



January 2015

CG25399

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

Attention: Mr. Ross Dickson

Dear Ross:

**Re: Southern Region Geohazard Assessment
2014 Annual Inspection Report
Site S43: Highway6:04, Pine Ridge Slide**

This report documents the 2014 annual site inspection of Site S43 – Pine Ridge Slide site, on Highway 6:04, approximately 10 km north of the Highway 5 junction near Waterton Park and 8.2 km south of Twin Butte (Township Road 40 junction), Alberta. At the site location, Highway 6 is a paved, two-lane roadway that is oriented roughly northwest to southeast and traverses along a southwest-facing valley slope. The legal description of the site area is 2-9-3-29-W4. Refer to Figure S43-1 for a map of the site location.

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., and Tyler Clay, E.I.T., of AMEC; Roger Skirrow, P.Eng., and Ross Dickson of AT during the 2014 Annual Tour.

1.0 SUMMARY

The site was in a similar condition as observed during the 2013 inspection and the cracking within the southwest road shoulder did not significantly worsen. The upslope ditch was noted as having little to no grade causing water to pond. AMEC's short term recommendations include improving the drainage at the site, including regarding of the upslope ditch, and maintaining the road surface as required with overlays and crack sealing. A geotechnical investigation would be required to better assess the slide hazard and provide longer term stabilization repairs. The Risk Level for the site is 35 which is unchanged from the 2013 assessment. The site conditions should be checked during the 2016 Annual Tour or in 2015 if the MCI notes changes to the site.

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2.0 BACKGROUND

AT was first notified by the maintenance contract inspector (MCI) of cracking within the southwest highway shoulder adjacent to the steep embankment in October 2012. AT requested an inspection of the site area during the 2013 Annual Tour with AMEC to assess the hazard and provide recommendations. According to AT, no other historical information exists for the site.

During the May 2013 inspection, damage was observed to the road shoulder and guardrail as a result of slow and ongoing slide movement due to the steep slope and probable groundwater and surface water flow at the site location. It was assessed that the slide movement likely has been ongoing for many years with probable periods of increased activity during to peak precipitation events, and has been managed by periodic crack sealing and paving overlays. AMEC recommended that AT consider implementing surficial drainage improvements to reduce movement and erosion rates to reduce the amount of ongoing maintenance at the site. It was also assessed that additional work to reduce the risk rating at the site, beyond the surficial drainage improvements would require a geotechnical investigation to better assess the slide conditions and the factors contributing to the instability. For further details on the site conditions, AMEC's assessment and recommendations, refer to the 2013 call-out report¹.

3.0 SITE OBSERVATIONS

Key observations regarding changes in the site conditions since the 2013 inspection are summarized below, show in Figures S43-2 to S43-3, and illustrated on Photos S43-1 to S43-4:

- The cracking in the southwest road shoulder had approximately 100 mm of aperture and 100 mm of down-drop within the previously observed crack sealed area. The extent and shape of the cracks were similar to the 2013 condition. Refer to Photos S43-1 and S43-2 for a comparison to the 2013 conditions.
- The guardrail was settled by approximately 30 cm. Refer to Photo S43-3.
- The upslope ditch was noted to have ponded water and had little to no grade towards the west. Refer to Photo S43-4.

4.0 ASSESSMENT

AMEC's 2013 assessment of the overall landslide conditions at the site remain valid and is summarized as follows:

No historical information was available from AT for this site, but based on the May 2013 observations, it appears that the damage to the road surface and guardrail are a result of slow and ongoing slide movement due to the steep slope and probable groundwater and surface water

¹ AMEC Environment & Infrastructure, 2013. *Southern Region Geohazard Assessment, Hwy 6 – Pine Ridge Call-Out Report*, submitted to AT February 2014.

flow along the draw feature. The highway may have been constructed by filling through a draw area that extends above and below the current highway alignment, creating preferential flow paths into the embankment fill. The slide movement has likely been ongoing for many years with probable periods of increased activity during to peak precipitation events, and has been managed by periodic crack sealing and paving overlays.

If AT wishes to reduce the amount of ongoing maintenance at the site, surficial drainage improvements should be considered. This work may involve ditch improvements, culvert installation and construction of lined swales. During the 2014 inspection it was observed that the upslope ditch had poor grade and was ineffective at managing the surface run-off at the site. Water was observed ponding in several areas, potentially increasing infiltration rates into the slide mass. The site should be visually monitored following any improvement measures to assess the effectiveness and potential requirement for further work. AMEC could provide a proposal and cost estimate of such work at AT's request.

Additional work to reduce the risk rating at the site, beyond the surficial drainage improvements would require a geotechnical investigation to better assess the slide conditions and the factors contributing to the instability. A suitable investigation would involve drilling two boreholes using a truck mounted auger drill rig to at least 40 m or auger refusal on the southwest road shoulder in the area affected by slide movement, and installation of piezometers and a slope inclinometer (optional). It would be necessary to remove sections of guardrail to enable drill access. Traffic control would be required to temporarily close one lane of the highway within the work area.

The landsliding at this site has affected only one lane of the highway and there is room for a detour in the upslope ditch. There was no sign of slide retrogression or significant worsening of the slope stability during the 2014 inspection.

5.0 RISK LEVEL

AMEC recommends the following Risk Levels based on AT's general geohazard risk matrix:

- Probability Factor of 7 due to the visible slide extents and apparent ongoing movement based on damage to the road surface but uncertainty regarding the rate of movement given the limited observation and knowledge of site history to date.
- Consequence Factor of 5 reflecting the visible damage to the road shoulder and potential partial closure to the road if the visible extents of the slide were to fail. Given the limited information on the landslide hazard to date there is potential the slide could affect a larger portion of the road surface. It would be possible to close the southbound lane and construct a temporary detour in the upslope ditch if required.

Therefore, the recommended Risk Level is 35 (i.e. 7 x 5) and is unchanged from the 2013 assessment.

6.0 RECOMMENDATIONS

AMEC recommends the following for this site:

6.1 Maintenance and Short Term Measures

- The ditch should be regraded towards the west to better manage surface run-off and prevent pooling of water within the slide area. If significant water pooling is observed, consideration should be given to installation of a culvert beneath the highway.
- Perform crack sealing and paving overlays as required.
- Inspect the site during the 2016 Annual Tour or in 2015 if the MCI note changes to the site.

6.2 Long Term Measures

- Construction of a temporary detour in the upslope ditch if damage along the southwest road shoulder worsens.
- Geotechnical investigation that includes:
 - One borehole in the southwest shoulder advanced to 40 m or auger refusal with 85 mm SI casing installed.
 - One borehole in the southwest shoulder advanced to 40 m or auger refusal with two vibrating wire piezometers installed.
 - Soil testing that includes moisture, plasticity and grain size analysis.
 - A report with slope stability analysis and preliminary repair options.
- Determine a repair option based on the geotechnical investigation. It may be possible to support the highway embankment with a GRS wall or equivalent if drainage improvements are not enough to reduce the rate of slide movement into the highway.

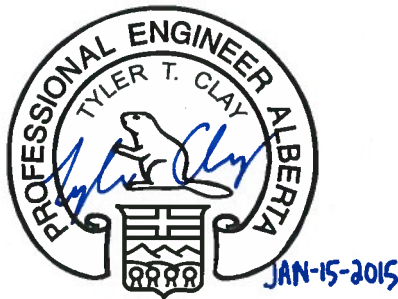
7.0 CLOSURE

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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**



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Reviewed by:

APEGA Permit to Practice No. P-04546

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