



September 8, 2008

CG25277.B

Alberta Transportation  
2<sup>nd</sup> Floor, 803 Manning Road NE  
Calgary, AB T2E 7M8

Attn: Mr. Ross Dickson

**Re: Southern Region Geohazard Assessment Program  
Site S32 – Bow River Upstream Of Crowfoot Ferry, Highway 56  
2008 Annual Inspection Report**

This letter documents the 2008 annual site inspection of Site S32 – Bow River Upstream Of Crowfoot Ferry, along Highway 56 and approximately 4.4 km southbound from the intersection between Highway 56 and Highway 1.

AMEC Earth & Environmental (AMEC), a division of AMEC Americas Limited, performed this inspection in partial fulfillment of the scope of work for the supply of geotechnical services for Alberta Transportation's (AT's) Southern Region (AT contract CE061/08).

The site inspection was performed on June 20, 2008 by Mr. Andrew Bidwell, P.Eng. and Mr. Bryan Bale of AMEC in the company of Mr. Ross Dickson and Mr. Roger Skirrow of AT.

## **BACKGROUND**

The June 2008 site inspection by AT and AMEC personnel was the first inspection of this site under the Southern Region Geohazard Assessment Program. The site was added to the 2008 inspection list because AT personnel had recently noted active erosion and slope instability along the left (east) bank of the Bow River adjacent to the highway.

## **SITE OBSERVATIONS**

Key observations from the June 2008 inspection were as follows:

- This segment of Highway 56 is a two lane, gravel road leading to the Crowfoot vehicle ferry approximately 200 m southbound from the site.
- The Bow River channel meanders significantly in this area, as shown on the airphoto on the attached Figure S32-1. The left (east) bank of the river at this site is along the

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outside of a meander bend. The Bassano Dam across the Bow River is approximately 10 km downriver from this site, and the upper reaches of the reservoir behind the Bassano Dam are approximately 3 km downriver from this site.

- There is significant bank erosion and a landslide along an approximately 200 m long segment of the left (east) river bank. The bank erosion appears to be triggering retrogressive slumping of the approximately 10 m high slope between the river bank and the adjacent upland area. The extent of the erosion and landsliding is illustrated on the schematic site plan on Figure S32-2.
- The minimum offset between the scarp of the landsliding and the fenceline along the west side of the road was 1.7 m at the time of the June 2008 site inspection. A cross-section through the slope at this minimum offset location is shown on Figure S32-3.
- The soils exposed in the landslide scarps consist of rounded to subrounded gravel to cobble sized rocks within a matrix of fine grained sand and fines. These soils are consistent with fluvial deposits on an old floodplain of the river.
- Exposed bedrock was visible along the waterline immediately upriver and downriver of the landslide toe. The bedrock exposure could not be inspected up close, but published geological mapping of the area shows that the bedrock should consist of clayey sandstone, bentonitic mudstone and carbonaceous shales of the Horseshoe Canyon Formation.

## ASSESSMENT

The landsliding adjacent to the highway is due to ongoing erosion along the east bank of the river. To date, the headscarp of the landsliding has not retrogressed across the west fenceline and into the highway right-of-way. However, if the river bank erosion causing the landsliding continues and the oversteepened upper portion of the landslide area retrogresses back to at 15 to 20° inclination similar to the existing slope in the lower portion of the landslide area, then an approximately 50 to 70 m long segment of the highway may be directly undermined by the landsliding in the future.

The risk to the highway from the landsliding could be mitigated with one of the following strategies:

- Establish erosion protection along the east bank of the river and stabilize the existing slope in the upper portion of the landslide area.
- Install a pile wall or equivalent measures to support the road surface adjacent to the landslide area.

- Eastward relocation of the highway, likely by 10 to 15 m, to a sufficient setback from the landslide area.

Significant erosion protection measures would likely be required for a river channel of this magnitude and the design of such measures would need to take into account the Crowfoot Ferry crossing a short distance downriver. Furthermore, the regulatory and environmental permitting process for significant bank protection work along the Bow River could be relatively onerous. For the likely low summer traffic counts along this segment of the highway (and presumably local traffic only during the winter months when the ferry does not operate), the most cost-effective approach may be to shift the road to the east. The site appears to be located within the Blackfoot Indian Reserve, the right-of-way acquisition aspects of which will need to be considered if contemplating shifting the highway alignment.

## **RISK LEVEL**

The recommended Risk Level for this site, based on AT's general geohazard risk matrix, is as follows:

- Probability Factor of 9 based on the active movement but with an assumed moderate, steady rate of movement.
- Consequence Factor of 4 to account for the potential for at least a partial closure of the existing road could be required if an increment of landslide movement in the near-future retrogresses eastwards through the fenceline and undermines the west shoulder of the road.

Therefore, the recommended Risk Level is 36. This may be slightly conservative if the rate of landslide movement is such that the west edge of the road will not be undermined in the near-future (e.g. in the next 5 years). However, this Risk Level is judged appropriate until future site inspections can be used to check the rate and progress of slope crest retrogression towards the west fenceline.

## **RECOMMENDATIONS**

### **Maintenance and Short Term Measures**

None recommended.

## **Investigation and Long Term Measures**

- A review of site airphotos, available river flow data and the information from the June 2008 inspection should be performed by a hydrotechnical engineer in order to assess if the current pattern and intensity of erosion along the east bank will continue or change in the near future, and from that interpret whether or not the active landsliding will continue or possibly worsen (or become less active). Such a review should also provide a basis to confirm the length of the highway segment that should be shifted eastward, if necessary.

If the assessment confirms that the landsliding will continue then AT should look into an eastwards relocation of the highway by 10 to 15 m. The cost for the assessment described above should be \$10,000 or less. AMEC can provide a proposed scope and cost estimate for this task to AT upon request.

Alternatively, the segment of the highway adjacent to the landslide could be shifted eastwards based solely on “guess-timates” of the length of road segment to be shifted and the magnitude of the shift.

- The site should be inspected again by AT and AMEC personnel during the 2009 annual inspection tour in order to check the site conditions and the position of the landslide headscarp relative to the fenceline west of the highway.

## **CLOSURE**

This report has been prepared for the exclusive use of Alberta Transportation for the specific project described herein. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it are the responsibility of such third parties. AMEC Earth & Environmental, a division of AMEC Americas Limited, cannot accept responsibility for such damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This report has been prepared in accordance with accepted geotechnical engineering practices. No other warranty, expressed or implied, is made.

We trust that this meets your needs at this time. Please contact the undersigned if you have any questions or require any further information.

Respectfully Submitted,

**AMEC Earth & Environmental,  
a division of AMEC Americas Limited**

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Associate Geological Engineer

APEGGA Permit to Practice No. P-04546

Reviewed by:

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Attachments: Airphoto  
Site Plan  
Cross-Section  
Photos