Stantec Consulting Ltd.
10160 112 Street, Edmonton AB T5K 2L6

ALBERTA TRANSPORTATION
LANDSLIDE RISK ASSESSMENT

SECTION A: GEOTECHNICAL FILE REVIEW

NORTH CENTRAL REGION

SITE NC80: FICKLE LAKE ROAD SLIDE

LEGAL LOCATION:	SE 24-51-19-W4M
NEAREST LANDMARK:	2.2 km NORTH OF FICKLE LAKE ROAD
Highway Control Section:	HWY 47:06, km 39.6
Date of Initial Observation:	2012
Date of Last Inspection:	2017
Last Inspected By:	Stantec Consulting Inc.
Instruments Installed:	2 Slope Inclinometers (2013), 2 Pneumatic Piezometer (2013), 1 Standpipe Piezometer (2013)
Instruments Operational:	1 Slope Inclinometer (2013), 2 Pneumatic Piezometer (2013)
Risk Assessment:	PF(9) · CF(6) = RL (54)
Last Updated:	September 2017 – Stantec Consulting Ltd.

1. LOCATION

The site is located on the east side of Highway 47:06 near km 39.6, approximately 20 km south of Highway 16, west of Edson, Alberta. Legal land description SE24-51-19-W5M.

2. GENERAL DESCRIPTION OF SLOPE INSTABILITY

The highway crosses a tributary to the Embarras River. There are two culverts on site: a 1200-mm culvert and a 760-mm overflow culvert 12 m apart. A 400 mm downdrain was located approximately 20 m south of the 760-mm culvert and west of the highway.

The embankment slopes were constructed in 1971 and were reported to be stable until 2011 when the first sign of distress was observed after an asphalt patch was placed to improve the road surface.

In early August 2012, Golder Associates personnel responded to a call-out request in August 2012. During this call-out signs of slope instability included a 40 m long depression in the northbound lane.

A second call-out was conducted by Golder in August 2013 due to further pavement subsidence and cracking upon patching of the highway During the 2013 call-out another toe bulge was observed south of the 760 mm culvert.

In general, given the wet ground conditions, Golder highlighted that pavement settlement was a wetting induced settlement of the cohesive clay fill material and was triggered by the silting in of the 1200-mm diameter culvert. The silting in of the culvert caused water to enter the gravel envelope around the pipe and flow down the slope of the CSP and blocked by the clay seal downstream. Clay fills when compacted properly can be a stable material but collapse and soften with wetting. The placement of 29-tonnes asphalt also triggered the slope instability in the area. In early August 2013, Golder (December 2013) suggested to cease the patching to limit the additional weight at the crest of the slope and the crack was sealed to limit additional surface water infiltration.

3. GEOLOGICAL/GEOTECHNICAL CONDITIONS

PHYSIOGRAPHIC REGION

Southern Alberta Uplands

BEDROCK GEOLOGY

Bedrock geology found on this site belongs to either the Paskapoo Formation consisting mudstones, siltstone, and stratified sandstone. Based on the water well records, bedrock is anticipated to be shallower than 15 m.

SURFICIAL GEOLOGY

The site is located in an area of glaciolacustrine sediments overlain by highway embankment fill. The valley slopes of the Buck Lake Creek tributary generally comprise of colluvial deposits overlying bedrock belonging to the Paskapoo formation.

SITE STRATIGRAPHY

Four (4) boreholes were advanced during a geotechnical investigation undertaken in August 2013. The boreholes were drilled to depths approximately between 12 m to 20 m below ground surface (bgs). The stratigraphy encountered within the borehole investigation generally consisted of embankment fill overlying a layer of medium plastic clay till. Ice-rafted clay shale was encountered in one borehole at approximately 940 m elevation.

HYDROGEOLOGY

The regional groundwater typically drains towards north east. The groundwater yields between 2 L/sec to 8 L/sec. During previous geotechnical investigation, groundwater level was approximately between 948 m to 950 m elevation.

