Dear Sandi:

Re: Detailed Design North Milk River Streambank Stabilization at Hilmer Site 
NE 10 – 2 – 21 – W4M, Cardston County

1.0 INTRODUCTION

The Milk River Watershed Council Canada (MRWCC) retained AMEC Earth & Environmental (AMEC) to undertake engineering design services for the Milk River Streambank Stabilization Project. AMEC undertook this study in conjunction with Vince Petherbridge of Enviroscapes, who provided vegetation input for the assessment and design. The conceptual streambank stabilization designs for three candidate sites were contained in the report *Milk River Streambank Stabilization Project Conceptual Designs*, AMEC, May 2010.

This report contains a detailed design of the Hilmer site located on the North Milk River at NE 10-2-21-W4M, Cardston County. The Hilmer site was selected by the MRWCC as the preferred site for detailed design based on the contents of the Conceptual Design report. The Conceptual Design report should be referred to for a discussion of the items listed below since they are not replicated herein:

- Site description and historic channel movement.
- Hydrology.
- Description of stabilization and restoration techniques.
- Preliminary fisheries assessment.

The detailed design contained herein provides the basis for construction of the works. This report is also intended as the supporting information necessary for regulatory applications for environmental approvals and permits.

2.0 MRWCC SITE SELECTION

The conceptual designs for the following three candidate sites are contained in AMEC (May, 2010) and were presented to the MRWCC at a meeting in Lethbridge on 16 March 2010.

- Site 1 – North Fork Milk River – Hilmer Bridge, Cardston County, NE 10-2-21 W4M;
- Site 2 – Milk River – Weir Bridge, County of Warner, SE 8-2-13 W4M; and,
- Site 3 – Milk River – Gold Springs Park, County of Warner, NE 6-2-15 W4M.
The MRWCC selected Hilmer as the preferred site for detailed design based on the following considerations:

- The streambank stabilization cost for the Hilmer site was considerably less than the other two sites since the project is the smallest in scope and given Cardston County’s contribution of a significant portion of the materials and equipment for construction.
- The Hilmer site utilizes a number of stabilization and restoration techniques that may have widespread applicability on the Milk River.
- The North Milk River used to go dry much more frequently prior to the St. Mary’s diversion. The post-diversion flow regime should be more conducive to the establishment of cottonwoods and other vegetation that could not establish prior to the diversion as they were subject to extended dry periods. Fencing to exclude cattle and techniques to prevent beaver and rodent protection are required for the vegetation to establish.
- The Hilmer site does not require a Navigable Waters Protection Act (NWPA) application to Transport Canada since the proposed works comply with the NWPA ‘minor works’ requirements. Both the Weir Bridge and Gold Springs Park sites require NWPA applications to Transport Canada.

3.0 SITE SURVEY

AMEC undertook a topographic survey of the Hilmer site in March 2010, which was required to produce the detailed design drawings and conduct the detailed hydraulic analysis. The site survey shown in the drawings at the back of this report included several channel and floodplain cross sections and a channel thalweg profile.

4.0 DETAILED HYDRAULIC ANALYSIS

Hydraulic analyses were conducted using the HEC-RAS water surface profile computer model in order to determine the river flood levels at the site. The hydraulic analysis was based on the following:

- The channel and floodplain geometry were based on AMEC’s topographic survey.
- An overall channel gradient of 0.003 m/m based on the AMEC survey.
- The 2-year and 100-year flood estimate for North Milk River of 24.8 m$^3$/s and 100 m$^3$/s, respectively.
- Manning’s ‘n’ channel roughness coefficients of 0.021 for the 100-year flood and 0.027 for the 2-year flood, respectively. These values are based on engineering judgement and also a comparison with values of 0.018 for the 100-year flood and 0.024 for the 2-year flood, respectively, for the Milk River at Milk River contained in the publication *Hydraulic and Geomorphic Characteristics of Rivers in Alberta*, 1972, Kellerhals, Neill and Bray, Research Council of Alberta. The channel roughness coefficients are greater for the North Milk River since it has larger sized bed material than the Milk River.
- Manning’s ‘n’ and floodplain roughness coefficient of 0.05, based on engineering judgement.

