Bear Creek **Environmental**

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Bridge and Culvert Assessment
Using Agency of Natural Resources' Protocol
Strafford Conservation Commission
Town of Strafford, Vermont
West Branch of Ompompanoosuc River Watershed

April 25, 2005

Prepared by:

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Prepared for:

Strafford Conservation Commission

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EXECUTIVE SUMMARY

- Bear Creek Environmental was retained by the Strafford Conservation Commission (SCC) to conduct a Bridge and Culvert Assessment of the West Branch of the Ompompanoosuc River (WBOR) Watershed limited to the Town of Strafford. The study relied on volunteers from the SSC to assist with field data collection.

- The Vermont Agency of Natural Resources (ANR) Bridge and Culvert Assessment and Survey Protocols (dated April 2004) were used to conduct a rapid assessment of stream crossings. The assessment results were entered into the ANR bridge and culvert database.

- The objective of the study was to red-flag structures that are potential barriers to fish and wildlife movement and/or are flood or erosions hazards.

- A total of 39 bridges and culverts within the Town of Strafford were surveyed during September 2004. The stream crossings included 28 bridges and 10 culverts on state and town roads and one private bridge within reach M05.

- All of the structures surveyed were red flagged by the ANR's database as being geomorphologically incompatible due to flood and/or erosion hazards.

- The structure width in relation to the channel width was used by Bear Creek Environmental as a first cut in prioritizing structures for replacement or further study.

- An inventory of bridges of less than 20 feet in length was conducted by the Town of Strafford in 2003. The ANR bridge and culvert survey data were combined with the results of the Town of Strafford's survey of small bridges to set priorities for the replacement of structures at stream crossings based on geomorphic compatibility, fish passage, and structural integrity.

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1.0 INTRODUCTION

Bear Creek Environmental was retained by the Strafford Conservation Commission (SCC) to conduct a Bridge and Culvert Assessment of the West Branch of the Ompompanoosuc River (WBOR) Watershed limited to the Town of Strafford. The Vermont Agency of Natural Resources (ANR) Bridge and Culvert Assessment and Survey Protocols (dated April 2004) were used to conduct a rapid assessment of stream crossings. The assessment results were entered into the ANR bridge and culvert database. The objective of the study was to red-flag structures that are potential barriers to fish and wildlife movement and/or are flood or erosions hazards.

Mary Nealon (Principal) of Bear Creek Environmental was responsible for the overall assessment and Quality Assurance (QA) review of the project. Mary Nealon and Lindsay Harrington (Environmental Technician) were field task leaders on the project. Sally Mansur and Steve Faccio of the Strafford Conservation Commission assisted with the field data collection. Christa Alexandar (Restoration Specialist) with the Vermont Fish and Wildlife Department provided valuable assistance on prioritizing the bridge and culverts for replacement based on geomorphic compatibility and fish passage issues.

In addition to the rapid stream geomorphic and habitat assessment of bridges and culverts conducted by the Strafford Conservation Commission in 2004, other bridge and culvert information is available from the Town of Strafford. A bridge inventory of structures of 20 feet and under (minor structures) was conducted by the Town of Strafford during July 2003 and a list of proposed culverts to be replaced was prepared in 2003 by the town. Bear Creek Environmental has reviewed the information collected by the Town of Strafford to help prioritize the replacement of bridges and culverts based just not on geomorphic and habitat condition, but also taking into account the physical condition of the structure.

The bridge inventory of minor structures conducted in 2003 looked at the condition of the bridges and rated them as excellent, good, fair, poor, or critical & closed. Based on records provided by the Town of Strafford, a total of 16 minor structures were inventoried.
The Town of Strafford also generated a list in 2003 of proposed culverts to be replaced. The culverts were identified by road name and size of the structure. A cost for replacement of each of the structures was provided by the town. None of the culverts on the list to be replaced by the Town of Strafford appeared to coincide with the culverts located at stream crossing surveyed by the Strafford Conservation Commission.

2.0 METHODOLOGY

The Bridge and Culvert Assessment and Survey Protocols specified in Appendix G of the Vermont Stream Geomorphic Assessment Handbook (Vermont Agency of Natural Resources 2004) were followed. All assessment data were recorded on the Agency of Natural Resources (ANR) Bridge and Culvert Assessment – Geomorphic & Habitat Parameters data sheet, and were entered into Version 4 of the Bridge and Culvert database. An ArcView shapefiles of stream crossings for the State of Vermont " TRANS_TRANSTRUC_POINT" was downloaded from the Vermont Center for Geographic Information. This shapefile includes stream crossings on state and town roads. All the structures that fell within the Strafford town boundary were included in the assessment. With the exception of the Alpaca Farm Bridge in reach M05, no private bridges were included in the assessment.

