August 20, 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 S16 – Chain Lakes, Highway 22:08**
**2009 Annual Inspection Report**

This letter documents the 2009 annual site inspection of Site S16 – Chain Lakes along Highway 22:08, approximately 45 km south of Longview, AB and approximately 3.6 km south of the junction between Highway 22 and Highway 533. The highway crosses an unnamed creek via a fill embankment at this site.

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 9, 2009 by Mr. Andrew Bidwell, P.Eng., and Mr. Bryan Bale, EIT of AMEC in the company of Mr. Ross Dickson and Mr. Neil Kjelland, P.Eng. 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 2007 annual inspection report[1] and are summarized as follows:

- A landslide occurred at this site in July 2005 and resulted in the closure of the southbound lane of the highway. A subsequent geotechnical site investigation determined that the landslide was seated in the glaciolacustrine silt and clay soils underlying the road embankment, with the failure surface possibly extending along the weathered surface of the underlying clay shale bedrock.

[1] AMEC report "Southern Region Geohazard Assessment, Annual Assessment Report, 2007", project number CG25263, submitted to AT on November 6, 2007.


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- Repair work consisting of a tied-back pile wall and the trenchless installation of a replacement culvert was completed during the summer of 2006.

- Two slope inclinometers (SI's) were installed in March 2007 to enable follow-up monitoring for landslide movement at this site. SI 2007-1 was installed immediately upslope of the central portion of the pile wall, and SI 2007-2 was installed a short distance downslope of the pile wall. These SI's have been monitored with spring/fall readings from 2007 to present.

AT and AMEC personnel have performed annual inspections of this site from 2007 to present in order to visually monitor the post-repair site conditions and supplement the SI monitoring.

## SITE OBSERVATIONS

Key observations from the June 2009 inspection were as follows:

- The previously-noted diagonal crack across the southbound lane in the south end of the area that was repaved in 2007 after the repair was still visible. The crack's aperture (5 to 10 mm) and downdrop (0 to 5 mm) of the road surface on the downslope side of the crack had not changed significantly since the 2008 inspection (Photo S16-1). The approximate location of the crack is shown on the attached site plan (Figure 1).

- The remainder of the area that was paved in 2007 continues to show no settlement or cracking (Photo S16-2).

- The exposure of the tops of most of the piles in the pile wall due to settlement of the backfill used to bury the pile wall and reconstruct the west embankment slope that was first noted in the 2008 inspection has not changed significantly. The downdrop of the backfill on the downslope side of the pile wall remains at up to approximately 50 mm and the open tension crack along the downslope side of the pile wall varied in aperture up to approximately 30 mm.

- No groundwater discharge was noted in the lower portion of the southwest embankment slope, unlike during the 2007 and 2008 inspections when wet areas and audibly flowing water were noted. However, the weeks prior to the June 2009 inspection were relatively dry.

- The French drain outlet on the east embankment slope and south of the culvert inlet was discharging water at the time of the site inspection, similar to observations during the 2007 and 2008 inspections.

The two SI's were read during the June 2009 inspection as a supplement to the May 2009 readings on the planned spring/fall cycle. Neither of the SI's showed any significant additional movement since the May 2009 readings. An updated displacement vs. time plot for the movement zones identified in both SI's is attached as Figure 2. The data from these two SI's shows continued landslide movement around the elevation of the failure surface for the 2005 landslide, with nominal amounts of movement upslope of the pile wall and roughly four to five times as much movement downslope of the pile wall. Please refer to the report on the Spring 2009 instrument readings[2] for a more detailed discussion of the interpretation of the data from these two SI's.

## ASSESSMENT

The site remains in good condition after the 2006 repair and the SI's continue to show that the pile wall appears to be preventing significant, ongoing landslide movement below the road surface. The cracking in the southbound lane may represent the southern flank of ongoing landslide movement that is damaging the road surface despite the pile wall installation and/or minor ongoing ground movement around the south end of the wall illustrating a three-dimensional characteristic to the landslide. However, given that the cracking has not changed or worsened significantly since it formed in 2007, it appears that it is more likely the result of normal post-construction settlement of the backfill used to reconstruct the upper portion of the road embankment.