The results of the hydraulic analysis are summarized in Table 4.1 and the water surface profiles and flood levels are shown on the attached Drawing 005.
TABLE 4.1
Detailed Hydraulic Analysis

<table>
<thead>
<tr>
<th>Flood Frequency Return Period (Years)</th>
<th>North Milk River at Hilmer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Water Depth (m)</td>
</tr>
<tr>
<td>1:2</td>
<td>1.8 to 2.3</td>
</tr>
<tr>
<td>1:100</td>
<td>2 to 3.3</td>
</tr>
</tbody>
</table>

5.0 DETAILED STREAMBANK STABILIZATION DESIGN

The Hilmer site detailed streambank stabilization design is shown on the attached drawings and consists of:

- Longitudinal Peak Stone Toe Protection (LPSTP) incorporating two rows of brush layering.
- Wattle fencing in upstream portion where the attack is not as severe. Pallisade to restore riparian buffer zone.
- Fencing to prevent grazing.
- Containerized shrub (2-gallon and plugs) planting in the swale parallel to the road approach from the south.

6.0 QUANTITY AND COST ESTIMATE

The quantity and cost estimate for the Hilmer site is detailed below in Table 6.1 and is based on Cardston County’s contribution of a significant portion of the materials and equipment for construction.

The following assumptions for the quality and cost estimate were based on discussions with the County and Enviroscapes:

- The County would provide an excavator for the duration of the project.
- Enviroscapes would act as field supervisor for the harvesting, storage and installation of the live cuttings for the brush layers, live palisades, willow wattle fence, and containerized shrubs.
- Most of the labour (5 to 6 people for the 13 day project duration) would be supplied by the County and MRWCC volunteers for the harvesting, and installation of the live cuttings.
- 90% of the riprap would be supplied by the County (assumes that some of the larger boulders may have to be obtained from a private source).
- The unit cost noted below for riprap is a factored value based on purchasing ten percent of the material from a private contractor and also hiring an operator for the excavator.
- An operator with experience in placing riprap would be hired for the duration of the project.
- Bedding gravel would be supplied by the County.
Native soil, topsoil, and native seed mix would be supplied by the County.

A nominal amount for Care of Water is included for erosion and sediment control measures such as silt fencing. This assumes no large scale isolation works such as cofferdams are required. If the site cannot be isolated with silt fence due to high water levels, then clean boulders for the base of the LPSTP will be will be placed without isolation. This approach must be further reviewed in the Aquatic Assessment and discussed with regulatory agencies. However, it has been successfully implemented in other recent projects in southern Alberta.