The bankfull channel width was measured in the vicinity of each of the structures. This measurement was compared to the Vermont Regional Hydraulic Geometry Curves as a QA check. Latitude and Longitude at each of the structures was determined using a Garmin Etrex Vista GPS unit. The assessment included photo documentation of the inlet, outlet, upstream, and downstream of each of the structures.

3.0 RESULTS

Twenty-nine bridges and ten culverts were included in the bridge and culvert assessment (see Figure 1). The geomorphic and habitat data for the ANR bridge and culvert assessment are provided on pages 1 through 78 of Appendix 1. As shown on the reports on pages 1 and 2 of Appendix 2, all 39 structures were flagged on the ANR's culvert failure mode report for geomorphic incompatibility.

The habitat data from the ANR bridge and culvert assessment was used to identify potential barriers to movement and migration. The Bridge Wildlife Passage Report and the Culvert Aquatic Organism and Wildlife Passage Report from the assessment are provided on pages 3 and 4 of Appendix 2. Five of the ten culverts assessed were identified as blocking aquatic organism passage (AOP) under flow conditions that existed at the time of the survey (September 2004).

In order to assist the Town of Strafford with priorities for replacement of these structures, priority lists were generated using the information and photographs taken during the assessment. The bridge span and the culvert diameter as a percentage of the channel width were used as a first cut in prioritizing the structures for replacement. Bridges and culverts with channel widths of approximately 50 percent of the bankfull width or less, which were significantly impeding natural sediment transport were placed in Category 1. Structures which block AOP were also generally placed in the Priority 1 category. Therefore, the Priority 1 category contains structures that have highest priority for replacement due to geomorphic incompatibility and AOP.

