

**ALBERTA TRANSPORTATION  
GEOHAZARD ASSESSMENT  
PEACE REGION (SWAN HILLS)  
SITE SH 26: GUNN'S CREEK NORTH EMBANKMENT  
FAILURE, HWY 2A:54**

**SECTION A – GEOTECHNICAL FILE REVIEW**

Submitted By:

**AMEC ENVIRONMENT & INFRASTRUCTURE  
EDMONTON, ALBERTA**

December 2012

## 1.0 PROJECT SETTING

### 1.1 LOCATION

Site SH-26 (Gunn's Creek North Embankment Failure) is located on Highway 2A:54 approximately 9.2 km east of the junction of Highway 2A and Highway 49. The legal land description of the site SH-26 is LSD03 – Sec 02 – Twp 75 – Rge 20 – W5M.

The Gunn's Creek embankment was constructed across Gunn's Creek with a corrugated steel pipe (CSP) bridge culvert installed beneath to carry the creek flow through the embankment. The In Service Year of the culvert is reported as 1959; therefore, it is assumed that the embankment was constructed during the same time. The north (upstream) side of the embankment forms site SH-26. The embankment was constructed to a height of approximately 20 m and was inclined at a slope of approximately 19 degrees (3H:1V).

Although not discussed herein, the south embankment slope also has a history of failures. The reader is directed to site SH15 for further details regarding the south embankment slope.

### 1.2 SITE GEOLOGY, HYDROGEOLOGIC AND GEOMORPHOLOGIC SETTING

**Physiographic Region:** The site is situated in the Peace River Lowland Region of Alberta

**Bedrock Geology:** The site is underlain by the Cretaceous Wapiti and/or Puskwaskau Formation. The Wapiti formation consists of feldspathic clayey sandstone, bentonitic mudstone, bentonite, and minor coal beds. The Puskwaskau formation consists primarily of clayshale with lesser amounts of sandstone.

**Surficial Geology:** The site is situated in a glaciolacustrine plain, where a thin layer of glaciolacustrine deposits occur above glacial till. The glaciolacustrine deposits could consist of clay, silt, or fine sand. The surficial deposits are likely relatively thin in this area.

**Hydrogeology:** The sandstone and coal beds of the Wapiti Formation have the potential for flow rates of up to 2 L/s. Near surface groundwater flow is interpreted to be towards Gunn's Creek which flows south to the Little Smoky River.

**Stratigraphy:** No geotechnical investigation has been completed to investigate the site; however, three geotechnical boreholes were advanced by Thurber Engineering Ltd. during the investigation for the design and construction of remedial works for the south embankment slope in 2002. The soils encountered within and below the south embankment slope generally consisted of clay fill over a thin layer of clay, over clay till. The clay fill in the south embankment was high plastic, silty, and varied in consistency from firm to hard (with consistency generally increasing with depth). Beneath the clay fill, the clay (interpreted as glaciolacustrine clay) was high plastic. The underlying clay till was of medium plasticity with a very stiff consistency.

## **2.0 HISTORICAL INFORMATION**

The history of this site is based on a review of Thurber Engineering Ltd. (2003 to 2007), Karl Engineering Consultants Ltd. (2008 to 2011), AMEC Environment & Infrastructure (2012), and Alberta Transportation files. Historical plans and photos of the site are found in Section F.

### **Circa 1959**

Culvert installed and embankment/highway constructed.

### **1990's**

There is indication that repairs to the north slope of the embankment that crosses Gunn's Creek may have been performed by Alberta Transportation in the 1990's. Anecdotal evidence indicates that a layer of granular fill may have been placed into the slope to help with drainage; however, there was no documented information on this repair found during the file review.

### **2005**

During the 2005 inspection of site SH15 (south embankment slope), a 10 m long crack, up to 25 mm wide, was observed within the pavement adjacent and parallel to the north edge of the highway. Further, the guardrail was observed to be bowed outward from the highway in this area. The estimated lateral deflection of the guardrail was between 0.2 m to 0.3 m.

### **2006**

During the 2006 inspection of site SH15, the aforementioned crack along the north edge of the highway had widened to 35 mm and lengthened to 22 m. Further, two new cracks measuring 8 m and 15 m in length had developed closer to the guardrail. At this time the north guardrail had been replaced.

### **2007**

The Gunn's Creek north embankment slope failure was first observed in the spring of 2007 and documented in a call out inspection report in the summer of 2007. The slide was observed west of the CSP culvert that passes through the embankment.

At this time, the slide dimensions were estimated to be 40 m by 40 m in plan view and the slide outline was marked by a scarp (up to 1.3 m high) along the top edge and west side of the slide and a toe roll up to 2 m high adjacent to the bush on its northwest flank. Also observed were an intermediate scarp and a 100 mm open crack running approximately parallel to the headscarp through the middle of the slide and a depressed area below the intermediate scarp. On the backscarp of the slide, the exposed soils were reported to consist of high plastic clay. Some sand and gravel was observed on top of the exposed clay surface near the backscarp and small areas of standing water were observed within the slide mass. The headscarp was measured to

be as close as 3.8 m from the highway guardrail at its closest point and the toe of the slide was located within about 10 m of the inlet of the Gunn's Creek culvert. Some erosion (15 m long by 15 m wide) was noted on the banks of the creek upstream of the culvert inlet.

