

August 28, 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
Highway 940, KM 25.9
June 10, 2009 Inspection Report**

This letter documents the June 10, 2009 inspection of a site along Highway 940, approximately 26 km northbound from the intersection between Highway 940 and Highway 3, in Coleman, AB and approximately 500 m southbound from the Highway 940 bridge over Vicary Creek. The site inspection was performed on June 10, 2009 by Mr. Andrew Bidwell, P.Eng. and Mr. Bryan Bale of AMEC Earth & Environmental (AMEC), in the company of Mr. Neil Kjelland, P.Eng. and Mr. Ross Dickson of Alberta Transportation (AT). The inspection was performed 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).

BACKGROUND

The June 2009 site inspection by AT and AMEC personnel was the second inspection of this site by AMEC. The site was first inspected in 2008 as part of the Highway 940 geohazard corridor review. Please refer to the 2008 corridor review report for more background information and the 2008 assessment of this site¹.

¹AMEC report, "Geohazards Review, Highway 742 And Highway 940 Corridors, Southwestern Alberta", submitted to AT April 8, 2009, AMEC project number CG25262.

SITE OBSERVATIONS

Please refer to the attached Figures 1 and 2, respectively, for a schematic site plan and cross-section.

Key observations from the 2009 inspection is summarized below:

- The site is located along a northeast/southwest oriented, straight segment of the highway a short distance southbound from the Vicary Creek bridge. This segment of the highway is an unpaved, two lane road that runs along the relatively flat upland area approximately 14 m above the northwest (left) bank of Vicary Creek. As shown in Photos 1 to 3, the downslope (southeast) edge of the road is immediately adjacent to the crest of the slope above the left creek bank.
- An erosion gully in the slope above the left creek bank is encroaching into an approximately 9 m wide segment of the downslope (southeast) edge of the road. This location is marked with a delineator post with some old (i.e. weathered and tattered) "Danger" flagging tied to it. As shown in Photo 3, at the time of the site inspection the gully had encroached approximately 0.1 to 0.2 m into the downslope edge of the road. The gully encroachment into the road was approximately the same as the 2008 inspection.
- The erosion gully has formed in a 38 to 40° inclination slope of exposed bedrock and rocky soil above the left creek bank, as shown in Photo 4. The slope is approximately 10 m high. The upper half of the slope exposes rocky soil that appears to be either a glacial till with up to boulder-sized rocks or perhaps the weathered and broken up surface of the underlying bedrock. The lower half of the slope and the left creek bank expose intact bedrock that is covered in places with colluvium and slope wash from above.
- The sandstone bedrock exposed upstream of the gully strikes at 30/210° and dips at 10 to 20° towards the northwest (i.e. the dip direction is downwards away from the creek channel at this site).
- Two survey stakes were installed at the upslope extent of the gully for future monitoring (as shown in Photo 1 and on Figure 1).
- There is a swale in the road surface along and parallel to the downslope edge of the road and extending approximately 5 m southbound from the head of the gully. This swale directs surface runoff into the head of the gully. Photos 1 to 3 show the position of the swale relative to the head of the gully.

ASSESSMENT

The assessment of the hazard conditions at this site is largely unchanged from the late 2008 inspection. In summary:

- The head of the gully will retrogress further into the northbound lane of the road over time. If left unchecked, the erosion will likely continue until the gully headwall and sideslopes eventually reach a marginally stable angle for the rocky soil in the order of 34 to 36°, which would result in the loss of at least the northbound lane of the road and leave the remaining road width in a marginally stable condition.
- The rate at which the existing gully has developed is not clear based on the two site inspections to date. However, the delineator post with the tattered “Danger” flagging that has been installed adjacent to the head of the gully suggests that it has been starting to encroach into the road for at least a couple of years and there was little to no change in the amount of encroachment between the late 2008 and June 2009 inspections. This suggests that the northbound lane of the road is not at a short-term risk (e.g. one to two years) of collapsing, however this is not certain. In addition, the current site condition without a guardrail is hazardous to northbound traffic because there is a potential for a vehicle to stray slightly towards the downslope edge of the road, catch a wheel in the head of the gully and be pulled off the road.
- The primary cause of the gully erosion appears to be the surface runoff from the road being directed into the head of the gully by the swale along the downslope edge of the road. Creek erosion along the toe of the slope below the road is judged to have little influence on the rate of gully erosion, because the creek bank consists of exposed bedrock that erodes slowly to a near-vertical bank of intact bedrock and/or is self armoring with boulder-sized blocks of bedrock that have broken away from the bank due to exposure and weathering.

RISK LEVEL

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

- Probability Factor of 11 based on the apparently active gully erosion along with the uncertainty regarding the rate of gully encroachment into the northbound lane.
- Consequence Factor of 4 based on the probable consequence of having to close the northbound lane of the road or at least reduce the width of the traveling surface adjacent to the gully.

Therefore, the current recommended Risk Level for this site is 44, which is unchanged from the 2008 inspection and assessment. The Risk Level will increase over time as the erosion continues and the gully encroaches further into the road.

RECOMMENDATIONS

It would be very difficult to stabilize the steep slope of rocky soil into which the gully is eroding. This is likely not a very good site for the use of launched soil nails because the rocky soils would limit the depth of nail penetration.

It is recommended that repair efforts consist of:

1. Reducing the rate of gully erosion by directing surface runoff from the road surface away from the gully area. The road surface should be graded to shed surface runoff towards the upslope side of the road (and maintained to remain that way in the future).
2. Installing a guardrail along the downslope side of the road to keep traffic away from the undermined edge of the existing road. This will result in a nominal reduction of the road width from the existing 10 to 11 m width, however should be feasible for a secondary, unpaved highway of this nature.

A permanent northwest/upslope shift of the road by at least 2 to 3 m would also be effective, however it is not recommended because that would disrupt the road alignment heading into the cut slope area a short distance northbound from this site.

The site should be inspected again in 2010 as part of the annual inspection tour. If the site conditions have not changed significantly as of the next inspection, the frequency of future inspections could be reduced unless repair work is completed and post-construction inspections are required to check the effectiveness of the work.

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**

Bryan Bale, M.Sc., E.I.T.
Geotechnical Engineer

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

APEGGA Permit to Practice No. P-04546

Reviewed by:

Pete Barlow, M.Sc., P.Eng.
Principal Geotechnical Engineer

Attachments: Site Plan
Cross Section
Photos