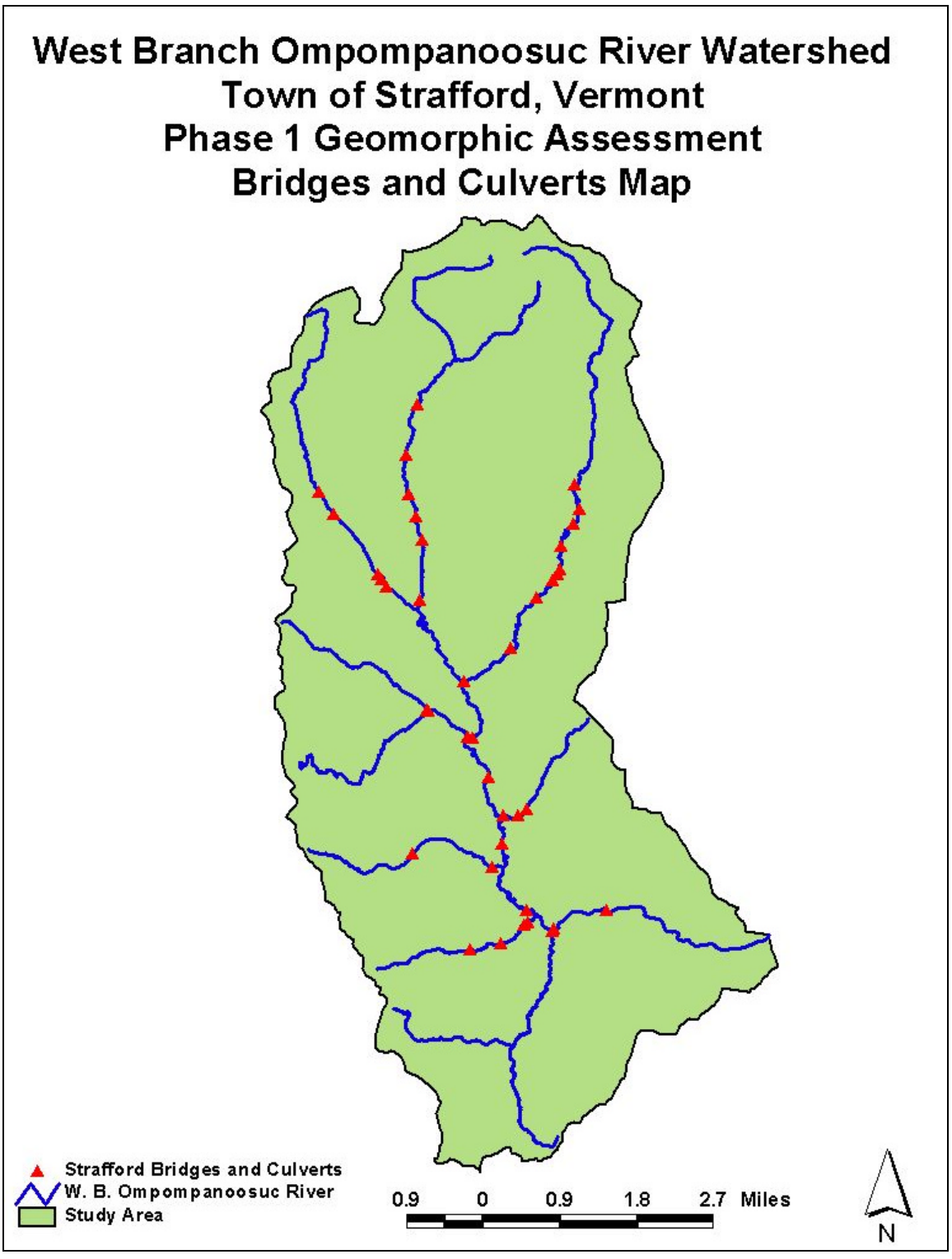

Figure 1. Bridges and culverts assessed during summer 2004 by the Strafford Conservation Commission using the ANR protocol

Category 2 structures included the remaining structures with percent bankfull widths less than 50%, which were not selected for Category 1. The priority 2 category is of lower priority for replacement, but still contains structures that may be incompatible in terms of sediment transport and aquatic organism passage. The priority 3 category contains stream crossings that have a percent bankful width which is greater than or equal to 50 percent.

3.1 Priority One Structures

The category 1 structures are summarized below in Table 1, and are identified on the map in Figure 2.

Table 1- Priority One Structures
Highest Priority for Replacement
Due to Sediment Transport and Fish Passage Issues

Structure #	Type	Location	% BF Width	Blocks AOP	Problems Noted By BCE	Condition Rated by Town of Strafford
58	Culvert	Van Dyke Road	19		Scour downstream of structure, riprap around outlet failing	
50	Bridge/ culvert	Van Dyke Road	19	*	Channel constriction	Fair
56	Culvert	Van Dyke Road	28	x	Downstream undermining, high debris jam potential	
31	Culvert	Alger Brook Rd.	29	x	Downstream undermining and armoring failing	
37	Bridge	Clover Hill Road	36		Stone footing failing, sediment obstruction	poor
19	Bridge	Old City Falls Road	37		Undermining, poor condition	poor
48	Bridge	White Road	38		Bridge failing, steep riffle upstream	poor
5	Culvert	Justin Morrill Mem Hwy	42	x	Extensive scour at outlet; upstream build up of sediment	

Table 1- Priority One Structures Highest Priority for Replacement Due to Sediment Transport and Fish Passage Issues						
Structure #	Type	Location	% BF Width	Blocks AOP	Problems Noted By BCE	Condition Rated by Town of Strafford
32	Culvert	Alger Brook Road	57	x	Extensive scour at outlet; upstream build up of sediment	
21	Bridge	Old City Falls Road	43		Undermining of footers; sediment obstruction	poor
26	Bridge	Justin Morrill Mem Hwy	43		Steep riffle, some sediment build up above structure	Fair
* =Culvert blocks aquatic organism passage (AOP) of all fish and stream salamanders, except for adult salmonids x = Culvert blocks aquatic organism passage of all fish and stream salamanders including adult salmonids						

Blocks Aquatic Organism Passage

Structure # 50, 56, 31, 5, and 32 are culverts that have been included as Category 1 structures because they were identified as blocking aquatic organism passage under flow condition found at the time of the assessment. The following conditions must be met at the time of the assessment for a culvert to be considered to block AOP of all fish (including adult salomonids) and stream salamander:

1. The culvert outlet configuration is free fall and the invert to the water surface distance is greater than or equal to 1.0 foot;

   OR

2. The water depth in the culvert at the outlet is less than 0.3 feet.

Structure 56 (see Figures 3 and 4 below) is an example of a culvert that blocks aquatic organism passage of all fish (including adult salmonids) and stream salamanders.

