

**ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION – SWAN HILLS
2020 INSPECTION**



Site Number	Location	Name	Hwy	km
SH006-1	North of Swan Hills	Klumph Creek	33:14	18.1-18.6
Legal Description		UTM Co-ordinates		
NE28/SE33-70-9-W5M		11U E 608,502	N 6,107,107	

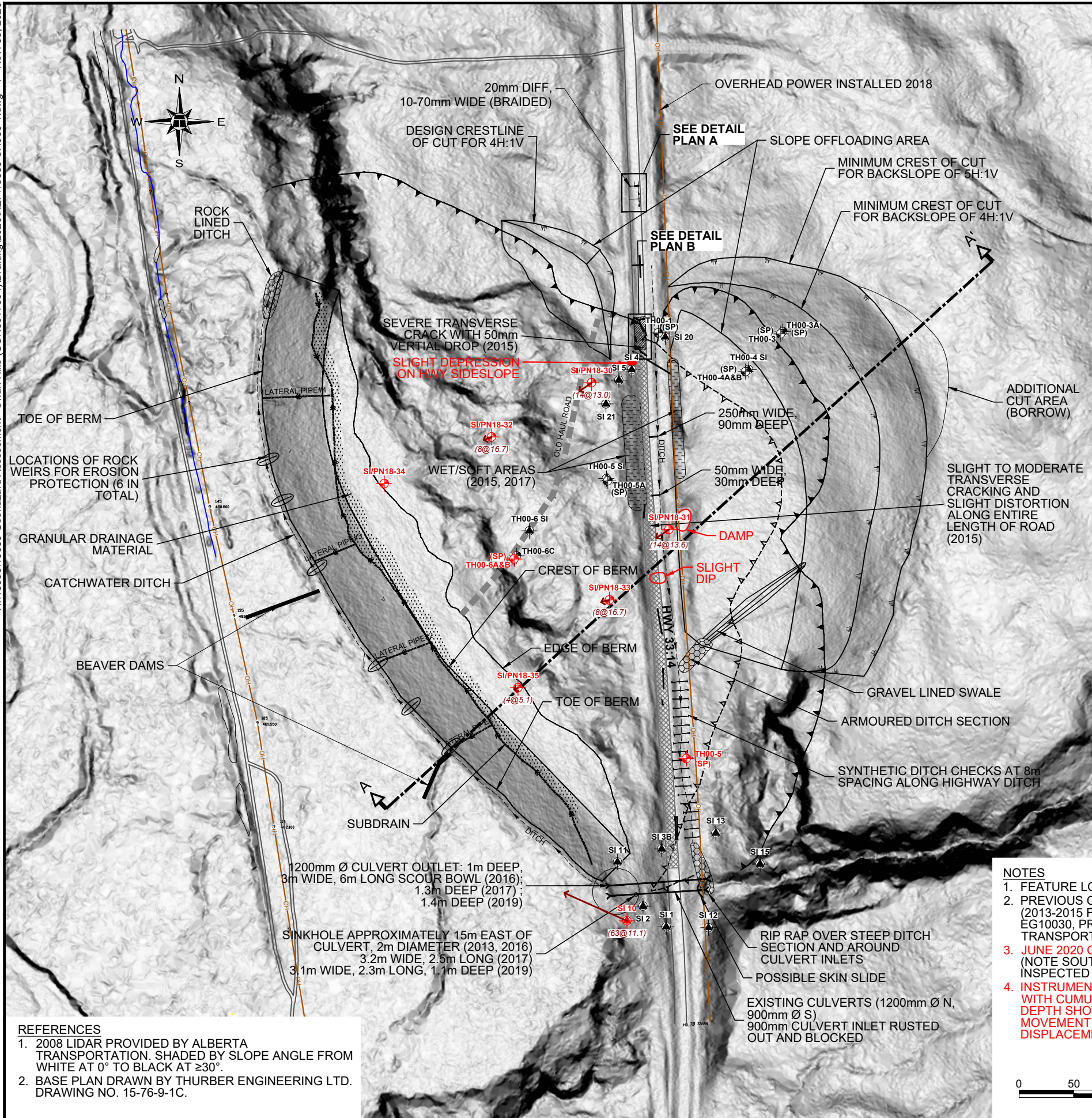
	Date	PF	CF	Total
Previous Inspection:	10-Jun-2019	10	4	40
Current Inspection:	1-Jun-2020	10	4	40
Road AADT:	670		Year:	2020
Inspected By:	Rocky Wang, TRANS Ed Szmata, TRANS Rodney Johnston, TRANS Ken Froese, Thurber			
Report Attachments:	<input checked="" type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input type="checkbox"/> Maintenance Items			

