December 2013

CG25399

Alberta Transportation
2nd Floor, 803 Manning Road NE
Calgary, AB T2E 7M8

Attention: Mr. Ross Dickson

Dear Ross:

Re: Southern Region Geohazard Assessment
2013 Annual Inspection Report
Site S5: Highway 36:02, Chin Coulee

This report documents the 2013 annual site inspection of Site S5 – Chin Coulee, on Highway 36:02, approximately 20 km south of Taber, AB on the north approach slope to the highway bridge across the Chin Coulee Reservoir. This site is located on the upper portion of the north slope above the Chin Coulee Reservoir, where the highway is oriented cross-slope as it descends to the bridge across the reservoir.

AMEC Environment & Infrastructure (AMEC), a division of AMEC Americas Limited, performed this inspection in partial fulfilment of the scope of work for the supply of geotechnical services for Alberta Transportation's (AT's) Southern Region (AT contract CON0013506).

The site inspection was performed by Bryan Bale, P.Eng., Hugh Wang, P.Eng., and Tyler Clay, E.I.T., of AMEC; and Roger Skirrow, P.Eng., and Ross Dickson of AT during the May 2013 Annual Tour.

1.0 SUMMARY

The site condition is relatively unchanged from the 2011 inspection. The retaining wall is in poor condition and no longer supports the road. Movement within the disturbed slide mass is ongoing along the previously observed extents. Risk has been reduced from construction of a detour in the upslope ditch. Only one slope inclinometer remains in operation, reducing the ability to effectively monitor deep slide activity and increasing risk. The overall risk level has increased to 25 from 20 assigned in 2011. The semi-annual readings should be continued. The annual site inspections should be discontinued unless conditions are observed to significantly change by the MCI or during the instrument monitoring.

AMEC Environment & Infrastructure
A Division of AMEC Americas Limited
140 Quarry Park Boulevard SE
Calgary, Alberta, CANADA T2C 3G3
Tel: +1 (403) 248-4331
Fax: +1 (403) 248-2188
www.amec.com

2.0 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[1].

Landslide movement undermining the downslope shoulder of the highway was first noted by AT in the fall of 1978 and was reported to have occurred again in the spring of 1997. The landsliding consisted of deep-seated instability (apparently inactive to intermittently active) in the north valley slope along with relatively shallower movements in the fill embankment immediately downslope of the affected segment of the highway. Geotechnical instrumentation was installed at this site in 1998 and the site has been monitored by AT and consultant personnel since that time.

Launched soil nails and a small retaining wall ("GCS wall" – supplier's product name of Geosynthetically Confined Soils) were installed in May 2008 in order to reinforce the headscarp of the shallower, fill embankment landsliding where it had undermined a segment of the guardrail. Please refer to AMEC's report to AT on observations from site visits during the soil nailing and wall construction[2] for further details.

3.0 SITE OBSERVATIONS

Key observations regarding changed site conditions since the 2011 inspection are summarized as follows, and illustrated on Figure S5-1 and Photos S5-1 to S5-5:

- A detour was constructed in the north (upslope) ditch with room for future upslope road shift, if necessary.

- The retaining wall was in poor condition, with additional deterioration since the 2011 inspection due to continued movement of the slide mass on which the wall was founded. The wall appeared to have settled 3 m to 4 m below the road elevation since construction. The wall was deformed but intact. Refer to Photo S5-1.

- Cracks were observed in the northbound lane offset 6 m from the edge of the concrete barrier to the east of the main slide encroachment area. The cracks were traced for approximately 6 m with 10 mm aperture and no vertical displacement. Refer to Photo S5-2.

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1 AMEC Environment & Infrastructure, 2008, *Southern Region Geohazard Assessment, Annual Assessment Report, 2008*, Project Number CG25277, Report submitted to AT on September 8, 2008.

2 AMEC Environment & Infrastructure, 2008, *Highway 36:02, Site S5 – Chin Coulee, Soil Nailing and GCS Wall Construction, Observations from Site Visits During Construction*, Project Number CG25276, Report submitted to AT on May 27, 2008.

- The retrogression of the landslide headscarp into the road surface appeared unchanged since the 2010 inspection. Diversion barriers were setup around the headscarp. Refer to Photo S5-3.

- The slide mass continued to deform within the same extents since the 2011 inspection, based on observations of the headscarp and flanks. The extent of the slide mass was unchanged. In an active slide area observed during the 2011 inspection west of the wall, there was downslope movement and erosion of the disturbed slide mass material. Refer to Photos S5-4 and S5-5 for a comparison of this area from the 2011 and 2013 inspections.

4.0 ASSESSMENT

4.1 Shallow Landsliding (Fill Embankment along Downslope Side of Road, Undermining the Guardrail)

The risk to the road surface from the shallower, fill embankment movements that were undermining the guardrail was reduced by the construction of the retaining wall and soil nails. The soil nails continue to provide support, however the retaining wall is no longer useful. The risk was reduced by shifting the road into the north ditch.