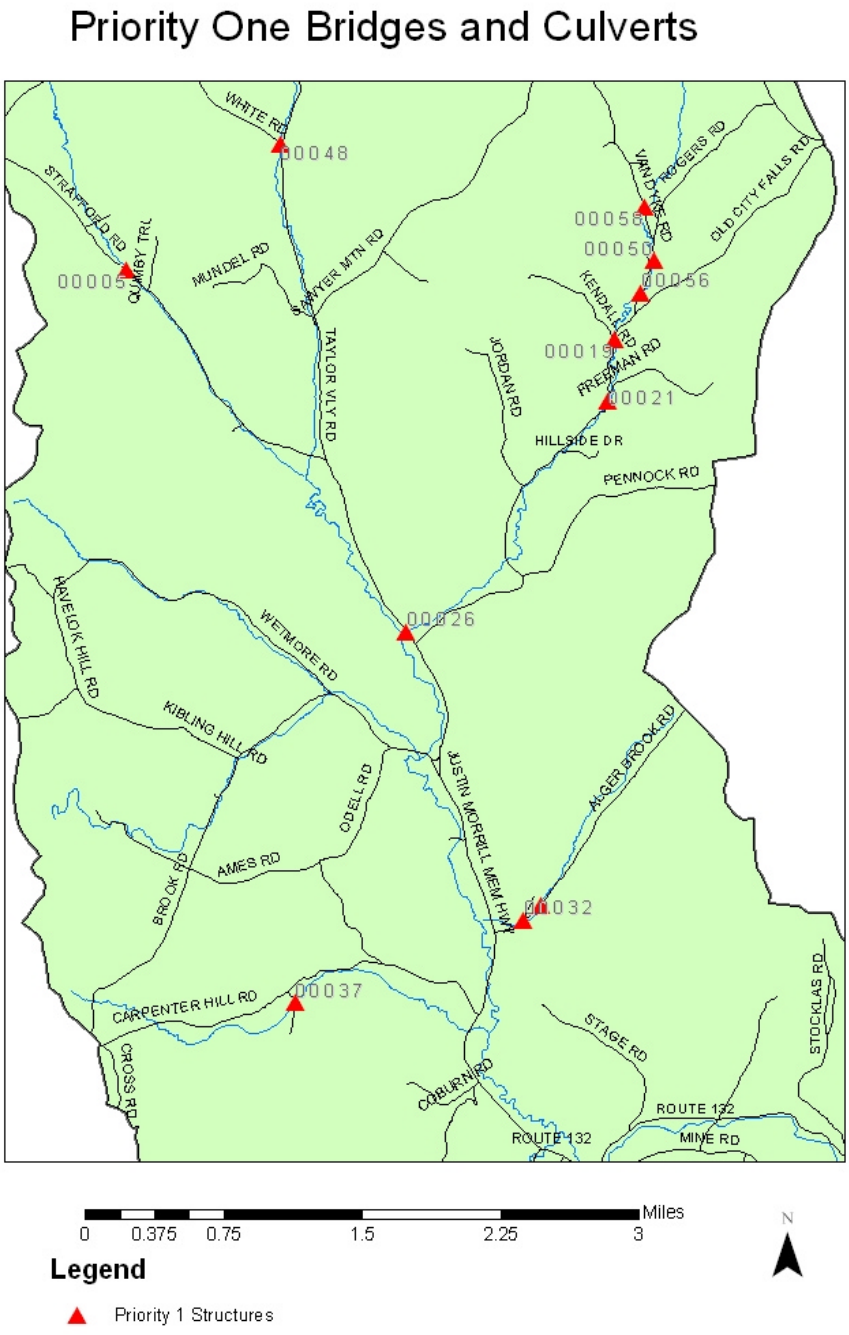

Figure 2. Stream crossings in Strafford, Vermont within the Ompompanoosuc River watershed considered to be high priority in terms of replacement due to geomorphic incompatibility, fish passage concerns, and condition.

Figure 3. Inlet of structure #56 on Van Dyke Road

Figure 4. The invert of the culvert outlet. Outlet of structure #56 is free fall.

Impedes Sediment Transport

Many of the structures within the Town of Strafford were noted to be undersized. Structure #37 is an example of a bridge that has a span that is only 36 percent of the bankful width. As shown in Figure 5, Structure #37 is impeding the natural movement of sediment. The structure opening is partially obstructed with sediment that has been transported by the stream. In addition, a steep riffle is present immediately upstream of the structure. This steep riffle is indicative of a depositional process that is being caused or exacerbated by the structure. The narrow span and limited clearance of the bridge make this structure prone to ice and debris jams.

