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# ALBERTA TRANSPORTATION LANDSLIDE RISK ASSESSMENT

## SECTION A: GEOTECHNICAL FILE REVIEW

### NORTH CENTRAL REGION

### SITE NC31: DEER LODGE

LEGAL LOCATION:	NW 21-56-8-W5M
NEAREST LANDMARK:	30 KM NORTH OF HWY 16
Highway Control Section:	HWY 22:32, km 28.9
Date of Initial Observation:	1998
Date of Last Inspection:	2017
Last Inspected By:	Stantec Consulting Inc.
Instruments Installed:	2 Slope inclinometers (2001), 2 Slope Inclinometers (2006), 2 Vibrating Wire Piezometer (2014), 1 Standpipe Piezometer (2006)
Instruments Operational:	1 Slope Inclinometer (2006), 2 Vibrating Wire Piezometer (2014), 1 Standpipe Piezometer (2006)
Risk Assessment:	PF(3) · CF(3) = RL (9)
Last Updated:	September 2017 – Stantec Consulting Ltd.



## **1. LOCATION**

The site is located along Highway 22:32 approximately 11 km south of Mayerthorpe near km 28.9 and approximately 30 km north of the junction of Highway 16, Alberta. The legal land description is NW 21-56-8-W5M.

## **2. GENERAL DESCRIPTION OF SLOPE INSTABILITY**

Highway 22 is a paved undivided highway, comprising of a single northbound and southbound lane. The highway crosses a creek that flows east through a 1200-mm diameter CSP culvert.

As per the documents available, the first call-out was conducted by Thurber Engineering in October 1998. At the time of inspection, the road is located on a sidehill fill up to 5 m high and it was noted that the west embankment slope has been experiencing movement since 1997. Several cracks were visible within the patched area of the pavement and vertical displacement ranging between 50 mm to 75 mm were visible. Water ponding in the east ditch was believed to initiate the distress. Based on the historical data, poor drainage, high groundwater level, and poor foundation soils might have triggered the slope movement in the area. Several positive drainage remediation measures had been completed including regrading along the highway and installation of a longitudinal drain, slot drain, and riprap. The 1200-mm SCP culvert was also extended to drain the water further away from the toe bulge.

Multiple slope stabilization attempts were conducted. The most recent remediation occurred in 2014 by Thurber Engineering Ltd. The project includes toe berm installation, regrading, widening of road shoulder, installation of new instrumentation to monitor the groundwater level, culvert extension, and widening of the ditch.

In general, previous GRMP reports provided by Alberta Transportation highlighted that the slope movement was mainly due to poor drainage and high groundwater level.

## **3. GEOLOGICAL/GEOTECHNICAL CONDITIONS**

### **PHYSIOGRAPHIC REGION**

West Central Plains

### **BEDROCK GEOLOGY**

Bedrock geology found on this site belongs to either the Paskapoo Formation or Scollard Formation consisting mudstones, siltstone, and sandstone. Based on the water well records, bedrock is anticipated at approximately 35 m below ground surface.



## **SURFICIAL GEOLOGY**

The site is located in the 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 one of either the Paskapoo formation or the Scollard Member.

## **SITE STRATIGRAPHY**

The most recent boreholes were advanced in November 2014 by Thurber Engineering Ltd. to install two vibrating wire located west of the existing ditch. Two (2) boreholes were advanced during a geotechnical investigation undertaken in April 2001. Five (5) test pit were conducted in 2000 and 2014. The boreholes were drilled to depths approximately between 2 m to 13 m below ground surface (bgs). The stratigraphy encountered within the borehole investigation generally consisted of embankment clay fill overlying a layer of medium plastic clay fill. High plastic clay was encountered in some test pit and borehole.

## **HYDROGEOLOGY**

Based on Alberta Energy Regulator hydrogeological map, regional groundwater flow is generally draining to the southeast and groundwater yields typically between 0.4 L/sec to 2 L/sec.

## **4. CHRONOLOGY**

### **GENERAL**

As documented in the historical reports provided by Alberta Transportation, slope instability first occurred in 1998 and the site has been inspected since. Multiple repair/maintenance have been completed with the most recent slope remediation completed in 2014 by Thurber Engineering Ltd.

### **1998**

First site inspection of NC31 was conducted by Thurber Engineering Ltd. in 1998. Pavement cracks with a vertical difference of up to 75 mm was visible. Thurber concluded that slope movements may be due to poor drainage around site.

### **2000**

In 2000, four trench drains backfilled with sandy pit run gravel were installed in the west sideslope. Three (3) test pits were excavated and found a water bearing organic layer containing log debris. A 10-m wide and 40-m long strip along the west sideslope was excavated to remove the log debris and the embankment reconstructed with inorganic clay fill.



## **2001**

Two slope inclinometers (SI) were installed and identified a slip surface within the organic clay. These SIs were sheared off in 2004. In 2001, cracking on the road surface was observed and the 1200-mm diameter CSP culvert separated approximately 12 m from the upstream end.

## **2002**

A toe berm and slot drain was constructed in 2002 as per Thurber's recommendation in June 2002; however, movements were noted after the repair and inspections continued in 2003.

