



August 28, 2009

CG25309.B

Alberta Transportation
2nd 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
2009 Annual Inspection Report**

This letter documents the 2009 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 11, 2009 by Mr. Andrew Bidwell, P.Eng., and Mr. Bryan Bale, EIT of AMEC in the company of Mr. Neil Kjelland, P.Eng., Mr. Ross Dickson and Mr. Paul Prout 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 reports¹.

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,

¹ AMEC report "Southern Region Geohazard Assessment, Annual Assessment Report, 2008", project number CG25277, submitted to AT on September 8, 2008.

however some redirection of surface runoff and regrading/lining of the road sideslope and ditch has been done (no documentation of this found during the file review).

SITE OBSERVATIONS

A summary of observations and discussions on site with the AT personnel from the June 2009 inspection is as follows:

- The cracking and settlement area along an approximately 30 m segment of the northeast shoulder and northbound lane of the highway that has had visible cracking since 2005 was patched a few days before the inspection. The recent extent and pattern of the cracking appeared to continue to delineate the headscarp of a rotational landslide that has retrogressed into the central portion of the northbound lane. Figure S3-1 shows the location of this patch, as does Photo S3-2. AMEC understands that as part of the repair, the road bed was excavated to a depth of 1.5 m and rebuilt with granular fill. The excavated soil was described as wet but suitable for road base material.
- The segment of the road ditch through the site had been repaired a few days before the inspection. As part of the repair, the ditch berm was reconstructed and a new liner was installed. The liner was a rubbery, apparently impermeable membrane and was incompletely buried at the time of the site inspection (see Photo S3-5 for an example of exposed liner). The finished ditch gradient was not uniform and a bit irregular in places, but is likely functional to ensure positive ditch drainage away from the site. The recently graded fill needs to be vegetated to resist erosion. Photos S3-1, S3-3, and S3-5 illustrate the condition of the ditch following the repairs.
- The visible tension cracks and slump blocks on the slope below the road did not appear to have changed significantly since the 2008 inspection. Photo S3-4 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.

The readings of the functioning instrumentation at this site in May 2009 showed continuing shallow downslope movement (e.g. less than 3 m depth) in several of the SI's at this site. Please refer to Figure S3-2 for a cross-section at the site, and to the Spring 2009 instrumentation monitoring report² for this site for a more detailed presentation and discussion of the instrument data.

² AMEC report "Southern Region Geohazard Assessment, Spring 2009 Instrumentation Monitoring Results, Site S3: Highway 22:16, COCHRANE", submitter to AT June 19, 2009.

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). However, the instrument data up to the spring 2009 readings does not show a definitive link between the damage to the road surface and the slumping area downslope of the fenceline. The June 2009 repairs to the ditch should prevent the possibility of peak ditch flows leaving the ditch and draining into the area around SI 2007-1 and further downslope with open tension cracks. This is favourable with respect to the slumping downslope from the road however likely will not address the ongoing shallow movement being measured at the SI's closer to the road.

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.

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.
- The segment of the repaired ditch should be graded further to a more uniform ditch gradient, and the exposed portions of the new ditch liner should be buried. Vegetation should be established on the recently graded fill. AMEC understands that this work is planned for the Summer 2009 following the replacement SI installation at this site.

Long Term Measures

Previous annual assessment reports have noted that a pile wall should be considered as a repair option for this site, with a ballpark estimated cost in the range of \$500,000 to \$750,000. However, AT should consider the possible cost for such a repair vs. the ongoing maintenance cost and effort in the context of the recommended Risk Level of 27 for this site. It is also understood that this segment of the highway may be twinned in the future and that 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**

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APEGGA Permit to Practice No. P-04546

Reviewed by:

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Principal Geotechnical Engineer

Attachments: Site Plan
Cross-Section
Photos