### TABLE 6.1
**Construction Cost and Quantity Estimate**

<table>
<thead>
<tr>
<th>Technique</th>
<th>Material</th>
<th>Unit Cost</th>
<th>Estimated Quantity</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longitudinal Peaked Stone Toe Protection (LPSTP)</td>
<td>Riprap (m³)</td>
<td>$ 50.00</td>
<td>260</td>
<td>$ 13,000.00</td>
</tr>
<tr>
<td>Bedding Gravel (m³)</td>
<td>$ -</td>
<td>30</td>
<td></td>
<td>$ -</td>
</tr>
<tr>
<td>Care of Water</td>
<td>$ 1,500.00</td>
<td>1</td>
<td></td>
<td>$ 1,500.00</td>
</tr>
<tr>
<td>Brush Layers behind LPSTP</td>
<td>Cost is per metre</td>
<td>$ 70.00</td>
<td>70 m</td>
<td>$ 4,900.00</td>
</tr>
<tr>
<td>Native Soil (m³)</td>
<td>$ -</td>
<td>200</td>
<td></td>
<td>$ -</td>
</tr>
<tr>
<td>Topsoil (m³)</td>
<td>$ -</td>
<td>50</td>
<td></td>
<td>$ -</td>
</tr>
<tr>
<td>Native Seed (m²)</td>
<td>$ -</td>
<td>260</td>
<td></td>
<td>$ -</td>
</tr>
<tr>
<td>Coir Fabric (m²)</td>
<td>$ 10.00</td>
<td>260</td>
<td></td>
<td>$ 2,600.00</td>
</tr>
<tr>
<td>Live Palisade</td>
<td>Cost is per metre</td>
<td>$ 55.00</td>
<td>140 m</td>
<td>$ 7,700.00</td>
</tr>
<tr>
<td>Willow Wattle Fence</td>
<td>Cost is per metre</td>
<td>$ 90.00</td>
<td>20 m</td>
<td>$ 1,800.00</td>
</tr>
<tr>
<td>Containerized Shrub Planting</td>
<td>Includes partial labor, shrub material (sixteen plugs and sixteen 2-gallon pots), and rodent protection collars</td>
<td>$ 1,300.00</td>
<td>LS</td>
<td>$ 1,300.00</td>
</tr>
<tr>
<td>General Construction Requirements</td>
<td>Fencing (m)</td>
<td>$ 10.00</td>
<td>100 m</td>
<td>$ 1,000.00</td>
</tr>
<tr>
<td><strong>Total Materials and Construction</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$ 33,800.00</strong></td>
</tr>
<tr>
<td><strong>30% Contingency</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$ 10,200.00</strong></td>
</tr>
<tr>
<td><strong>Total Construction Cost</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>$ 44,000.00</strong></td>
</tr>
</tbody>
</table>
Table 6.2 contains the plant materials list for the various treatments.

### TABLE 6.2
**Plant Materials List**

<table>
<thead>
<tr>
<th>Treatment Length</th>
<th>Species (see note 1)</th>
<th>Number of Cuttings/Plantings</th>
<th>Length &amp; Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brush Layer = 70 m</td>
<td>Any Salix sp. Beaked, Yellow and Smooth Willow are most common</td>
<td>70 m * 20 cuttings/m * 2 layers = 2800 cuttings</td>
<td>Length = 2 – 3 m Dia = 30 mm (min)</td>
</tr>
<tr>
<td>Wattle Fence = 20 m</td>
<td>Any Salix species available, as above</td>
<td>20 m * 18 cuttings/m =360 cuttings</td>
<td>Length = 2 – 3 m Dia = 30 mm (min)</td>
</tr>
<tr>
<td></td>
<td>Larger willow or Narrow Leaf Cottonwood, Balsam Poplar (Black Poplar)</td>
<td>20 m * 2 posts/m = 40 posts</td>
<td>Length = 3 – 4 m Dia = 100 mm (min)</td>
</tr>
<tr>
<td>Live Pallisade = 140 m</td>
<td>Any Willow species, Red Osier Dogwood, Smaller diameter N L Cottonwood or Balsam Poplar</td>
<td>20 m * 14 cuttings/m = 280 cuttings</td>
<td>Length = 2 – 3 m Dia = 30 mm (min)</td>
</tr>
<tr>
<td></td>
<td>Typically, either Cottonwood species as above</td>
<td>20 m * 7 posts/m = 40 posts</td>
<td>Length = 3 – 4 m Dia = 100 mm (min)</td>
</tr>
<tr>
<td>Containerized Shrub Plantings</td>
<td>A mixture of plugs and containerized plants, depending on availability. Thorny Buffalo Berry, Wolf Willow, Red Osier Dogwood, Yellow Willow</td>
<td>16 Plugs Sixteen 2-Gallon Pots</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Notes:**

1. As shown above a mixture of species could potentially be used for a given treatment. The proportion of a particular species used will be determined during construction and will be based on species availability.
2. Bow Point Nursery (Phone # 403 – 686 – 4434) can be contacted regarding the availability of the containerized species list as they may be able to provide the size and quantity with a one year advance notice.