## RISK LEVEL

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

- The Probability Factor for this site should be set at 6 to reflect the active landslide movement that has been confirmed in SI 2007-2 downslope of the pile wall and the lesser, but confirmed, landslide movement measured to date in SI 2007-1 upslope of the pile wall. This is unchanged from the 2008 assessment, and an increase from the value of 5 recommended after the 2007 inspection based on the SI data from the spring of 2008 onwards that confirmed the landslide movement upslope of the pile wall.

- The Consequence Factor for this site should be set at 1 to reflect the design of the pile wall that does not rely on support from the embankment slope downslope of the pile wall to maintain support to the road surface. This also reflects the fact that the road surface

[2] AMEC report "Southern Region Geohazard Assessment, Spring 2009 Instrumentation Monitoring Results, Site S16: Highway 22:08, Chain Lakes", submitted to AT on June 19, 2009, AT contract no. CE061/08, AMEC project number CG25309.C.

cracking to date in the south end of the repair area is very minor and can be managed as a maintenance issue.

Therefore, the current recommended Risk Level for this site is 6, which is unchanged from the value recommended after the 2008 inspection.

## RECOMMENDATIONS

### Maintenance and Short Term Measures

AT's maintenance contractor should seal the crack across the southbound lane at the south end of the repaved area. This was also recommended after the 2008 inspection.

### Monitoring and Long Term Measures

AMEC recommends that the SI's be read again in September 2009 as part of the planned semi-annual instrument readings in the Southern Region. The condition of the crack in the road surface can also be checked at that time.

If the September 2009 SI readings show that the downslope movement around 91.9 m elevation in SI 2007-1 tapers off to negligible rates and the visual inspection of the road surface does not show any significant damage that appears to be related to landslide movement downslope of the highway, then the monitoring of the SI's can be reduced to an annual frequency (e.g. in the fall of each year) starting in 2010 if not discontinued.

The annual site inspections by AT and AMEC personnel should be discontinued. The site inspections could be reinstated if the September 2009 SI readings or visual inspections by the maintenance contractor show a change in conditions.

## 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**

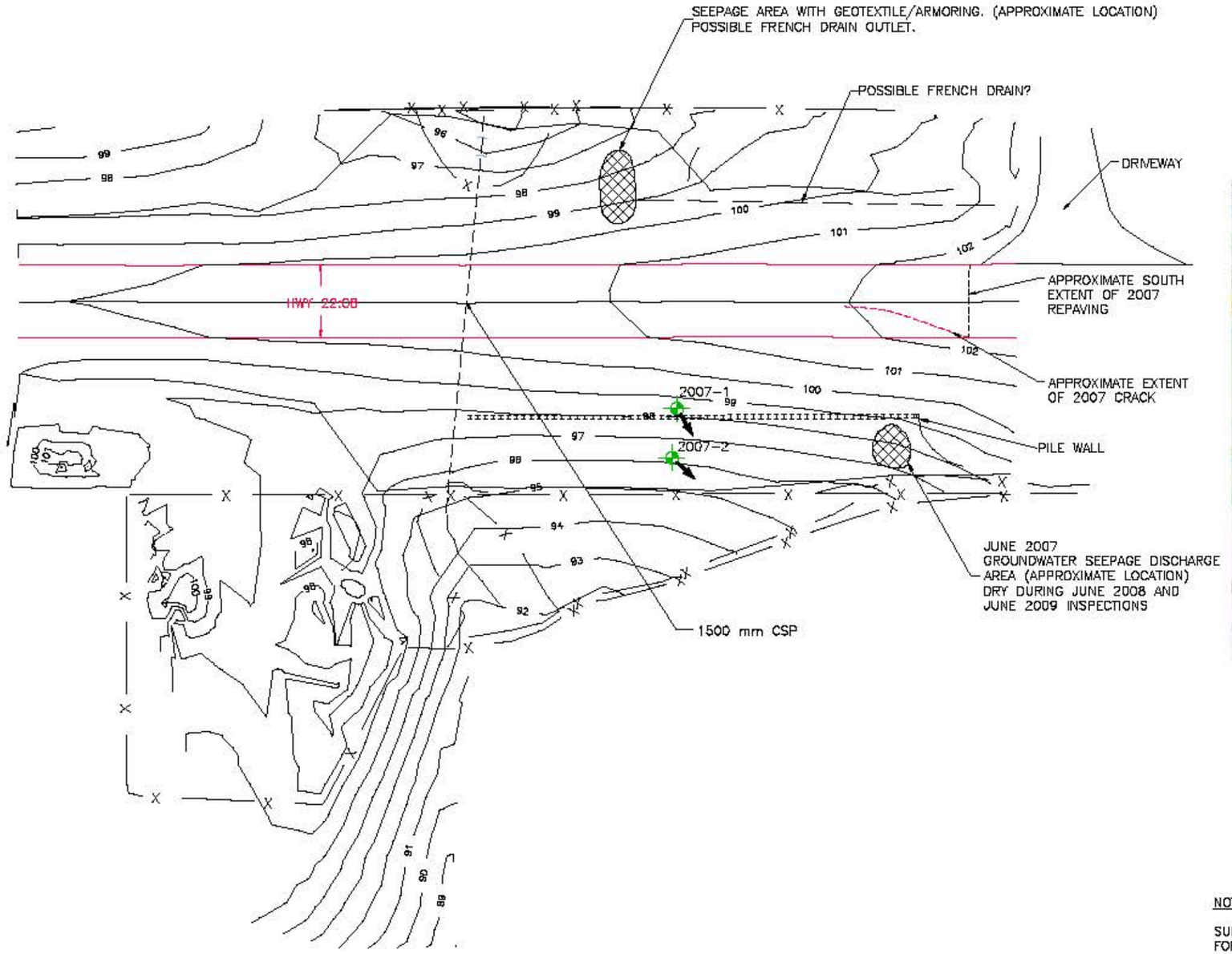
Andrew Bidwell, M.Eng., P.Eng.
Associate Geological Engineer