4. CHRONOLOGY

GENERAL

As documented in a Golder call-out inspection report (August 2013) and geotechnical investigation report (December 2013), a distress first occurred in 2011 with a call-out requested in 2012 and 2013. The highway pavement has been continuously patched until 2013 when further geotechnical investigation was conducted to repair the slope. Driven steel piles wall was installed in October 2013, east of the highway.

2011

A patch was placed and shortly after placement, an arc shaped crack and dip in the northbound lane occurred. Additionally, the upstream and downstream sloped ends of the 1200 mm culvert had become separated. Following the separation, the upstream channel had silted in and vegetation had grown to the elevation of the 760 mm overflow culvert.

2012

Golder responded to a call-out in August 2012. During the call-out, a 200 mm to 300 mm depression was observed on the northbound lane. During the call-out it was noted that struts were installed in the culverts to prevent collapse from improper culvert installation during final grading in the 1970s.

2013

During the June 2013 annual site inspection, a toe bulge was observed within the lower third of the east slope above the 1200 mm culvert outlet.

A second call-out was conducted by Golder in August 2013. The inspection found further pavement distress and slope movement. A second toe bulge was observed south of the 760 mm culvert at about the same elevation as the initially observed toe bulge. A potential third bulge was also observed to be bulging into the channel. The distress was believed to have occurred due to placement of fill material near the crest of the embankment. Golder ceased the pavement patching and conducted a geotechnical investigation comprised of four boreholes and several monitoring instruments (two slope inclinometers, one pneumatic piezometer, and one standpipe piezometer). The SIs were initialized in August 28, 2013 and the site was added to the regular GRMP instrumentation reading and inspection schedule.

In October 2013, a driven pile wall was installed east of the highway. The pile wall comprised of 75-12.2 m 'H' piles HP360x108 at 900 mm centre-to-centre spacing. The construction was completed in 2014.

5. GEOTECHNICAL INSTRUMENTATION

Two slope inclinometers, one pneumatic piezometer, and one standpipe piezometer were installed at the site to monitor ground movements and groundwater levels. The location of these instruments is shown on **Figure 1.**

6. REFERENCES

Alberta Transportation, Geotechnical Files.

Alberta Energy Regulator, October 17, 2005, "Hydrogeological map of the Edson area, Alberta, NTS 83F."