Primary Site Issue:	Highway crosses active slide area approximately 700 m in width over an overall slope height of 57 m. Movement appears to be 6 m to 13 m deep in upper portion of weathered bedrock or in bottom of clay overburden at bedrock contact likely triggered initially by toe erosion by the highly-mobile Swan River. Movement is manifested on the highway at each end of the scarp: transverse cracking at the north and culvert distress at the south.
Dimensions:	500 m of highway length with an embankment fill height between 4 m to 10 m in height (north to south).
Date of Remediation:	1988: 40 m wide portion of west slope of embankment failed damaging both culverts which was repaired. 2001: Construction of toe berm (600 m long) with sand subdrains using excavated material (390,000 m ³) from upslope areas for off-loading. Outlet of 1200 mm and 900 mm culverts at Klumph Creek repaired and extended.
Maintenance:	2016: ACP patch placed over cracks at north end of site. 2017: Overhead powerline installed on east side of highway.

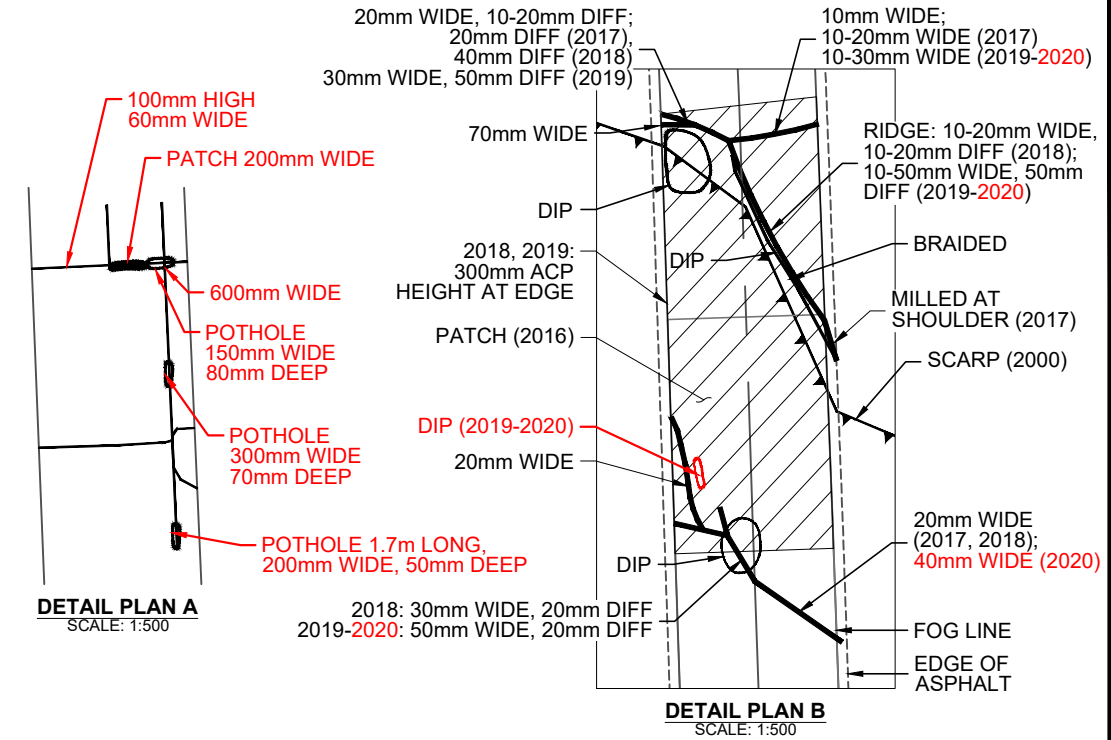
Observations:	Description	Worsened?
<input checked="" type="checkbox"/> Pavement Distress	Crack pattern at north end of site has reflected through patch. Deterioration of driving surface observed over most of the highway length.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Slope Movement	Ongoing movement observed in instruments and confirmed by pavement distress; possible skin slide observed near culvert inlets in 2019.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Erosion	Erosion at outlet of north culvert riprap apron noted in 2014 deepened in 2017 and again in 2019.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Seepage	Soft/wet areas sometimes observed along ditches in north half of site.	<input type="checkbox"/>
<input checked="" type="checkbox"/> Bridge/Culvert Distress	Sinkhole (3 m by 2 m) observed in 2013 has not changed in size.	<input type="checkbox"/>