## **2006**

Two replacement SIs and one standpipe piezometer was installed in the area by Jacques Whitford during remediation of Highway 22.

## **2014**

Two test pits were excavated on the west side of highway 22 on July 2014. Two vibrating wire were installed on the west of the ditch. Slope remediation was conducted by Thurber Engineering Ltd. in 2014. The project included toe berm installation, regrading, widening of road shoulder, culvert extension, and widening of the ditch.

## **5. GEOTECHNICAL INSTRUMENTATION**

Two slope inclinometers, two vibrating wire piezometers, and one standpipe piezometer were operational 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 Wabamun Lake, Alberta, NTS 83G."

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, June 26, 2014, "North Central Region – Edson Area: 2014 Annual Inspection Report," File: 13-1376-0027.

Thurber Engineering Ltd., October 27, 1998, "HWY 22:32, 30 km North of HWY 16 – Assessment of Two Embankment Failures," File: 15-16-114.



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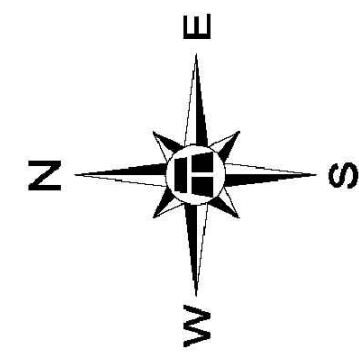
Thurber Engineering Ltd., June 23, 2000, "Two Area of Fill Slope Instability – WHY 22:32, 30 km North of HWY 16," File: 15-16-114.

Thurber Engineering Ltd., August 4, 2000, "Two Area of Fill Slope Instability – WHY 22:32, 30 km North of HWY 16," File: 15-16-114.

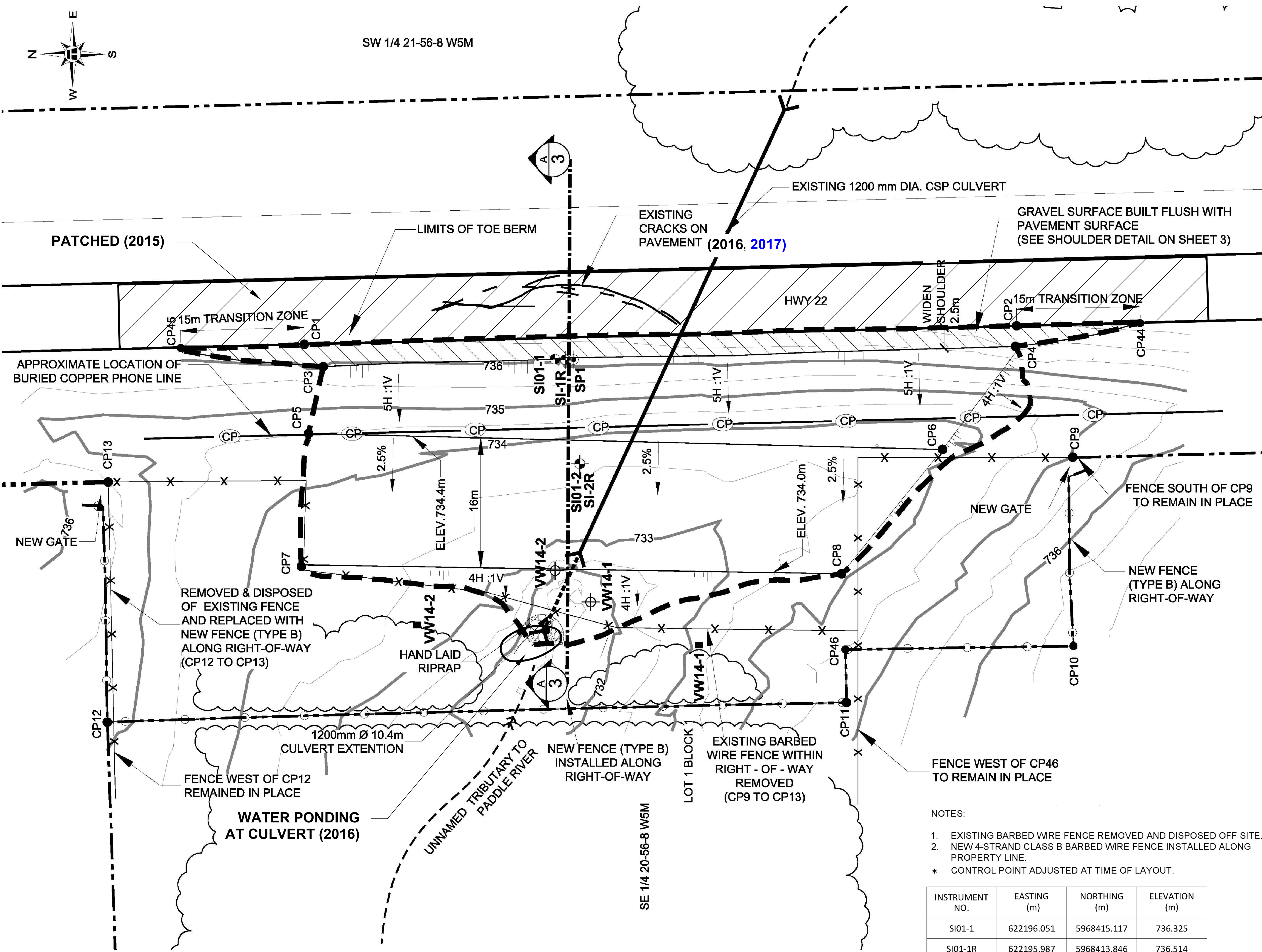
Thurber Engineering Ltd., October 6, 2004, "North Central Region Geohazard Assessment – Highway 22:32 Deer Lodge, KM 29.9 (NC31) 2004 Annual Inspection Report," File: 15-16-192.

