommendations

Overall, the Neshobe watershed within the Town of Goshen appeared to be in a stable geomorphic condition. Approximately half of the thirteen reaches assessed were given a rating of good for reach condition, while the other half appeared to be in reference condition. The Phase I assessment predicted that four of the reaches (30percent) have gone or are going through channel adjustment processes. As a result of flood mitigation work following floods several decades ago, the impacted stream reaches likely incised, widened and then aggraded. This has led to the formation of a new floodplain at a lower elevation.

Based on the results of the Phase I Stream Geomorphic Assessment, Bear Creek Environmental recommends the following:

1. Minimize future flood damage by improving culvert/bridge widths. If additional funds are available it may make sense to conduct a Bridge and Culvert Assessment using the protocols recommended by the Vermont Agency of Natural Resources. The condition information contained in the Town of Goshen's bridge and culvert survey could be cross referenced with the ANR Bridge and Culvert Assessment to prioritize the replacement of bridge and culverts with the Town of Goshen.
2. Protect the riparian corridor by adopting setbacks for development. Minimize disturbance of riparian vegetation to provide maximum shading, bank stability, pollutant removal, and habitat conditions. Prevent houses, roads, and other infrastructure from encroaching on the stream corridor.
3. Avoid channelizing water on till/ice contact soils, which are highly erodible. Channelized stormwater, even a distance from the stream, can lead to mass failures, sediment in the river, and then years of stream adjustment. This is especially important given the soils and the steepness of the valley side slopes.
4. Given the low impact ratings from the Phase I study and the good to reference geomorphic condition observed in this watershed during the windshield survey, a Phase 2 study of selected reaches in this watershed is of low priority.