The Spring 2013 instrument readings of SI GA98-2 show continued minor movement at 8 m depth. This SI is located at the downslope road edge to the west of the main slide encroachment, and the detected movement may indicate retrogression of the landslide into the road surface in this area. SI 2002-1, installed in the upslope ditch, is no longer accessible due to the detour construction, although historically this SI has not shown slope movement. The reduction in monitoring capability combined with the ongoing slide movement increases the uncertainty of potential slide retrogression.

4.2 Potential Deep-Seated Landsliding

The tension cracks and scarps noted on the slide mass below the wall indicate that the colluvium within the old slide area continues to creep or slide down the slope. This may indicate a retrogressive type failure in the long-term.

The spring 2008 repair work was targeted to address the shallower, fill embankment movements and does not have any effect on the risk to the road from a potential reactivation of the overall deep-seated landsliding at this site. The risk to the highway from deep-seated landsliding has been managed by the planning and preliminary design for an upslope shift of the highway alignment as part of the 2004 Functional Planning Study. If required in the future, AMEC could quickly finalize this repair design if there was a reactivation of deep-seated landsliding that caused significant damage to the highway.

5.0 RISK LEVEL

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

5.1 Shallow Landsliding (Fill Embankment along Downslope Side Of Road, Undermining The Guardrail)

- Probability Factor of 11 based on the apparent increasing rate of slow to moderate ongoing shallow movement in the slope below the highway and west of the retaining wall (i.e. the ground movement that sheared-off SI 98-3 on the slope below the highway shortly after it was installed in 1998). The functioning SI at this site is outside of the shallow landsliding, therefore the movement has been conservatively assumed to be ongoing. This is consistent with the observations of cracking and scarps in the slide mass.

- Consequence Factor of 1 based on the potential loss of a portion of the roadway but not requiring closure of the entire roadway. This is the same value recommended in 2010, and is higher than the value of 1 recommended after the 2009 inspection (i.e. while the retaining wall was still effective).

Therefore, the current recommended Risk Level with respect to the shallow landsliding is 11, which is unchanged from 2011.

5.2 Potential Deep-Seated Landsliding

- Probability Factor of 5 since there is an increased level of uncertainty due to only having one slope inclinometer in operation. The instrument data has shown that the deep-seated movement below the road alignment has been inactive for several years and the probability of remobilization is judged to be low. This is increased from the 2011 factor of 4 due to the reduced monitoring coverage.

- Consequence Factor of 5 on the basis that a large portion of the highway could be significantly damaged by a reactivation of the deep-seated failure mode.

Therefore, the current recommended Risk Level with respect to the potential deep-seated landsliding is 25, which is increased from the Risk Level of 20 assigned from the 2011 inspection.

Therefore, the current recommended Risk Level for this site is 25.

6.0 RECOMMENDATIONS

6.1 Maintenance and Short Term

The road shift has removed the immediate risk to the highway. The site should be inspected regularly to monitor for retrogression into the road surface.

6.2 Long Term Measures

- Continue the semi-annual instrument readings, including a visual inspection of the condition of the wall and adjacent slope face during each site trip for instrument readings.

- Discontinue the annual site inspections by AT and the regional geotechnical consultant unless the observations during the semi-annual instrument readings or inspection by the maintenance contractor identifies something of concern.

- Prepare a repair design to properly address the ongoing damage to the road surface and the potential for a larger increment of landslide retrogression to intersect the northbound lane. AMEC understands that the preferred repair is to shift the highway to the northwest in advance of a sudden failure. Alternatively, the damage to the road surface could be reduced by excavating and then rebuilding one lane with geosynthetic reinforcement, but this would likely require single lane traffic during the work.

6.3 Investigation

No further investigation work for this site is recommended at this time. There are no functioning SI's in the active landslide area below the retaining wall. Although access to this area would be difficult, it may be worthwhile to consider the installation of additional instrumentation in this area, especially if AT elects to restore equipment access below the highway in order to remove the debris from the retaining wall from the slope.

Access to SI 2002-1 (made inoperable due to detour construction) would be made possible by hand excavation and installation of an extension kit. This is not recommended as traffic control would be required for subsequent readings. Installing instrumentation is not considered critical if there is a plan ready to shift the road to the upslope if landsliding damages the road significantly. Additional instrumentation may be required if GA98-2 becomes inoperable, but is not required in the meantime.

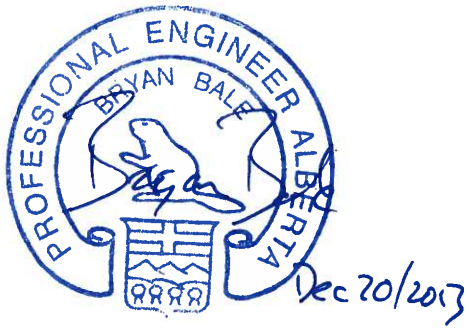
7.0 CLOSURE

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 Environment & Infrastructure, 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 Environment & Infrastructure,
a division of AMEC Americas Limited



Tyler Clay, B.A.Sc., EIT
Geological Engineer

Bryan Bale, M.Sc., P.Eng.
Senior Geotechnical Engineer

APEGA Permit to Practice No. P-04546

Reviewed by:
Georgina Griffin, M.Eng., P.Eng.
Associate Geotechnical Engineer