

November 2012

CG25399

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

**Attention: Mr. Ross Dickson**

Dear Ross:

**Re: Southern Region Geohazard Assessment  
2012 Annual Inspection Report  
Site S40: Highway 848:02, Dorothy Sinkholes**

This report documents the 2012 annual site inspection of Site S40 – Dorothy Sinkholes, on Highway 848:02, approximately 1.35 km west of Dorothy, Alberta, along Highway 848, 1.2 km southwest of the junction of Highway 848 and Highway 570, southwest of the Red Deer River. This segment of Highway 848 is a gravel, two lane undivided roadway at a hairpin turn segment of a switchback that winds up through a tributary valley draining towards the Red Deer River. Various sections of the road have been undermined by sub-surface erosion as a result of the highly erodible soils and water flow throughout the site.

AMEC Environment & Infrastructure (AMEC), a division of AMEC Americas Limited, performed this inspection in partial fulfilment of the scope of work for the supply of geotechnical services for Alberta Transportation's (AT's) Southern Region (AT contract CON0013506).

The site inspection was performed by Georgina Griffin, P.Eng., Bryan Bale, P.Eng., and Tyler Clay, E.I.T., of AMEC; and Roger Skirrow, P.Eng., Ross Dickson, and Nathan Madigan, E.I.T. of AT during the 2012 Annual Tour.

## **1.0 BACKGROUND**

A general description of the geohazard conditions at this site are provided in the call-out report<sup>1</sup> from AMEC's November 21, 2011 inspection of the site. The inspection was requested by AT after the MCI had reported several holes that developed in the road surface. AMEC's understanding is that the November 2011 inspection was the first as part of the Geohazard Monitoring Program, and that no repairs have been implemented at the site aside from ongoing maintenance by the MCI.

A general site layout with the relative location of the highway to the surface drainage and sinkhole features is shown on Figure 1.

---

<sup>1</sup> AMEC Environment & Infrastructure, *Southern Region Geohazard Assessment Program, Site S40 –Highway 848 – Dorothy Sinkholes Site – Report on November 21, 2011 Site Inspection*, CG25352.400, April 12, 2012.

## 2.0 SITE OBSERVATIONS

Key observations in the site conditions from June 2012 inspection are summarized as follows, and illustrated on Figure S40-1 and Photos S40-1 to S40-4:

- At the time of the 2011 inspection, the MCI showed AMEC three areas along a 150 to 200 m long section of the road where sinkholes had developed within the last year (one such area shown on Figure 1). There were no changes in these previously identified areas since the callout inspection. Refer to Photo S40-1 for an overall view of the site.
- AMEC traversed the site area and found numerous sinkholes in the ditches and gullies at the site in addition to those identified during the November 2011 call-out inspection. Many of the sinkholes had fresh soil exposed. Approximately 17 separate sinkholes were identified (shown on Figure 1), the largest were up to 3.5 m wide and 4.0 m deep and some appeared to be connected by subsurface erosion tunnels (refer to Photos S40-2 to S40-4). All significant sinkholes that were found were measured and their positions were recorded via handheld GPS (refer to Table 1) for future reference. The majority of these sinkholes were within 25 m distance from the road surface; however, no sinkholes or other damage in the road surface were observed.
- No major changes were noted at the two culvert outlets along the slope towards the ravine north of the road. During the 2011 callout inspection one of the culvert outlets was observed to be broken and significant soil erosion around the culvert outlets had occurred. The culvert inlet locations could not be confirmed during the inspections, but one possible culvert inlet is shown on Figure 1.

## 3.0 ASSESSMENT

The assessment for the hazard at this site remains unchanged from the November 2011 inspection and is summarized as follows:

- There are numerous voids near the road and voids with sub-surface tunnels that may create a hazard to the road.
- The voids are most likely formed by subsurface groundwater flow and infiltration causing erosion and piping.
- Voids may form suddenly following precipitation events or periods of high groundwater flow. Subsurface investigations such as drilling or geophysical surveys would likely not be useful as the conditions likely change quickly.
- Altering the apparent source of the erosion (groundwater flow) is considered impractical relative to managing and limiting surface water infiltration and treating erosion issues with regular maintenance.