It was hypothesized, by the consultant at that time, that the slide was mainly the result of saturation of the highly plastic clay embankment fill and that the slide may have been a two sequence event with the lower portion of the slide below the intermediate scarp possibly occurring first, followed by the upper portion of the slide occurring next. It was postulated that the embankment slope was too steep for the saturated, softened clay. It was further postulated that the slide may have been somewhat progressive due to gradual weakening of the clay fill caused by freeze thaw and wetting and drying cycles leading to a loss of cohesion.

### **2009/2010**

Some minor growth of the slide area and retrogression of the headscarp of the slide was reported in 2009 and 2010. During this period, tension cracks behind the headscarp were also reported.

### **2011**

Some minor growth of the slide area, tension cracks, and retrogression of the headscarp of the slide was reported in 2011. At this time the headscarp of the slide was estimated to be about 2 to 3 m from the highway edge.

### **2012**

The headscarp of the slide was measured at 2 m from the edge of the pavement at its closest point and tension cracks up to 40 mm wide were observed adjacent to the pavement behind the headscarp. Furthermore, a longitudinal crack had formed in the pavement behind the headscarp indicating that the slide had begun to affect the highway.

Below and to the northwest of the embankment failure, a shallow slope failure was observed on the west bank of Gunn's Creek. This failure was approximately 10 m wide by 15 m long. Also erosion and slumping on the east and west banks of Gunn's Creek upstream of the culvert inlet was observed (originally observed in 2007) and a sinkhole had developed immediately upslope and adjacent to the west side of the culvert inlet.

AMEC proposed a geotechnical field investigation program for the design and construction of longer term remedial measures for the embankment failure. The proposed field program comprised both boreholes and test pits to characterize the embankment fill soils and conditions at the interface of the fill and underlying native soils. It was recommended that remedial measures for the site should also include repairs for the aforementioned shallow slope failure on the west bank of Gunn's Creek and repair of the erosion and slumping on the east and west banks of Gunn's Creek. At this time, a Class B cost estimate for noted investigation and remedial repairs was submitted to AT.

## REFERENCES

1. Energy Resources Conservation Board, 2008. "ERCB/AGS Map 421, Surficial Geology of the High Prairie area (NTS 83N/SE), scale 1:100,000."
2. Alberta Research Council, 1980. "Earth Sciences Report 79-3, Hydrogeology of the Winagami Area, Alberta."
3. Thurber Engineering Ltd., July 3, 2003. "Construction Summary Report Gunn's Creek Slide Repair, 9 km East of Hwy 49, Hwy 2A:54 – km 18.410 to km 18.460."
4. Thurber Engineering Ltd., December 19, 2005. "Peace Region (Swan Hills Area) Geohazard Assessment, Hwy 2A:54 Gunn's Creek Slide (SH 15), 2005 Annual Inspection Report."
5. Thurber Engineering Ltd., December 11, 2006. "Peace Region (Swan Hills Area) Geohazard Assessment, Hwy 2A:54 Gunn's Creek Slide (SH 15), 2006 Annual Inspection Report."
6. Thurber Engineering Ltd., July 12, 2007. "Peace Region - Swan Hills Area - Geohazard Assessment (CE047/2004), Call-Out for Embankment Failure (SH 26) on Hwy 2A:54 ~9 km East of Junction of Hwy 49."
7. Karl Engineering Consultants Ltd., December 31, 2008. "Peace Region (Swan Hills) GeoHazard Assessment, (SH26) Hwy 2A:54 Gunn's Creek South Embankment Slope Failure, 9 km east of Hwy 49."
8. Karl Engineering Consultants Ltd., December 31, 2008. "Peace Region (Swan Hills) GeoHazard Assessment, (SH 26) Hwy 2A:54 Gunn's Creek South Embankment Slope Failure at North Facing (Upstream) Slope, 9 km east of Hwy 49."
9. Karl Engineering Consultants Ltd., December, 2009. "Peace Region - Swan Hills GeoHazard Risk Assessment, Site Inspection Form, SH 26, Gunn's Creek North Embankment Failure, Hwy 2A:54."
10. Karl Engineering Consultants Ltd., November, 2010. "Peace Region - Swan Hills GeoHazard Risk Assessment, Site Inspection Form, SH 26, Gunn's Creek North Embankment Failure, Hwy 2A:54."
11. Karl Engineering Consultants Ltd., November, 2011. "Peace Region - Swan Hills GeoHazard Risk Assessment, Site Inspection Form, SH 26, Gunn's Creek North Embankment Failure, Hwy 2A:54."

Alberta Transportation  
Geohazard Assessment  
Peace Region (Swan Hills)  
Site SH 26: Gunn's Creek North Embankment Failure,  
Hwy 2A:54  
December 2012



12. Amec Environment & Infrastructure, July 4, 2012. "Peace Region - Swan Hills GeoHazard Risk Assessment, Site Inspection Form, SH 26, Gunn's Creek North Embankment Failure, Hwy 2A:54."