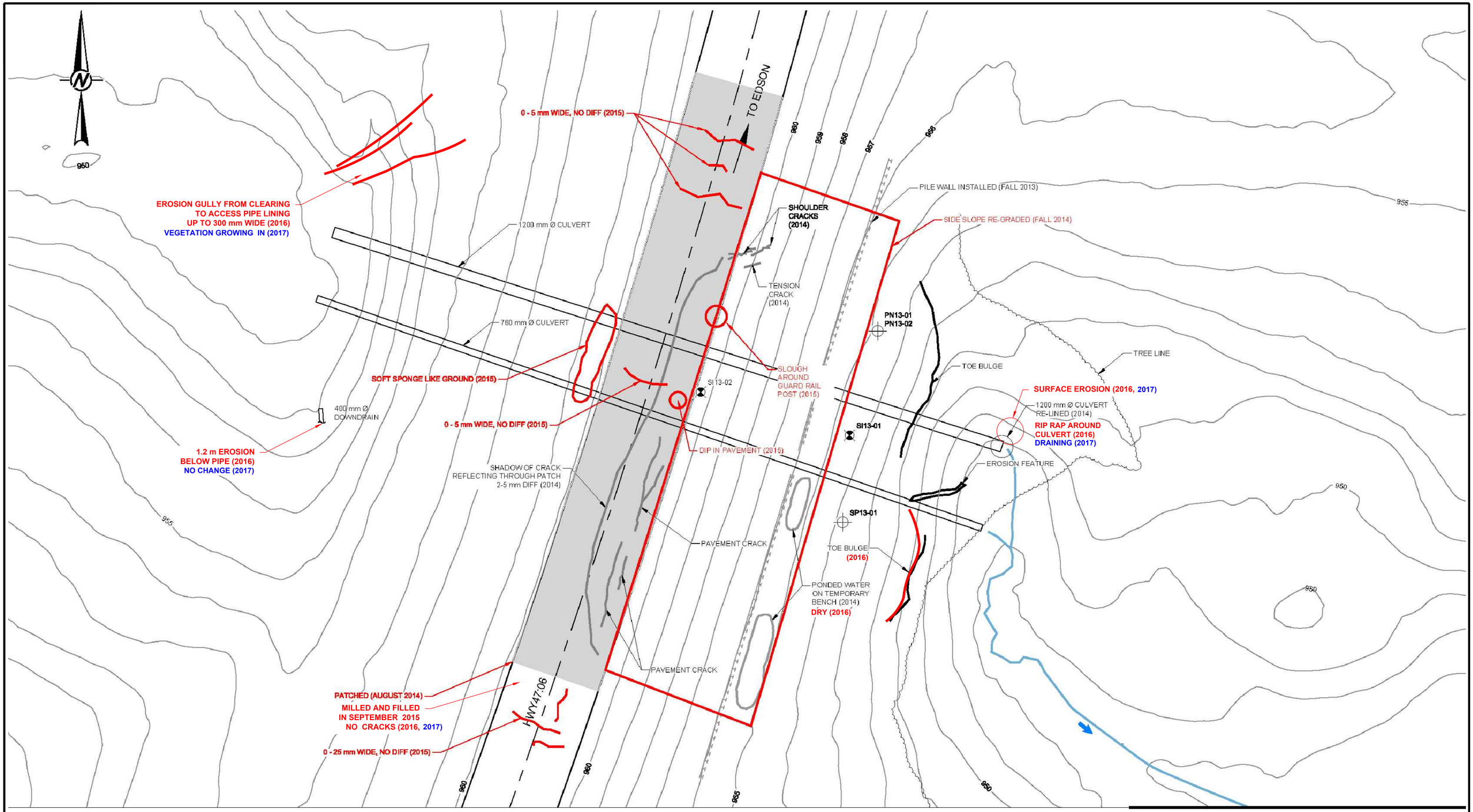
Alberta Energy Regulator, 2013, "Alberta Geological Survey Map 600 – Bedrock Geology of Alberta."

Alberta Energy Regulator, 2013, "Alberta Geological Survey Map 601 – Surficial Geology of Alberta."

Golder Associates, August 7, 2013, "North Central Region – Edson Area: Call-out Report," File: 13-1376-0027.

Golder Associates, December 6, 2013, "NC80 – Fickle Lake Slide: Geotechnical Investigation, Analysis and Preliminary Design," File: 13-1376-0066.

Golder Associates, January 8, 2014, "NC80 – Fickle Lake Slide Repair: Construction Summary Report," File: 13-1376-0066.



LEGEND

- FLOW ARROW
- CONTOUR (5 m INTERVAL)
- WATER COURSE
- PIEZOMETER LOCATIONS
- SLOPE INCLINOMETER LOCATIONS
- DRIVEN STEEL PILE

NOTES

1. FEATURE LOCATIONS ARE APPROXIMATE.
2. PREVIOUS OBSERVATIONS SHOWN IN BLACK.
3. 2015/16 OBSERVATIONS SHOWN IN RED
4. 2017 OBSERVATIONS SHOWN IN BLUE

REFERENCE

LIDAR CONTOURS OBTAINED FROM CLIENT.

0 8 16 24
SCALE METRES

Stantec

STANTEC CONSULTING
10160-112 STREET
EDMONTON ALBERTA CANADA

ALBERTA TRANSPORTATION
GEOHAZARD MONITORING PROGRAM
NC80 FICKLE LAKE ROAD SLIDE
SITE PLAN

DRAWN WW / MK	CHECK CDM	APPROVE ID
DATE 15 SEP. 2017	SCALE AS SHOWN	PROJECT # 123312435

FIGURE - 1 -