- Please refer to the November 2011 call-out report for further detail on the site assessment.

#### **4.0 RISK LEVEL**

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

- Probability Factor of 9, based on the numerous active sinkhole formations in the area surrounding this segment of the highway and likely steady, ongoing development rate.
- Consequence Factor of 8, reflecting the fact that the sinkholes form with little warning, could potentially be large enough to cause damage to vehicles or injuries and warrant a road closure and detour pending repair of the sinkhole(s).

Therefore, the recommended Risk Level is 72. This is an increase from 56 during the November 2011 call-out inspection due to the increased extent and significance of active erosion discovered during the annual inspection.

#### **5.0 RECOMMENDATIONS**

##### **5.1 Maintenance and Short Term Measures**

The short term recommendations for this site remain unchanged from the November 2011 call-out report and are summarized as follows:

- Sinkholes that develop in the road surface should be backfilled with dirty gravels (fines  $\geq 20\%$ ). A gravel fill stockpile on site could help ensure timely repairs.
- Clean gravels should not be used as backfill since this may create preferential pathways.
- Maintenance should inspect the site daily and keep records of any sinkhole formations in the road.
- Warning signs and reduced speed limit signs should be placed at the site.
- Surface water throughout the site should be managed and infiltration limited by means of impermeable ditch liners and culvert maintenance (keeping open inlets and preventing additional erosion at the outlets).

Please refer to the November 2011 call-out report for further detail on the short-term recommendations and maintenance.

##### **5.2 Long Term Measures**

The long term recommendations for this site remain unchanged from the November 2011 call-out report and are summarized as follows:

- Potential repairs could include excavation of erodible soils and rebuilding with designed fill and geosynthetics or constructing pile supported slabs to span known void locations.
- Further study to determine site conditions could include a geophysical survey and sub-surface investigation for correlation. The value of mapping void locations is potentially limited if they form rapidly.

Please refer to the November 2011 call-out report for further detail on long-term measures.

## **6.0 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 AND STAMPED NOVEMBER 20, 2012**

Tyler Clay, B.A.Sc., EIT  
Geological Engineer

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

Reviewed by:

APEGA Permit to Practice No. P-04546

Georgina Griffin, M.Eng., P.Eng.  
Associate Geotechnical Engineer

**Table 1 - GPS Referenced Sinkhole / Erosion Features**Alberta Transportation -  
Southern Region  
Geohazard Assessment**S40 - Hwy 848 - Dorothy Sinkholes**

Waypoint Number	Latitude	Longitude	Date	Depth Below Ground Surface (m)*	Diameter (m)*	Notes
95	51.27558	-112.34171	22-Jun-12	0.70	1.70	hole at surface
96	51.27497	-112.34163	22-Jun-12	3.10	1.50	hole at surface
97	51.27499	-112.3416	22-Jun-12	1.30	3.20	hole at surface
98	51.27555	-112.34187	22-Jun-12	1.50	1.60	hole at surface
99	51.27555	-112.34131	22-Jun-12	0.60	1.50	hole at surface
100	51.27552	-112.34117	22-Jun-12	0.70	1.20	hole at surface
101	51.27548	-112.34058	22-Jun-12	0.90	1.10	hole at surface
102	51.27554	-112.34063	22-Jun-12	1.70	1.90	hole at surface
103	51.27559	-112.34054	22-Jun-12	2.00	2.00	hole at surface
104	51.27582	-112.33931	22-Jun-12	3.50	4.00	hole at surface w/ visible tunneling
105	51.27577	-112.33931	22-Jun-12	> 2.5 m	1.40	hole at surface w/ visible tunneling
106	51.27607	-112.33883	22-Jun-12	1.20	1.40	hole at surface
107	51.27609	-112.33888	22-Jun-12	> 1.5m	2.50	hole at surface, difficult measurement due to vegetation cover
108	51.27638	-112.33817	22-Jun-12	0.40	1.70	hole at surface
109	51.27642	-112.33821	22-Jun-12	0.60	3.50	2 x holes at surface, possibly connected below ground
110	51.27613	-112.33887	22-Jun-12	1.00	0.30	hole at surface
111	51.27553	-112.33935	22-Jun-12	1.50	4.00	hole at surface

\*All measurements approximate.