Figure 5. Inlet of structure #37

Figure 6. Outlet of structure #37

Structure Condition

As previously noted, the condition of the structure was taken into consideration when prioritizing it for replacement. Ten of the sixteen minor bridge structures that were inventoried by the town were also included in the ANR's bridge and culvert survey conducted by the Strafford Conservation Commission. Of these ten structures, six of them were ranked as priority 1 structures by Bear Creek Environmental. The condition of priority one structure # 37, 19, 48 and 21 were rated by the Town of Strafford as poor, while structures 50 and 26 were rated in fair condition.

Alpaca Bridge

A private bridge at the Alpaca Farm, located off of Route 132, was included in the bridge and culvert survey at the request of the Strafford Conservation Commission. This bridge is at risk of failure due to the high rate of lateral migration in this stream reach. Sediment deposition was noted upstream of the structure indicating this structure is undersized. This structure was also flagged for poor location or alignment. Bear Creek Environmental would recommend that further studies be conducted within the vicinity of this private bridge to determine possible alternatives for the replacement of this structure.

3.2 Priority Two Structures

Based on the results of the ANR Bridge and Culvert Assessment, some of the structures with percent bankfull widths of less than fifty percent were placed in the list of priority two structures because they did not appear to be a high priority in terms of fish passage or sediment transport. A brief explanation of these structures is provided below.

Structure 51 – This bridge located on Taylor Valley Road was noted to have a footer that was undermined. This structure did not appear to be a barrier to fish passage or to impede sediment transport, and this structure was rated in good condition by the Town of Strafford. Protruding bedrock was noted on the right bank. It is recommended that if

possible that the right abutment be moved back to alleviate flow constriction and reduce footer/abutment scour potential.

Structure 49 - In 2003, this structure was rated in poor condition by the Town of Strafford. Since the time of this survey, this structure located on Dow Road appeared to be replaced or newly repaired. Material was placed inside the structure likely in an attempt to reduce undermining. Given the amount of constriction at bankfull flows it is likely this small material will not hold. Eventually a wider structure may be needed, but given the new structure and the lack of impact on the stream at this point, it is not a priority.

Structure 17 – The results of the ANR bridge and culvert survey indicate this structure, which is 55 percent of the bankfull width, blocks the passage of all fish and stream salamanders except for adult salmonids. No apparent sediment transport issues were noted, and this structure appears to be fairly new and in good condition. Rather than replacing this structure, it may be possible to retrofit the structure to eliminate the outlet perch or to possibly install a downstream grade control structure.

Structure 52- Although this structure is undersized and the span is only 43 percent of the bankfull width, there was no apparent sediment transport problems noted. Notes prepared by Bear Creek Environmental indicate the large stone masonry abutment on the left bank has the potential to fail. The Town of Strafford Inventory form for minor structures shows the bridge was replanked in 2000. Unless the potential for failure of the left abutment is a safety concern, the replacement of this structure is likely a low priority.

Structure 72 - No sediment transport issues relating to bridge Structure 72, located on Eastburn Road, were found during the Bridge and Culvert Assessment performed by Bear Creek Environmental and the Strafford Conservation Commission. The Inventory form for minor structures completed by the Town of Strafford in March 2003 indicates Structure 72 is in poor condition. Unless this structure is a high priority of the Town of Strafford's due to the condition, the replacement of this structure is of low priority.

Structure 2 – This culvert, located on Route 132 was noted to be at grade and was not a concern of blocking aquatic organism passage under the flow conditions at the time of the survey. Bank erosion was high downstream of the structure. Although no debris or sediment was observed within the structure, this structure may be an issue in terms of ice and debris jam potential. In addition, the structure may block aquatic organism passage under certain flow conditions. The structure appeared to be in good condition and is not recommended for replacement at this time. At some point in the future it may make sense to replace this culvert with a bridge or arch with a wider span, which will not restrict the movement of aquatic organisms.

3.3 Priority Three Structures

All of the remaining structures with culvert diameters or spans of greater than 50 percent bankfull width were placed in category three. At this time, the priority 3 structures are a lower priority for replacement. In the future, these structures could be further evaluated to assist the Town of Strafford with replacement.

4.0 RECOMMENDATIONS

The Vermont Fish and Wildlife Department and the Agency of Natural Resources are in the process of preparing a publication for the design and construction of stream crossings. This publication is expected to be available at some point in the near future for public review. Bear Creek Environmental recommends that the Town of Strafford acquire this design publication when available and work with the Agency of Natural Resources to provide stream crossings that offer geomorphic compatibility and passage for aquatic organisms and wildlife.

REFERENCES

Vermont Agency of Natural Resources. 2004. Vermont Stream Geomorphic Assessment, Appendix G: Bridge and Culvert Assessment and Survey Protocols. Waterbury, Vermont