

June 28, 2019

Alberta Transportation
 2nd Floor, 803 Manning Road NE
 Calgary, Alberta
 T2E 7M8

Alex Frotten, E.I.T.
Construction Engineer

Dear Mr. Frotten:

**CON0017609 Southern Region GRMP Instrumentation Monitoring
 Site S028; H3A:06 km 2.4, Slide East of Lundbreck Falls
 Section C - 2019 Spring Readings
 DRAFT**

1 GENERAL

Two pneumatic piezometers (PNs) installed in borehole PP09-1 on the north shoulder of Highway 3A were read on April 29, 2019 by Mr. Evan Fong, E.I.T. of Klohn Crippen Berger Ltd. (KCB). The site is located on Highway 3A:06 km 2.4, approximately 3 km westbound from the Town of Lundbreck, Alberta on a slope above the Crowsnest River.

The geohazard at this site consists of a landslide approximately 6 to 12 m deep, seated in bedrock above the Crowsnest River and impacting approximately 100 m of Highway 3A. A 450-mm-diameter corrugated steel pipe (CSP) culvert which discharges into a 750 mm diameter CSP culvert partway down the slope appears to function as slope drainage. Patching of the cracks was carried out in mid-2014. A summary of the status of site instrumentation is provided in Tables 1.1 and 1.2. Both PNs are located on the north shoulder of the road, as shown on Figure 1.

The PNs were read up to September 2017 using a Slope Indicator model 256 dry-nitrogen pneumatic piezometer readout box. Readings after September 2017 have been read using an RST model C109 pneumatic piezometer readout box.

Table 1.1 Status of Slope Inclinerometers

Instrument #	Location		Date Installed	Stickup (m)	Depth (m)	Cumulative Resultant Movement Direction from A0 groove
	Lat	Long				
S109-1	-	-	2009	-	-	N/A. Non-functional since May 2014 due to excessive deformation
S109-2	-	-	2009	-	-	N/A. Non-functional since May 2014 due to excessive deformation
S109-3	-	-	2009	-	-	N/A. Non-functional since May 2014 due to excessive deformation

Table 1.2 Status of Pneumatic Piezometers

Instrument #	Location ⁽¹⁾		Date Installed	Tip El. (m)	Depth ⁽²⁾ (m)	Soil Unit	Condition
	Lat	Long					
PP09-1 59186	49° 35.230'	114° 11.576'	Feb 2009	1143.4	23.4	Bedrock	Functional
PP09-1 59187	49° 35.230'	114° 11.576'	Feb 2009	1155.9	10.9	Clay Till	Functional

Notes:

¹ Instrument locations were measured using a handheld GPS with +/- 5 m.

² Measured from ground surface.

The instruments were installed by previous consultants, during a 2009 geotechnical investigation and instrumentation implementation at the site, consisting of two PNs and three slope inclinometers (SIs). The boreholes for the instrument installation encountered weak fill underlain by high plastic clay, underlain by medium to high plastic clay till, and underlain by slickensided shale and sandstone bedrock. The three slope inclinometers (SI09-1, SI09-2, SI09-3) have been inoperable since May 2014 due to excessive deformation.

2 INTERPRETATION

2.1 General

Plots of the piezometric data are in Appendix I and summarized in the following sections. Historical precipitation data included in the appended piezometer plots was drawn from the Alberta Climate Information Service (ACIS) database, referencing township T008R04W5 for instruments clustered near Crowsnest.

2.2 Slope Inclinometer Movement Zones

Previous readings from the now inoperable SIs indicated the zone of movement to be between 6.5 m and 11 m depth below ground surface. The historic maximum rates of movement were reported to vary between 28.2 mm/year and 62.3 mm/year in November 2011, after which deformations precluded further SI readings.

The SIs were destroyed prior to KCB involvement, and therefore the previously observed movements have not been verified, and no new zones of movement have been identified. Field observations suggest that the slide continues to be active.

2.3 Interpretation of Monitoring Results

Previous assessments have resulted in the conclusion that SIs are not an effective method of monitoring for instability at this site. The previous SIs have not been replaced.

Pneumatic piezometer data from 2009 to date is presented in Appendix I. From 2009 to mid-2013, the historic piezometric data suggested seasonal fluctuations of at shallow depth (PN 59187) with less fluctuation at depth (PN 59186). Between spring 2013 and spring 2016, the piezometric levels recorded by both piezometers experienced a greater degree of fluctuation with large decreases

occurring in the October 2013 and May 2015 readings. The reason for the fluctuations is unknown, however there is a possibility that the observed variations were due to the movements of the landslide towards the highway, and/or improvements to drainage of the instrumented area.

From spring 2016 to present day, piezometric elevations have returned to generally static levels, and appear to show an ongoing slight upward trend. During this time period, it appears that there has been less precipitation, which may attribute to the more static water levels. A summary of the pneumatic piezometer data is included in Table 2.1.