<input type="checkbox"/> Other		<input type="checkbox"/>
Instrumentation (as of Fall 2020):		
SI10	Ongoing movement at 10.5 m depth with a current rate of about 5.9 mm/year compared to the average rate (since 2013) of about 2.2 mm/year with cumulative movement of 62 mm. The rate of movement has noticeably accelerated in the last year.	
SI18-30 to -35	Two deeper movements zones have been identified in SI18-30 (14 m depth) and SI18-31 (13.3 m depth) with cumulative movements of 14 mm and 14 mm, respectively, which is an increase of 9 mm and 8 mm since Fall 2019. Previous tentative movement zones identified in SI18-32 at 15.5 m depth and SI18-33 at 16.7 m depth have resolved into active zones with cumulative movements of 8 mm. After some initial movement, the near-surface movement zone at SI18-35 has not developed further; the potential movement zone at 5.4 m depth appears to be resolving with 4 mm of cumulative movement. No movement pattern has been apparent yet at SI18-34.	
SP00-2, SP00-6A, SP00-6B	SP00-2 and SP00-6B have shown an upward trend over the last two years and are now at or above historical high water levels. The steady increasing trend at SP00-6A that was been ongoing since 2001 appears to have stabilized in Fall 2019 at a historical high.	
PN18-30 to -35	Water levels in 2018 piezometers increased from installation to historical highs in Fall 2019 or Spring 2020 and have now begun to decrease with PN18-32 and -33 below initial water levels.	
Damaged/ Destroyed	SI11 (5.7m depth), SI00-5, SI00-6, SP00-5 (unable to locate)	
Assessment:		
<p>The landslide is still active albeit at a slow, creeping rate of movement. Instrumentation installed in March 2018 initially measured slow movements near the highway at about 13 m to 14 m depth and has now, in 2020, identified movement zones further downslope from the highway. Asphalt milling and patching is still required about every two to three years to maintain the roadway at the north end of the site where it crosses the landslide scarp although has not been undertaken for a couple of years and the highway surface is noticeably deteriorating. Milling should be undertaken to reduce the humps at the north end of the site. Cracks have widened slightly, and the differential height is increasing in the absence of routine maintenance. A new dip in the highway profile was observed in 2020 approximately in line with SI18-35.</p>		
Recommendations:		
<p>Short-term road maintenance (patching and milling to provide a safe, smooth surface) should continue as required and the annual GeoHazard inspection and twice-annual instrumentation readings should continue as scheduled.</p> <p>The recommended instrumentation was installed in early 2018 and are starting to reveal ongoing creep movement patterns. Given the large size of the landslide and slow movements, periodic patching of the asphalt at each flank appears to be the current most cost-effective method of dealing with the landslide movements. However, continued monitoring of the site (visual and instrumentation) is recommended to manage the risks.</p>		