Table 6.3 outlines the environmental and engineering services costs for future phases of the project and is based on the following assumptions:
• The Qualified Aquatic Environmental Specialist (QAES) assessment would be conducted by a consultant. This Fisheries Assessment may not be required since the works are not expected to adversely affect the site but rather enhance the site. The requirement for a fisheries assessment will be discussed with the regulators during the environmental approval application process.

• The MRWCC would handle most of the liaison required for permitting with Department of Fisheries and Oceans, Alberta Sustainable Resource Development and Alberta Environment; however, AMEC would assist with this process.

• Engineering inspections during construction would be undertaken frequently by the consultant.

• Water Quality monitoring during construction (if required) would be undertaken by the MRWCC.

### TABLE 6.3
Environmental and Engineering Services Cost Estimate

<table>
<thead>
<tr>
<th>Task</th>
<th>Personnel Hours</th>
<th>Personnel Cost (per hour)</th>
<th>Expenses</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fisheries Assessment</td>
<td>120</td>
<td>$ 115.00</td>
<td>$ 1,000.00</td>
<td>$ 14,800.00</td>
</tr>
<tr>
<td>Client and Regulatory Liaison</td>
<td>20</td>
<td>$ 115.00</td>
<td>$ 200.00</td>
<td>$ 2,500.00</td>
</tr>
<tr>
<td>for Environmental Permitting</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction Services</td>
<td>90</td>
<td>$ 115.00</td>
<td>$ 2,050.00</td>
<td>$ 12,400.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>300</strong></td>
<td></td>
<td></td>
<td><strong>$30,000.00</strong></td>
</tr>
</tbody>
</table>

In summary, the total future project cost including engineering and environmental services and construction, based on the contributions made by Cardston County is **$77,000.00**. Further cost savings based on contributions from the County may be possible (e.g. if 100% of the riprap is supplied by the County and/or the County can supply an excavator operator experienced in riprap placement). Hence, with those additional contributions, the anticipated costs could range from $60,000 to $70,000.

### 7.0 TIMING

The Restricted Activity Period (RAP) for the Hilmer Bridge site is problematic since the allowable instream construction window (April 16 to September 15) coincides with the period of high diversion flows. ASRD was contacted regarding conducting construction during the restricted activity period. The restricted activity period in the early spring (February/March) was waived (pers. comm., T. Clayton). No instream construction can occur during the restricted activity period in the fall (October/November) to protect spawning mountain whitefish in the vicinity of the Hilmer Bridge.

There are three key factors to consider for the timing of construction. The first is that the diversion flows start on or near April 1 each year. The second is the fact that the project duration will likely be two to three weeks to complete the construction. The third is that it is necessary that the live
cuttings are harvested when the plants are dormant. Therefore, the best opportunity for construction based on these three factors is March 1st to March 21st, 2011.

8.0 CLOSURE

This report has been prepared for the exclusive use of the Milk River Watershed Council Canada for specific application to the area within this report. This report is based on and limited by the interpretation of data, circumstances, and conditions available at the time of completion of the work as referenced throughout the report. AMEC Earth & Environmental has performed its services in a manner consistent with the standard of care and skill ordinarily exercised by members of the profession practicing under similar conditions in the geographic vicinity and at the time the services were performed. AMEC Earth & Environmental believes that this information is accurate but cannot guarantee or warrant its accuracy or completeness including information provided by third parties.

Recommendations presented herein are based on an evaluation of the findings of the office and field investigations noted. If conditions other than those reported are noted during subsequent phases of the project, AMEC should be notified and be given the opportunity to review and revise the current recommendations, if necessary.

Yours truly,

AMEC Earth & Environmental

Reviewed by:

Senior Water Resources Engineer
Direct Tel.: (403) 387-1669
Direct Fax: (403) 248-1590
E-mail: liv.hundal@amec.com

Gary R. E. Beckstead, M.Sc., P.Eng
Senior Associate

Chad Nixon, B.Sc., E.I.T.
Water Resources Engineer

Permit to Practice No. P-4546
DETAILED DESIGN DRAWINGS