October 1, 2010

CG25332.200

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**
**2010 Annual Inspection Report**

This letter documents the 2010 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 21, 2010 by Mr. Bryan Bale, P.Eng., and Mr. Andrew Bidwell, P.Eng., of AMEC in the company of Mr. Ross Dickson, Mr. Neil Kjelland, P.Eng., and Mr. Roger Skirrow, 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 more 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.

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

- Based on the "Ritchie ditch chart" rock fall 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 rock fall 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 rock fall 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 2010 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 2010 site inspection, there were up to boulder-sized rock fall deposits in the north ditch. The volume, distribution and maximum size of the rock fall debris looked similar to what was observed during the 2009 inspection, however the size of the debris cones appears to have increased. Boulders have rolled down the debris cones to within 2 m of the paved surface. There were also gravel sized rocks along the paved shoulder and cobble sized rocks immediately adjacent to the paved surface. Refer to Photos S20-2 and S20-3.

- The gully eroding into the rocky soil in the natural slope above the crest of the rock cut slope was visually reviewed from the highway and appeared to have retrogressed slightly further upslope since the 2009 inspection. The rocky soil exposed in the gully appeared to continue to be the primary source of rock fall 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). Active rock fall was observed from this area during the site visit. These cones extended more than halfway across the ditch at the time of the June 2010 inspection. Refer to Photo S20-1.

## ASSESSMENT

The rock fall hazard at this site appears to have increased slightly since the 2009 inspection. In summary:

- There remains a risk that rock fall debris from the cut slope will bounce or roll onto the road surface. With the large debris cones noted during the June 2010 inspection obstructing the ditch and the presence of large boulders near the road edge, it is judged more likely that a larger boulder will reach the road surface in the future.

- The risk to motorists is only 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.

## RISK LEVEL

The recommended Risk Level for this site, based on AT's rock fall geohazard risk matrix, should be increased from the values recommended after the previous site inspections, as follows:

- Probability Factor of 15 based on the appearance of the debris that suggests that there is ongoing rock fall at this site. This is unchanged from the 2009 inspection.

- Consequence Factor of 4 based on:

    - The presence of large boulders that have landed within 2 m of the road surface, and the fact that they would cause serious damage or accidents if they were struck. These larger rocks are landing closer to the road due to the debris cones filling the ditch and reducing the ditch capacity.

    - This is an increase from the value of 3 assigned in 2009 based on the increased likelihood that a large boulder will land on the road.

Therefore, the recommended Risk Level for this site is 60, which is an increase from the 2009 level of 45. Note that the risk could be returned to the 2009 level if the debris cones are removed to restore the effective ditch width.

## RECOMMENDATIONS

### Maintenance and Short Term Measures

As recommended following the previous annual inspections, AT's maintenance contractor should clean the accumulated rock fall 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 rock fall volumes. Ditch cleaning should be treated as an ongoing maintenance task and performed as required. It may be possible to reduce the Consequence Factor for this site if it can be relied upon that the ditch will be consistently kept clean and near its maximum capacity.

### 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 (if the underlying bedrock surface is not too shallow). 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 rock fall 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 rock fall debris that has been contained in the ditch. It will be necessary to keep cleaning the rock fall debris from the ditch after the barriers are in place.

    - Consider scaling the cut slope in order to attempt to reduce the volume of rock falls over the short term (e.g. a few years).

- The trial application of a hanging rock fall barrier net at this site that was discussed during the June 2008 inspection could be considered. The trial had been deferred pending a planned Summer 2009 ground-based LiDAR survey of the slope at this site by a University of Alberta graduate student. AMEC's understanding is that the LiDAR survey data was determined to be not suitable for use by AT. The trial application could proceed with or without a LiDAR survey.

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

**Investigation**

If AT would like to proceed with the trial application of the hanging rock fall barrier net, AMEC could provide a proposal and cost-estimates for different options, including a LiDAR survey suitable for determining the required size and location for the net.

AMEC could also prepare a draft tender package for rock slope scaling work for this and other sites at AT's discretion.

## 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**

ORIGINAL SIGNED
OCTOBER 1, 2010

Bryan Bale, M.Sc., P.Eng.
Geotechnical Engineer

APEGGA Permit to Practice No. P-04546

Reviewed by:

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

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