H:\13000\13355 Geohazard Assessment - Swan Hills (CON0017604)\Drafting\2020\KEF\13355 SH006-1.dwg - 1 - Nov. 30, 2020

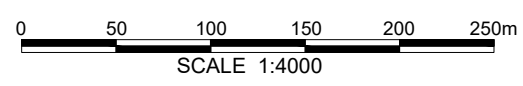



- REFERENCES**
- 2008 LIDAR PROVIDED BY ALBERTA TRANSPORTATION. SHADED BY SLOPE ANGLE FROM WHITE AT 0° TO BLACK AT >30°.
 - BASE PLAN DRAWN BY THURBER ENGINEERING LTD. DRAWING NO. 15-76-9-1C.



- LEGEND**
- APPROXIMATE TEST HOLE LOCATION
 - (SP) STANDPIPE PIEZOMETER
 - ▲ APPROXIMATE SLOPE INCLINOMETER LOCATION
 - ➔ MOVEMENT VECTOR DIRECTION
 - (63@11.1) CUMULATIVE MOVEMENT (mm) @ MOVEMENT DEPTH (m)
 - ▾ MAJOR SCARP (CHECKED IN FIELD) (2000)
 - ▾ MINOR SCARP (ESTIMATED FROM AIR PHOTOS) (2000)
 - - - DITCH
 - ▬ SUBDRAIN
 - OH — OVERHEAD POWER LINE

- NOTES**
- FEATURE LOCATIONS ARE APPROXIMATE.
 - PREVIOUS OBSERVATIONS SHOWN IN BLACK (2013-2015 FROM AMEC FIGURE 1, PROJECT EG10030, PROVIDED BY ALBERTA TRANSPORTATION).
 - JUNE 2020 OBSERVATIONS SHOWN IN RED.** (NOTE SOUTH PORTION OF SITE WAS NOT INSPECTED IN 2018).
 - INSTRUMENTS SHOWN IN RED ARE ACTIVE WITH CUMULATIVE DEFLECTION AT MOVEMENT DEPTH SHOWN FOR INCLINOMETERS. MOVEMENT DIRECTIONS AND CUMULATIVE DISPLACEMENT UPDATED FALL 2020.**






PEACE REGION (SWAN HILLS)

