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August 28, 2009

CG25309.B

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 Highway 940, Mean Creek Culverts, KM 67.7 June 10, 2009 Inspection Report

This letter documents the June 10, 2009 inspection of the highway crossing of Mean Creek, approximately 68 km northbound along Highway 940 from the intersection between Highway 940 and Highway 3, in Coleman, AB and roughly 7 km southbound from the intersection between Highway 940 and Highway 532. The site inspection was performed 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 site was first inspected in 2008 as part of the Highway 940 geohazard corridor review. The highway is aligned northwest/southeast at this site. Mean Creek flows from northeast to southwest across the highway alignment via two culverts:

- North culvert approximately 1600 mm diameter.
- South culvert approximately 900 mm diameter.

The 1600 mm diameter culvert appears to be newer than the 900 mm culvert.

The June 2009 site inspection by AT and AMEC personnel was the second inspection of this site by AMEC. Please refer to the 2008 corridor review report for more background information and the 2008 assessment of this site<sup>1</sup>.

<sup>&</sup>lt;sup>1</sup>AMEC report, "Geohazards Review, Highway 742 And Highway 940 Corridors, Southwestern Alberta", submitted to AT, April 8, 2009.

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## SITE OBSERVATIONS

Key observations from the 2009 inspection are summarized below:

- The inlet of the 1600 mm culvert on the east side of the road remains angled upwards (refer to Photo 2), without significant change from the 2008 inspection. There is negligible soil cover over the culvert inlet at the east edge of the road. Two concrete lock-blocks have been placed over the inlet, apparently to prevent it from deforming further upwards. The remainder of the 1600 mm culvert appears to be aligned properly and it was open and clear of debris at the time of the site inspection.
- As noted in the 2008 inspection, the 900 mm diameter culvert has an approximately 50 mm wide separation in the crown of the culvert between the last two segments of the culvert pipe adjacent to the outlet (refer to Photo 3 and 4). It appears that the separation continues to be restricted to the upper portion of the connection between the culvert segments and that the bottom of the culvert segments is still connected. However, the bottom connection could not be observed directly due to the flow within the culvert. Overall, there appears to be little change to the condition of this culvert some erosion remains visible around the base of the 900 mm culvert around where the culvert segments are separated at the top, however at the time of the inspection there was no flow outside of the culvert (i.e. no apparent leakage due to culvert separation).
- At the time of the inspection there was a large area of ponded water in the order of at least 1 m deep upstream of the culvert inlets (refer to Photo 1) and similar to that noted during the 2008 inspection. This water was impounded upstream of the highway embankment as well as a field access trail/ditch block immediately south of the culvert inlets. It appears that the ditch block/field access trail may have been established in order to force the creek flow into the culverts at this location and prevent the creek flow from being diverted southwards to flow along the east highway ditch. There is somewhat of a shoreline eroded along the south side of the ponded water, which suggests that the water level in June 2009 was a typical level at approximately 1.5 m below the highway grade.
- The culverts appeared to be draining the ponded water steadily. However, the topography of the creek channel upstream/east of the highway along with the elevation of the culvert inlets is such that a basin of ponded water remains upstream/east of the highway. The surface of the ponded water was at the invert elevation of the 1600 mm culvert.
- There are some cobble to boulder sized rocks around and immediately upstream of the inlet of the 900 mm culvert. It appears that if these rocks were removed then the effective inlet elevation of the 900 mm culvert would be lower and it may be possible to



at least reduce the level of any ponded water upstream of the highway. However, there is a layer of heavy geotextile visible under the rocks and it is inferred that the geotextile was placed and covered with the rocks as part of a repair in recent years to minimize erosion around the inlet of the 900 mm culvert.

# ASSESSMENT

The site conditions were essentially unchanged from the late 2008 inspection, and the assessment from the highway corridor geohazard review remains valid. In summary:

- The combined capacity of the existing culverts appears to be sufficient to handle the creek flow at this site. However, the effective inlet elevations are such that water ponds upstream of the highway. It appears that the existing culverts are sufficient to keep the water level upstream of the highway from rising above the level observed at the time of the September 2008 and June 2009 site inspections.
- Based on the observations during the September 2008 and June 2009 site inspections, it appears that there is typically around 1.5 m of freeboard between the ponded water elevation and the road surface and it does not appear that the ponded water has overtopped the highway in recent years. It is also understood that there have not been any reported problems at this site. However, it does appear that the 1600 mm culvert is relatively newer than the 900 mm culvert. This, along with the geotextile noted underlying the large rocks apparently placed at the inlet of the 900 mm culvert, suggest that in recent years there may have been some erosion around the inlet of the 900 mm culvert that was repaired and that the 1600 mm culvert was installed at the same time to supplement the 900 mm culvert. Extensive erosion was noted in the east ditch to the southeast of the culverts that was several years old. It is possible that this erosion was due to the creek overtopping the left embankment, perhaps before the 1600 mm culvert was installed.
- The visible separation of the 900 mm culvert segments around the joint near the culvert outlet appears to have been of little consequence to date. Any leakage of culvert flow through the separation is very close to the culvert outlet, and any resulting erosion would be largely outside of the road embankment.
- It is unclear why the 1600 mm culvert inlet is angled upwards. The culvert appears to be functioning well, aside from the upwards deformation. However, as noted above, the 1600 mm culvert would be more effective if the inlet elevation were slightly lower. AT's Maintenance Contract Inspector was unavailable to meet and discuss the repair history at this site.



## **RISK LEVEL**

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

- Probability Factor of 5 due to the potential for the ponded water upstream of the highway to saturate and destabilize the embankment, but with uncertainty as to whether or not it is a significant hazard to the highway embankment if the maximum water level is around that seen in September 2008 and June 2009.
- Consequence Factor of 5 based on the possibility of at least partial closure of the road in the event that the water level upstream of the highway rises despite the culverts (e.g. blockage of the culvert inlets by floating debris) and water seeps through the highway embankment and begins to erode the embankment.

Therefore, the current recommended Risk Level for this site is 25, which is the same as recommended after the September 2008 inspection.

## RECOMMENDATIONS

#### Maintenance and Short Term Measures

A meeting with AT's Maintenance Contract Inspector for this area was planned during the inspection, but the inspector was not available. Topics that were to be addressed included:

- Review the site conditions and discuss the site history.
- Discuss how the 1600 mm culvert inlet became angled upwards.
- Discuss the history/reason for the geotextile and rock fill placed around the inlet of the 900 mm culvert.

AT should investigate these questions with the inspector.

#### Long Term Measures

Subject to revision based upon the comments from the maintenance contract inspector, it is recommended that:



- A survey of the creek channel elevation upstream and downstream of the highway be performed in order to determine the optimum inlet elevation for the 1600 mm culvert in order to line up with the natural creek gradient.
- Reconstruct the 1600 mm culvert inlet at a lower elevation, based on the survey above, so that the creek flow will pass freely through the culvert without ponding water upstream of the highway.

This work should be performed within the fisheries window for Mean Creek and the Livingstone River that is a short distance downstream and include sedimentation control measures to minimize the impact on the water quality in the creek.

Depending on how significantly the inlet of the 1600 mm culvert needs to be realigned, it may be possible to keep the highway open to one lane of traffic during the work.

The site should be inspected again following a repair or if conditions are noted to have worsened. Otherwise, further annual inspections by AT and AMEC personnel are not required.



## 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 Earth & Environmental, a division of AMEC Americas Limited

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APEGGA Permit to Practice No. P-04546

Reviewed by:

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Attachments: Photos