

GEOHAZARD RISK ASSESSMENT
CENTRAL REGION

SITE C21: H576:02 Fill Slide and Internal Erosion

LEGAL LOCATION: **15-29-17-W4**

REFERENCE LOCATION
ALONG HIGHWAY:

UTM COORDINATES: **N 5,703,395 E 408,240** (NAD83)

AT FILE: **H576:02**

AT PLAN & PROFILE: The intersection of H851:02 and H576:02 approximately
30 km east of Drumheller

Date of Initial Observation: 2001 (AMEC)

Date of Previous Inspections: May 16, 2002 (KCCL)
May 21, 2003 (KCCL)
September 24, 2010 (KCB)
June 20, 2011 (KCB)

Inspected By: Klohn-Crippen Consultants Ltd. (KCCL)
Klohn Crippen Berger Ltd. (KCB)

Date of Current Inspection: **June 14, 2012**

Inspected By: KCB

Instruments Installed: 1 Slope inclinometer, 3 Pneumatic Piezometers
(June, 2001)

Instruments Operational: None

Date of Last Reading: May 15, 2003

Read By: KCB

Risk Assessment: $PF(1) * CF(1) = 1$

Last Updated by: KCB (June 2012)

Location and General Description of Instability

The intersection of H851:02 and H576:02 is located approximately 30 km east of Drumheller. About 150 m east of the intersection, an approx. 100 m length of highway is experiencing significant settlement of the order of about 1 m over the full width of the road (approx. 11 m). Gravel fill has been placed to maintain the highway grade.

AMEC's review of the airphotos as part of the 2001 site investigation indicated that the construction of H576 blocked the natural north to south drainage pattern of the area. The outcome of this is that a ponded water area about 15 m wide by 150 m long is present to the north of the highway creating a seepage gradient through the fill. The highway surface is about 1 m higher than the water level. To the south of the highway, the vegetation denotes a seepage area.

The instrumentation was indicating that the highway fill was saturating as a result of the ponded water to the north. Due to the general nature of high plasticity fills of this type and based on the SPT N values observed, it is estimated that the fill was not compacted to an adequate density. It is assumed that the material is highly dispersive as evidenced by several sinkholes and collapse features observed along the shoulder of the highway. The dispersion and internal erosion is resulting in voids that are subsequently collapsing.

Geotechnical Conditions

A site investigation program at the site was conducted in June 2001 by AMEC Earth and Environmental and is reported in the document "Geotechnical Slope Assessment, Secondary Highway 576 near Drumheller, Alberta", dated September 2001.

The stratigraphy at the highway settlement location, as determined by AMEC, comprises 3.1 m of high plasticity clay fill over 4.8 m of high plasticity clay till overlying sandstone bedrock at 7.9 m depth. The fill and till are both described as silty clay with trace of sand with a soft to firm consistency. The material is generally of high plasticity with liquid limits in the range of 50% to 60%. Below about 2 m, the natural moisture content is very consistent at about 25%. SPT N values range from 5 to 14, with an average of about 10.

Chronology (Refer to Section G for Further Information)

1949 to 1970

In 1949, the road existed at the same location but does not appear to be as built up as shown in a 1970 air photograph. To the east, the highway was realigned with a higher fill across a coulee.

June 2001

Site investigation by AMEC Earth and Environmental in an area of cracking along the shoulder on the south side of the highway.

2003

Severe settlement of the highway was observed. The slope inclinometer was indicating a movement to the south in the clay fill overlying the till at a depth of about 2 m. The maximum observed movement at the surface was about 70 mm. Movements in the underlying clay till were essentially zero. It was considered that the observed movement is the instrument responding to the settlement of the fill, possibly due to internal erosion. The piezometer data indicated a linear phreatic surface between a pond that existed on the north side of the highway and the low area to the south. Pond to the north is drained via a new culvert and highway is re-graded to remove dip. The approximate cost of the work was \$30,000 for the new culvert and about \$15,000 for the re-grading work.

2010

Approximately a 90 m length of highway experienced significant settlement of the order of about 0.5 m over the full width of the road. In 2003, cracks showing signs of internal erosion were present; however, significant cracking was not observed at the time of September 2010 site inspection. New surfacing gravel was placed. A new 600 mm diameter CSP culvert was installed at the east end of the settlement area to completely drain the area to the north of the highway. Three gravel filled drains were also installed in trenches excavated across the highway in an attempt to preferentially carry seepage flows south under the road fill. The drains were equally spaced along the area of road settlement. At the base of the drain, a 150 mm diameter perforated HDPE pipe was provided and daylighted south of the highway at the toe of the fill. The excavated trenches were about 1 m wide by about 3 m deep. The road grade was restored with compacted gravel fill from an AT gravel pit located about 10 km from the site.

June 2011

The area of major settlement of the highway extended for a length of about 100 m over the full width of the road. Minor settlement extended for a further 50 m to the east. The settlement is significant and was estimated to be up to 1 m. Significant cracking was observed at the time of the site inspection, particularly along the south shoulder of the road. The settlement appeared to be following a buried channel that links the vegetated area north of the road to a similar vegetated area on the south side of the road

The settlement of the road was storing runoff from the high levels of rainfall. The culvert at the east end of the site (installed in 2010) was flowing; however, the pipe suffered significant settlement over the southern half and the outlet was tilted upward. The soil at the surface both north and south of the road was very soft.

It was considered that the highway fill and till subgrade was saturated as a result of a high groundwater table created by springs to the north of the road and the very high levels of rainfall. Due to the general nature of high plasticity fills of this type and based on the SPT N values observed, it was estimated that the fill was not compacted to a very high relative density. It is assumed that the subgrade material is highly dispersive as evidenced by several sinkholes and collapse features previously observed along the shoulder of the

highway and in the area to the south. It was conjectured that material softening and internal erosion is causing the settlement at the surface. Site investigations were recommended which included topographic survey, refraction seismic tomography and MASW (multi-channel analysis of surface waves) and drilling. However, the highway grade was restored with the placement of additional gravel fill.