Table 2.1 Pneumatic Piezometer Summary

Instrument #	Date Initialized	Tip El (m)	Ground El. (m)	Pressure Head Above Tip (m)	Date of Prev. Reading	Previous Pressure Head Above Tip (m)	Current Water Level ⁽¹⁾ (mbgs)	Change from Prev. Reading (m)
PP09-1 59186	Feb 2009	1143.4	1166.9	16.03	Oct 29, 2018	16.52	7.46	-0.50
PP09-1 59187	Feb 2009	1155.9	1166.9	6.04	Oct 24, 2018	6.40	4.95	-0.35

Notes:

¹ Metres below ground surface (mbgs)

3 RECOMMENDATIONS

3.1 Future Work

The instruments should continue to be read at this site. As part of ongoing maintenance, AT's maintenance contractor should continue to seal and patch the cracks in the road surface at this site, as well as place overlays as required to maintain a suitable driving surface. Milling of the existing highway cracks could be used to reduce transitions between deformed areas of the pavement.

3.2 Instrument Repairs

None required.

4 CLOSURE

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Please contact the undersigned if you have any questions or comments regarding this report.

KLOHN CRIPPEN BERGER LTD.

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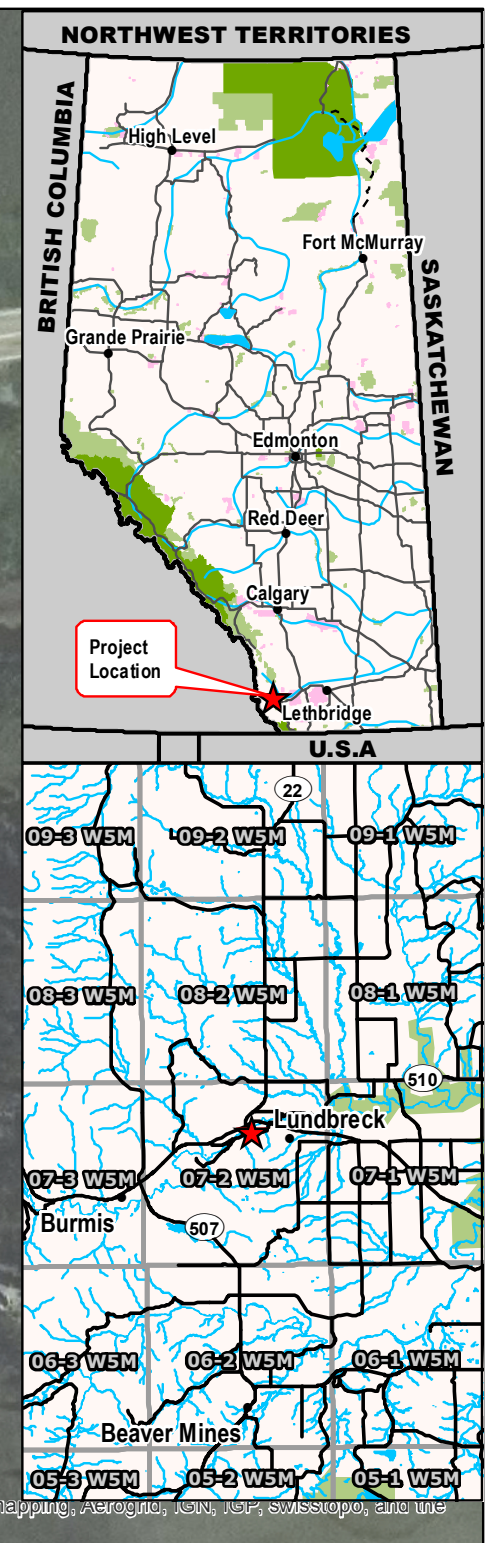
CC: Chris Morgan, M.Sc., P.Eng. and Chris Gräpel, M.Eng., P.Eng.

Attachments

Figure
Appendix I Piezometric Data Plot

DRAFT

FIGURE



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Legend

- Pneumatic Piezometer
- Outlet of 750 mm diameter CSP slope drain
- Cracks (Approximate Location)
- Culvert
- 750 mm CSP Slope Drain (Approximate Location)
- Possible Extent of Slide Area

NOTES:
 1. HORIZONTAL DATUM: NAD83
 2. GRID ZONE: UTM Zone 11N
 3. IMAGE SOURCE: World Imagery from ESRI
 ArcGIS Online. Image dated July 15, 2012

CLIENT

PROJECT	SOUTHERN REGION GEOHAZARD RISK MANAGEMENT PROGRAM	
TITLE	Site Plan S028 - Slide East of Lundbreck Falls Hwy 3A:06, km 2.367	
SCALE	PROJECT No.	FIG No.
1:1,250	A05115A03	1

Time: 16:20:03 PM
 Date: November 14, 2018
 File: Z:\AEDM\A05115A03 ABT Southern Region GRMP\400 Drawings\2018\3. Section C\GIS\MXD\S028_181114.mxd