

October 28, 2011

CG25352.200

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

Attn: Mr. Ross Dickson

**Re: Southern Region Geohazard Assessment Program
Site S5 – Chin Coulee, Highway 36:02
2011 Annual Inspection Report**

This letter documents the 2011 annual site inspection of Site S5 – Chin Coulee on Highway 36:02, approximately 20 km south of Taber, AB and 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 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 21, 2011 by Mr. Bryan Bale, P.Eng., and Mr. Tyler Clay, E.I.T., of AMEC, in the company of Mr. Neil Kjelland, P.Eng., and Mr. Ross Dickson 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.

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 consists 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

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

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 construction² for further details.

SITE OBSERVATIONS

Key observations from the 2011 inspection area as follows:

- The retaining wall was in poor condition, with additional deterioration since the 2010 inspection due to continued movement of the underlying ground. The wall appeared to have settled an additional 1 m (approximately) since the June 2010 inspection. As of June 2011, the top of the wall was about 2 m below the road surface (it was nearly level with the road shoulder when constructed). The cracking at the bottom west corner of the wall had not worsened significantly since 2010; however, in general the wall showed increased signs of strain in the form of misaligned blocks. Refer to Photos S5-1 and S5-2.
- The landslide headscarp had retrogressed into the road surface by 1.3 m (approximately 0.5 m from the fog line) since the 2010 inspection. The guardrail was poorly supported. The GCS wall was no longer supporting the road edge. Refer to Photo S5-3.
- The soil nails along the headscarp had become exposed due to erosion of soil from around the nails (Photo S5-4 and S5-5). The nails continued to provide support to the steep slope face at the scarp, but had become slightly less effective due to the ongoing erosion.
- A recent landslide scarp had formed on the slide mass below and to the west of the retaining wall (at the culvert outlet), and indicates that slide movement was ongoing. Refer to Photo S5-6.

The May 2011 instrument readings at this site did not show any confirmed slope movement, which continues the trend of no significant slope movement at the instrument locations since 2000 and 2002. Based on the locations of the functioning slope inclinometers GA98-2 and 2002-1 (illustrated on the site plan, Figure S5-1), this indicates that the previous landslide

² AMEC report “Highway 36:02, Site S5 – Chin Coulee, Soil Nailing and GCS Wall Construction, Observations From Site Visits During Construction”, submitted to AT on May 27, 2008, AT Service Contract Number R1/037/08, AMEC project number CG25276.

movement delineated by the visible scarp just below the south shoulder of the highway has not expanded laterally or retrogressed upslope and below the highway, nor has there been any recent reactivation of the deeper-seated landslide movement extending below the highway.

ASSESSMENT

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 had been reduced by the construction of the retaining wall and soil nails. The soil nails continue to provide support, however the retaining wall is becoming less effective in supporting the guard rail posts and the damage to the road surface is increasing. Fill placement on top of the wall may be effective to support the guardrail posts in the short term; however this would in turn cause further settlement and eventual collapse of the wall. Alternatively, longer guardrail posts could be installed; however, this would not necessarily prevent loss of ground from between the guardrail posts. The paved shoulder has been damaged and requires repair for safe operation. It is expected that the retaining wall will collapse in the near future.

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/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. This repair design could be finalized promptly if required in the future due to a reactivation of the deep-seated landsliding with significant damage to the existing highway.

RISK LEVEL

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

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

- Probability Factor of 10 based on the estimated moderate rate of ongoing shallow movement in the slope below and adjacent to the highway (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 two functioning SI's at this site are 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 2 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 20, which is unchanged from the 2010 rating and is equal to the risk level prior to construction of the GCS wall and soil nails.

Potential Deep-Seated Landsliding

The risk associated with potential deep-seated landsliding at this site has not changed in recent years. In summary:

- Probability Factor of 3 since instrument data shows 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.
- 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 15, which is unchanged from the 2010 inspection.

RECOMMENDATIONS

Maintenance and Short Term Measures

- The retaining wall is not properly supporting the guardrail posts and road surface. Fill placement and/or longer guardrail posts are required to restore support. It should be noted that placing additional fill atop the GCS wall would temporarily support the guardrail but it would also further destabilize the wall and would not be a long-term repair. The road surface should also be patched to maintain a smooth surface. The maintenance contractor should be aware that the wall is expected to degrade in the future, and the site should be inspected regularly to determine when repairs are required.

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 require the construction of a detour lane and single lane traffic during the work.

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. 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.

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**

ORIGINAL SIGNED
OCTOBER 28, 2011

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Geotechnical Engineer

APEGGA Permit to Practice No. P-04546

Reviewed by:

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Attachments: Site Plan
Photos