

October 31, 2011

CG25352.200

Alberta Transportation  
2<sup>nd</sup> Floor, 803 Manning Road NE  
Calgary, AB T2E 7M8

Attn: Mr. Ross Dickson

**Re: Southern Region Geohazard Assessment Program  
Site S36 - Highway 800:02, Belly River Erosion Site  
2011 Annual Inspection Report**

This letter documents the 2011 annual inspection of the S36 - Belly River site located in 18-3-27 W4M, approximately 9 km northbound along Highway 800 from the junction of Highway 5 and Highway 800 and approximately 17 km westbound along Highway 5 from Cardston, AB. The site is located within the boundaries of the Blood Indian Reserve 148.

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. Andrew Bidwell, P.Eng., 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 call-out inspection<sup>1</sup> was performed at this site in June 2009 by AMEC after AT reported that the riverbank and valley slope above the Belly River had retrogressed rapidly towards Hwy 800 and that the road surface may have been at risk of becoming undermined. The inspection noted that landsliding was occurring on the outside bank of a meander of the Belly River, and that the nearly vertical upper scarp would likely continue to retrogress into the highway ditch and road shoulder. At the time of the inspection the headscarp was offset 3 to 4 m from the fence line and approximately 12 m from the paved road surface. Short-term repair work was recommended to stabilize the upper scarps. The selection and design of an overall and more permanent repair for the site was also recommended.

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<sup>1</sup> AMEC report "Highway 800:02 – Belly River Erosion Site, Report on June 26, 2009 Site Inspection", submitted to Ross Dickson of AT, July 2, 2009, AMEC File No. CG25309.D.

AMEC inspected the site again on May 12, 2010 after AT reported that the headscarp of the landslide had retrogressed further towards the highway. At the time of the May 2010 inspection it was noted that the headscarp had retrogressed to approximately 2 to 3 m upslope of the fenceline and had reached the ditch invert, and was approximately 5 to 6 m from the downslope edge of the road surface. An approximately 15 m long segment of the fence had been undermined since the June 2009 inspection. The overall condition of the site area remained similar to that noted in June 2009, and the 2009 to 2010 retrogression of the headscarp was consistent with the 2009 assessment of the landslide conditions.

AT proceeded with a temporary repair at the site in late May and early June 2010, with geotechnical input provided by AMEC. An approximately 40 to 50 m wide segment of the landslide headscarp centered around the point of maximum retrogression towards the road was excavated back to a 1H:1V slope and 6 m long launched soil nails were installed in the excavated slope face. The approximate area of the repair work is shown on Figure 1. Nails were installed on a 1 m grid, with 2 to 3 rows of nails installed.

Subsequent to the installation of the launched soil nails, AT's maintenance contractor installed a buried drainage pipe along the west ditch across the landslide encroachment area in order to intercept ditch flow and divert it around the slide area to prevent the water from discharging directly into the landslide headscarp area.

AMEC is currently working on the design of an overall repair for the site under Consulting Services Agreement CON0010713 with AT. This work is ongoing, with ranked design options provided for AT's selection at the time of writing. As part of the repair design, AMEC performed a geotechnical investigation in March 2011 that included the installation of two slope inclinometers and seven vibrating wire piezometers.

## **SITE OBSERVATIONS**

Please refer to Figure S36-1, attached, for a site plan, and also to AMEC's June 2009 call-out inspection report for more information on the general site layout and conditions.

The key observations from the June 2011 inspection are as follows:

- The active landsliding noted at the site in 2009 and 2010 appeared to have slowed, based on the increased vegetation and slightly weathered appearance of the slide mass in comparison to the June 2010 inspection. Photos S36-1 and S36-2 present a comparison of the slide mass from the June 2010 and June 2011 site inspections. The slide mass as of June 2011 was mostly vegetated, and the hummocky surface of the colluvium in the landslide area had become slightly subdued and eroded since the summer of 2010. In general, the landslide had not significantly retrogressed headwards or slumped further into the river since June 2010.

- The river was near peak flow at the time of the site inspection. River flow information obtained from a recording station near Mountain View, AB indicated that the flow rate at the time of the inspection was approximately 75 m<sup>3</sup>/min, and was roughly equal to the flow rate at the time of the June 2010 inspection. The peak river flow rate for 2011 was also approximately the same as the 2010 flow rate.
- The landslide scarp at the main encroachment area did not appear to have retrogressed any closer to the highway than was observed during the June 2010 inspection (5 to 6 m). The soil nail and grading work performed at this area in 2010 was in good condition, and appeared to be supporting the scarp quite well (refer to Photo S36-3).
- The temporary ditching and buried drainage pipe installed across the head of the main encroachment area was in good condition, and appeared to have been effective at preventing ditch flow from entering the landslide headscarp (refer to Photo S36-4).
- Some areas of fresh instability were noted along the headscarp and along the slide mass, indicating that although the rate of slide movement appears to have reduced since 2010, it is still ongoing at some locations. The unstable areas are visible in Photo S36-5 as unvegetated areas where the soil has recently sloughed or flowed.
- Areas of wet soil and ponded water are also visible on the slide mass and scarp, likely indicating seepage discharge locations. The seepage discharge locations were approximately 5 to 7 m below the ground surface. During the June 2010 inspection, the seepage was noted at 1 to 2 m depth below ground surface.

## ASSESSMENT

Landsliding appeared to be less active during 2011, as compared to previous inspections. Some toppling and sloughing of the headscarp had continued, but this movement was relatively minor. River erosion was ongoing and had visibly removed a portion of the slide mass since June 2010. The peak river flow for 2011 was comparable to the 2010 flow rates, when significant landsliding occurred; therefore, it appears that river erosion is not the sole factor for destabilizing the landslide. The construction of the drainage pipe in the ditch to prevent surface runoff from entering the headscarp area, as well as potentially lower groundwater levels in 2011 as compared to 2010 are likely the reasons for the reduced slide movement in Spring/Summer 2011. The ditch diversion work along the headscarp is performing well, and will continue to be useful in the short term.

As described in previous reports, based on the post-failure slope angle in the lower portion of the landslide area it is expected that without repair measures the headscarp of the landsliding will eventually retrogress further and undermine the highway surface. The typical year-over-year rate of crest retrogression is not certain; however, the amount of retrogression between 2009 and 2010 indicates that the road may become undermined in the near future (e.g. the next 1 to 3 years).

## **RISK LEVEL**

AMEC recommends the following Risk Level for this site, based on AT's general geohazard risk matrix:

- Probability Factor of 13, based on a high rate of movement that is steady or increasing. Even though the slide movement has slowed in 2011, the landslide is considered to be susceptible to renewed movement following peak precipitation events. The landslide movement may not be steady year over year, but will likely move incrementally every several years.
- Consequence Factor of 3, reflecting the potential for loss of service of a portion of the roadway and potentially partial closure of the road (e.g. closure of the southbound lane).

Therefore, the recommended Risk Level is 39 (i.e. 13 x 3), which is unchanged from the 2010 assessment.

## **RECOMMENDATIONS**

AMEC recommends that repair works to stabilize the slide area be undertaken as soon as possible in order to reduce the risk of the highway becoming undermined. The process of selecting and designing repair measures for this site is underway at the time of writing, as described above.

Prior to the repair work, the position of the headscarp should be monitored by AT's maintenance contractor. If further retrogression towards the road occurs, it may be necessary to perform additional short-term repairs and/or construct a detour lane along the east ditch.



## **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 31, 2011

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Geotechnical Engineer

APEGGA Permit to Practice No. P-04546

Reviewed by:

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

Attachments: Site Plan  
Photos