



September 29, 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 S3 – Cochrane, Highway 22:16  
2008 Annual Inspection Report**

This letter documents the 2008 annual site inspection of Site S3 – Cochrane, on Highway 22:16, south of Cochrane, AB and approximately 1 km southbound from the Highway 22 bridge over the Bow River. This site is located on the upper portion of the south slope of the Bow River valley, and has been monitored under the Geohazard Assessment Program due to landsliding on the slope below/northeast of the highway that appears to be encroaching into the highway surface.

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 19, 2008 by Mr. Andrew Bidwell, P.Eng., and Mr. Bryan Bale, EIT of AMEC in the company of Mr. Roger Skirrow of AT.

## **BACKGROUND**

A general description of the geohazard conditions at this site along with the site geological setting and chronology of previous events, investigations, monitoring and repair work were provided in the Geotechnical File Review (Section A of binder) and summarized in previous annual inspection reports<sup>1</sup>.

The landsliding at this site has been monitored by AT and their consultants since the early 1990's. AMEC understands that no major repairs have been performed at this site to date, however some redirection of surface runoff and regrading/lining of the road sideslope and ditch may have been done (no documentation of this found during the file review).

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<sup>1</sup> AMEC report "Southern Region Geohazard Assessment, Annual Assessment Report, 2007", project number CG25263, submitted to AT on November 6, 2007.

## SITE OBSERVATIONS

There were no fundamental changes in the visual appearance of the slumping on the slope below the highway, nor to the pattern of cracking and settlement in the northbound lane of the highway, since the 2007 inspection.

- The cracking and settlement along an approximately 30 m segment of the northeast shoulder and northbound lane of the highway that has been noted in the annual inspections starting in 2005 continues to be visible and has re-formed through several patches and overlays in recent years. Photos S3-1 and S3-2 show this area.
- The location and pattern of the cracking appears to delineate the headscarp of a rotational landslide that has retrogressed into the central portion of the northbound lane.
- The apparent headscarp noted above aligns with a tension crack and lateral separation in the ditch berm, as illustrated on the attached site plan and shown in Photo S3-4. The lateral separation in the ditch berm had a 500 to 600 mm high scarp and aperture at the time of the site inspection.
- The visible tension cracks and slump blocks on the slope below the road did not appear to have changed significantly since the 2007 inspection. Photo S3-3 shows this area. As shown on the attached cross-section, tension cracks were visible as far upslope as SI 2007-1. There were no discernable tension cracks or other landslide features between SI 2007-1 and the highway, aside from the above-noted breach in the ditch berm.

The readings of the functioning instrumentation at this site in May 2008 showed continuing shallow downslope movement (e.g. less than 3 m depth) in several of the SI's at this site, however the data up to the spring of 2008 does not confirm a link between the visible active slumping downslope of SI 2007-1 and the cracking and settlement in the northbound lane and across the ditch berm in recent years. Please refer to the Spring 2008 instrumentation monitoring report for this site for a more detailed presentation of the instrument data.

## **ASSESSMENT**

There is a risk to the integrity of the northbound lane of the highway at this site based on the ongoing cracking and settlement of the road surface since 2005. This damage appears to be due to shallow movement (e.g. less than 3 m depth) of the slope below the highway but may also be linked to slightly deeper-seated movement in the slumping area downslope of SI 2007-1 (i.e. around and downslope of the fenceline on the slope below the highway).

In recent years the damage to the northbound lane of the highway has been managed as a maintenance issue and based on the instrument monitoring data and annual site inspections it does not appear that the rate and magnitude of damage to the northbound lane will increase significantly in the near-term. Also, the existing instrumentation at site provides monitoring for a link between the apparent shallow movement causing the damage to northbound lane and possibly deeper-seated movement occurring further downslope below the highway.

However, the lateral separation/breach of the ditch berm makes it possible for peak ditch flows to flow downslope into the area with open tension cracks (around SI 2007-1 and further downslope). If this occurs, the water flowing into the open tension cracks could trigger a significant acceleration of the ongoing movement in this area and cause it to retrogress further upslope towards the highway.

## **RISK LEVEL**

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

- Probability Factor of 9 in order to reflect the ongoing slope movement observed in the area around and downslope of SI 2007-1 as well as ongoing shallow movement in several of the other SI's.
- Consequence Factor of 3 based on the magnitude of damage to the northbound lane in recent years that has been managed as a maintenance issue.

Therefore, the current recommended Risk Level for this site is 27, which is unchanged since the 2005 assessment.

## **RECOMMENDATIONS**

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

- Road surface patching and overlays as required to mitigate the settlement and cracking along the shoulder and in the northbound lane.
- AT's maintenance contractor should perform repairs to the breach in the ditch berm (Photo S3-4) and adjacent portions of the ditch liner as necessary to restore the integrity of the berm and prevent ditch flow from entering or percolating downwards into the slope movement area downslope of the highway. The intent is to have the ditch flow across this area contained within the ditch by a continuous ditch berm of sufficient height along with an impermeable ditch liner. The details of the required repair will need to be a "field fit" after removing the cobble cover over the existing, damaged ditch liner and soil excavation as required in order to develop sufficient working space to repair or replace with an impermeable liner.

### **Long Term Measures**

- Consideration of installing a pile wall to support the approximately 30 m segment of the northbound lane that has been damaged by the ongoing cracking and settlement.
  - A ballpark cost for a pile wall is \$500,000 to \$750,000
  - This possible cost will need to be considered vs. the ongoing maintenance cost and effort in the context of the recommended Risk Level of 27 for this site.
  - AMEC can perform the design of a pile wall with the existing subsurface data from this site, if requested.
  - It is understood that this segment of the highway may be twinned in the future – it may be preferable to install a pile wall in conjunction with the twinning work.
- The semi-annual readings of the functioning instruments should be continued.
- The annual site inspections should be continued.

### **Investigation**

No further investigation work for this site is recommended at this time.



## **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**

Andrew Bidwell, M.Eng., P.Eng.  
Associate Geological Engineer

APEGGA Permit to Practice No. P-04546

Reviewed by:

Pete Barlow, M.Sc., P.Eng.  
Principal Geotechnical Engineer

Attachments: Site Plan  
Cross-Section  
Photos