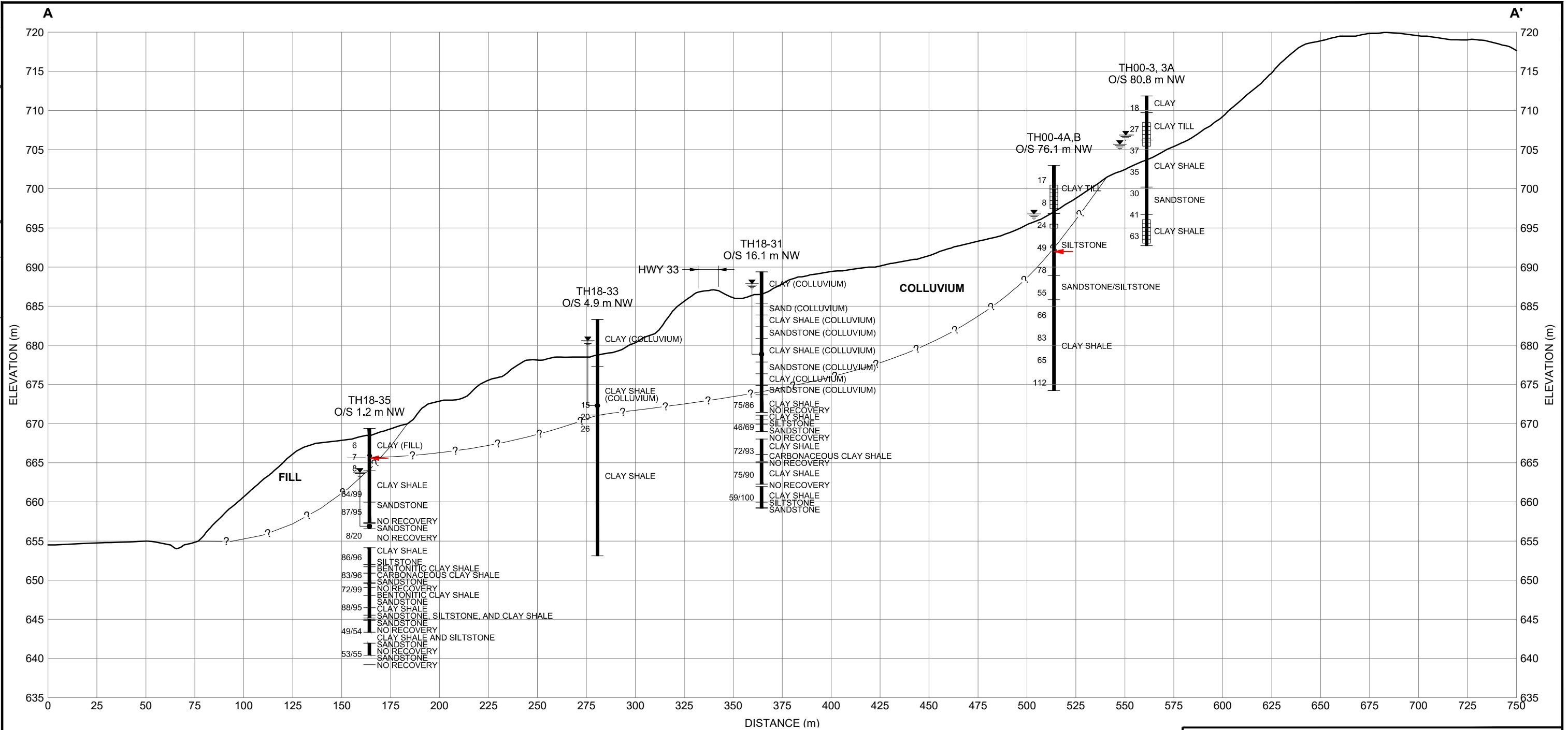
SH006-1: KLUMPH CREEK SLIDE ON HWY 33:14
2020 SITE INSPECTION PLAN

DWG No. 13355-SH006-1-1

DRAWN BY	KLR
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	1:4000
DATE	NOVEMBER 2020
FILE No.	13355



THURBER ENGINEERING LTD.



LEGEND

- SPT N VALUE
- WATER LEVEL IN PIEZOMETER
- PIEZOMETER TIP LOCATION
- STANDPIPE PIEZOMETER SCREENED INTERVAL
- ZONE OF MOVEMENT IN SLOPE INCLINOMETER

NOTES

1. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT THE TEST HOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN TEST HOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN.
2. VERTICAL SHIFT OF +172m REQUIRED TO MATCH ORIGINAL GROUND (FROM THURBER DRAWING 15-76-9-1, MAY 2000) TO GEODETIC ELEVATION.



PEACE REGION (SWAN HILLS)

**SH006-1: KLUMPH CREEK SLIDE ON HWY 33:14
CROSS - SECTION A - A'**

DWG No. 13355-SH006-1-2

DRAWN BY	KLW
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	H 1:2000 V 1:500
LAST UPDATED	AUGUST 2018
FILE No.	13355





Photo 1 – Looking south from east shoulder at main scarp crack and patch at north end of site.



Photo 2 – Looking south from west shoulder at main scarp crack and patch at north end of site.
Note powerline installed on east side of highway since 2017 visit.



Photo 3: Looking north at hump over main scrap crack at north end of the site.



Photo 4: Looking south at crack at south end of patch at north end of the site.



2018 UAV Image of patch section at north end of slide with drill access road to the west and new powerline on the east.