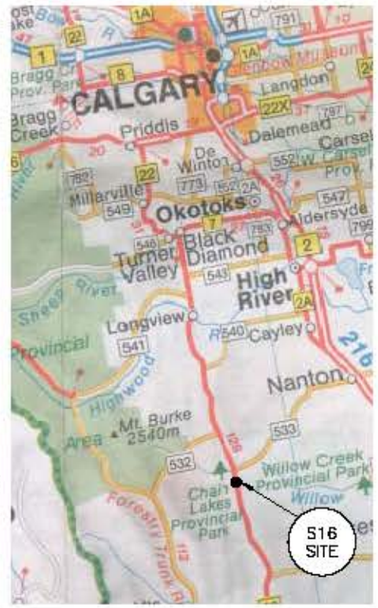
APEGGA Permit to Practice No. P-04546

Reviewed by:

Paul Cavanagh, M.Eng., P.Eng.
Associate Geotechnical Engineer

Attachments: Figures 1 and 2
Photos S16-1 and S16-2




LEGEND:

SLOPE INCLINOMETER WITH MOVEMENT DIRECTION (SEE ATTACHED DISPLACEMENT VS. TIME PLOT)

NOTES:

SURVEY PROVIDED BY AMEC INFRASTRUCTURE FOR LANDSLIDE REMEDIATION CONTRACT NO. 7231/06

SCALE
1:750
0 5 10 15 m

amec Earth & Environmental

CLIENT: Alberta Transportation

PROJECT: SOUTHERN REGION GEOHAZARD ASSESSMENT

TITLE: HWY 22:08 S16 - CHAIN LAKES SITE PLAN

| DATE: | JOB No.: | CAD FILE: | FIGURE No.: | REV. |
|---|---|---|---|---|
| JULY 2009 | CG25309.B | 25309N22.dwg | FIGURE 1 | A |