Thurber Engineering Ltd., November 23, 2007, "North Central Region Geohazard Assessment – Highway 22:32 Deer Lodge, KM 29.9 – NC31: 2007 Annual Inspection Report," File: 15-85-68.





SW 1/4 21-56-8 W5M



CONTROL POINT	EASTING (m)	NORTHING (m)	ELEVATION (m)
CP1*	622197.842	5968445.499	736.370
CP2*	622200.084	5968359.093	737.360
CP3*	622195.134	5968443.221	736.340
CP4*	622197.658	5968359.225	737.300
CP5	622187.030	5968444.997	734.400
CP6	622185.091	5968368.076	734.400
CP7	622170.902	5968445.871	733.812
CP8	622170.016	5968380.318	734.000
CP9	622184.152	5968352.271	735.666
CP10*	622161.251	5968352.202	736.760
CP11*	622154.395	5968379.736	734.780
CP12*	622152.026	5968469.401	735.150
CP13	622181.142	5968469.288	735.598
CP44*	622200.405	5968344.096	737.730
CP45*	622197.402	5968460.492	736.290
CP46*	622160.831	5968379.865	734.500

- LEGEND**
- SLOPE INCLINOMETER LOCATION (SI)
  - APPROXIMATE STANDPIPE PIEZOMETER LOCATION (SP)
  - VIBRATING WIRE PIEZOMETER TIP LOCATION (VW)
  - TREE LINE (APPROX.)
  - EXISTING GROUND SURFACE CONTOUR - SURVEYED ON OCTOBER 13, 2015 (CONTOUR INTERVAL = 0.5m)
  - CRACK ON HIGHWAY
  - PROPERTY LINE
  - APPROXIMATE BURIED COPPER PHONE LINE
  - APPROXIMATE FENCE LINE (EXISTING)
  - FENCE LINE (TYPE B) (NEW)
  - CONTROL POINT
  - VIBRATING WIRE PIEZOMETER LEADS STEEL PROTECTOR (APPROX.)

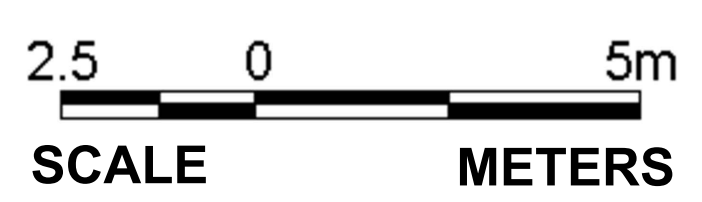
- NOTES:**
- EXISTING BARBED WIRE FENCE REMOVED AND DISPOSED OFF SITE.
  - NEW 4-STRAND CLASS B BARBED WIRE FENCE INSTALLED ALONG PROPERTY LINE.
- \* CONTROL POINT ADJUSTED AT TIME OF LAYOUT.

INSTRUMENT NO.	EASTING (m)	NORTHING (m)	ELEVATION (m)
SI01-1	622196.051	5968415.117	736.325
SI01-1R	622195.987	5968413.846	736.514
SP1	622195.987	5968413.846	736.514
SI01-2	622183.351	5968412.101	734.319
SI-2R	622183.360	5968412.034	734.412
VW14-1 TIP	622166.586	5968410.779	-
VW14-1 CASING	622161.356 (APPROX.)	5968397.620 (APPROX.)	-
VW14-2 TIP	622170.402	5968415.079	-
VW14-2 CASING	622163.808 (APPROX.)	5968431.793 (APPROX.)	-

**NOTES**

- PREVIOUS OBSERVATIONS SHOWN IN BLACK
- 2017 OBSERVATIONS SHOWN IN BLUE

**REFERENCE**  
 THURBER ENGINEERING LTD, JOB No.15-16-322, PLAN No. RD19252-C  
 DATE NOVEMBER 25, 2015.



STANTEC CONSULTING  
10160-112 STREET  
EDMONTON ALBERTA CANADA

**ALBERTA TRANSPORTATION  
GEOHAZARD MONITORING PROGRAM  
NC31 HWY 22-32  
SITE PLAN**

DRAWN	WW	CHECK	CDM	APPROVE	ID
DATE	05 AUG, 2016	SCALE	AS SHOWN	PROJECT #	123312435

FIGURE - 1