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
Site S20 – Highwood House Rock Cut, Highway 541:02
2009 Annual Inspection Report

This letter documents the 2008 annual site inspection of Site S20 – Highwood House Rock Cut, on the north side of Highway 541:02, approximately 800 m east of the junction between Highways 40, 541 and 940 at Highwood House.

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 10, 2009 by Mr. Andrew Bidwell, P.Eng., and Mr. Bryan Bale, EIT of AMEC in the company of Mr. Ross Dickson, Mr. Rick Nash 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:

- The site consists of a near-vertical to vertical rock cut slope with an estimated maximum height of greater than 20 m, with natural soil and bedrock slopes up to 35° inclination above the crest of the cut slope. An approximate slope cross-section is attached as Figure S20-1.

- There is a rockfall hazard at this site that was first documented during the 2005 geohazards review of the Highway 40/541 corridor.

[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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- Based on the "Ritchie ditch chart" rockfall catchment ditch design guidelines, the existing ditch adjacent to the cut slope is slightly undersized for the estimated maximum height of the cut slope.

- The rockfall debris typically consists of gravel sized rocks that have eroded out from the shale, coal and conglomerate beds exposed in the cut slope. However, up to boulder-sized rockfall debris has been noted in the ditch and along the north edge of the pavement during past inspections. This has included a boulder-sized rock that came to rest along the north edge of the paved surface .

SITE OBSERVATIONS

Key observations from the June 2009 inspection were as follows:

- The appearance of the cut slope had not changed significantly since the previous inspections. Photo S20-1 shows a general view of the cut slope taken from the south side of the highway.

- At the time of the June 2009 site inspection, there were up to boulder-sized rockfall deposits in the north ditch (Photo S20-2) including several rocks that appeared to have fallen since the previous inspection in June 2008. There were also gravel to cobble sized rocks deposited up to the north edge of the pavement and many gravel sized rocks on the paved highway itself at the time of the inspection.

- The gully eroding into the rocky soil in the natural slope above the crest was visually reviewed from the highway and appeared to have retrogressed slightly further upslope since the 2008 inspection. The rocky soil exposed in the gully appeared to continue to be the primary source of rockfall debris along the ditchline, based on the distribution of the accumulated debris along the ditch at the time of the inspection (i.e. the largest talus cones had formed along the toe of the cut slope below the gully). These cones extended more than halfway across the ditch at the time of the June 2009 inspection.

- Boulder sized rockfalls at the west end of the site appeared to be from the fractured bedrock exposure immediately above the crest of the cut slope (see Photo S20-1).

AMEC understands that AT has given permission for a graduate student at the University of Alberta to perform LiDAR mapping of the rock cut slope and adjacent slope faces at this site. The data from this mapping may be suitable for replacing the approximate slope profile shown in Figure S20-1.

ASSESSMENT

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

- There remains a risk that rockfall debris from the cut slope will bounce or roll onto the road surface.
- The risk is somewhat mitigated by the “Watch For Fallen Rock” signs in place for traffic approaching the cut slope segment of the highway from both directions along with the available catchment capacity of the east ditch.
- However, the accumulation of rockfall debris in the ditch reduces the effective ditch dimensions further below those recommended on the Ritchie Ditch guidelines for a near-vertical cut slope of this height.

RISK LEVEL

The recommended Risk Level for this site, based on AT’s rockfall geohazard risk matrix, is unchanged from the previous site inspections and is summarized as follows:

- Probability Factor of 15 based on the appearance of the debris that suggests that there is ongoing rockfall at this site.
- Consequence Factor of 3 based on:
  - The presence of gravel to cobble sized rockfall debris on the pavement on the north shoulder of the road and in the westbound lane during the current and past site inspections.
  - The previous observation of a boulder that had landed along the north edge of the pavement. This illustrates that it is possible for rockfall debris of this size to be deposited at locations along the edge of the road where they could be struck by a vehicle (particularly under poor visibility conditions or at night) and cause damage in the order of a flat tire or temporary loss of vehicle control at highway speed.

Therefore, the recommended Risk Level for this site is 45.

RECOMMENDATIONS

Maintenance and Short Term Measures

As recommended following the previous annual inspections, AT's maintenance contractor should clean the accumulated rockfall debris from the ditch at this site as required in order to maintain the ditch capacity reasonably close to its maximum, particularly in the areas at the west end of the site where the talus cones accumulate at the toe of the rock cut and fill the ditch. The frequency of cleaning will depend on future rockfall volumes. Ditch cleaning should be treated as an ongoing maintenance task and performed as required. If the ditch is consistently kept clean and near its maximum capacity, then it may be possible to reduce the Consequence Factor for this site.

Long Term Measures

- The following additional measures that were recommended for consideration after the previous annual inspections in order to reduce the dependence on timely cleaning of the ditch remain valid:
  - Increasing the ditch depth if possible. There is a Telus pedestal in the north ditch at the west end of the site, therefore it would likely be necessary to relocate the buried Telus line if the ditch depth is increased.
  - Placing a line of jersey barriers along the north shoulder of the highway to increase the effective ditch capacity. This will help to contain rockfall debris in the ditch. This should only be done if AT's requirements for a minimum clear zone can be met (and also practicality with respect to snow-plowing). The barriers would also be effective in preventing vehicles that may run into the north ditch for other reasons from striking boulder-sized rockfall debris that has been contained in the ditch. It will be necessary to keep cleaning the rockfall debris from the ditch after the barriers are in place.
  - Consider scaling the cut slope in order to attempt to reduce the volume of rockfalls over the short term (e.g. a few years).
- The trial application of a Trumer-Schutzbauten brand hanging rockfall barrier net at this site that was discussed during the June 2008 inspection should be deferred until after the data from the planned Summer 2009 ground-based LiDAR survey of the slope at this site by a University of Alberta graduate student has been completed and the data provided to AMEC via AT for review. The trajectories of potential rockfall paths originating from the upper portion of the eroding gully above the crest of the cut slope can be checked with this data in order to determine if such rockfall paths could impact

the highway, and therefore if a hanging net could provide significant benefit in reducing the risk. The data could likely also be used to upgrade the schematic slope profile shown on Figure S20-1.

- The annual site inspections by AT and AMEC personnel should be continued.

Investigation

If AT receives the above-noted Summer 2009 ground-based LiDAR survey data for the cut slope from the University of Alberta, it should be provided to AMEC for review as described above.

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

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Associate Geological Engineer

APEGGA Permit to Practice No. P-04546

Reviewed by:

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

Attachments: Figure S20-1
Photos S20-1 to S20-3