**2007-1 and 2007-2 (SI) Resultant Displacement**
**S16 - Ranchlands Maintenance Facility Site**

**Figure 2**

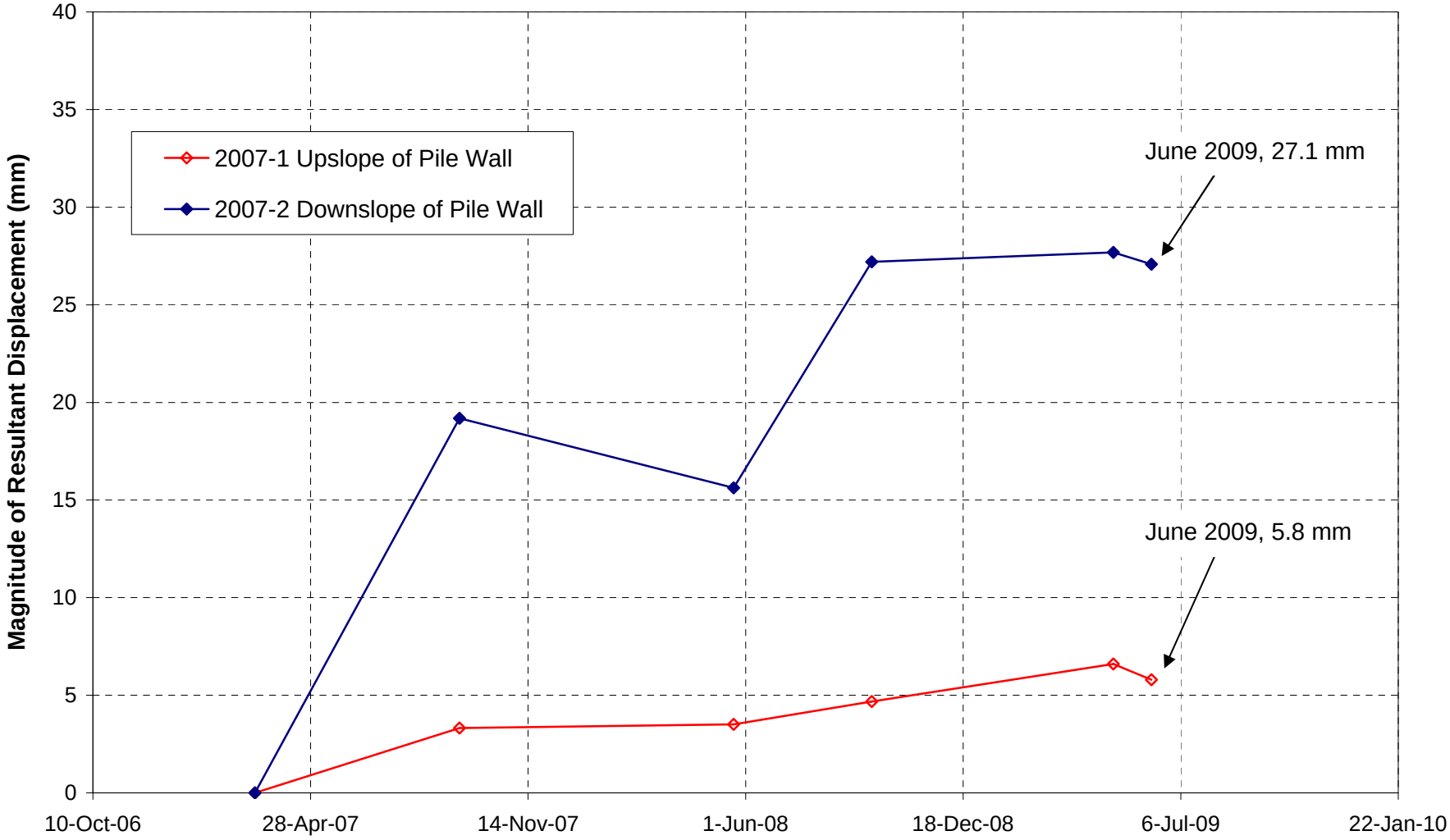


**Photo S16-1 (top) – June 2009**
Facing south across the southern end of the repair area that was repaved in early 2007. The crack across the southbound lane remains visible, and has not changed significantly since it formed during 2007.

**Photo S16-2 (bottom) – June 2009**
Facing north across the repair area that was repaved in early 2007. Aside from the crack at the southern end (shown in Photo S16-1) there has been no significant settlement or cracking of the road surface adjacent to the 2006 pile wall repair and trenchless culvert replacement.