ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION (PEACE RIVER DISTRICT)
2022 INSPECTION

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy	km
SH014-1	Northeast of High Prairie	Salt Creek Slide	750:02	30.57
Legal Description		**UTM Co-ordinates**		
NE34-76-14-W5		11U E 558,308	N 6,165,584	

	Date	PF	CF	Total
Previous Inspection:	29-Jun-2021	10	5	50
Current Inspection:	30-May-2022	10	5	50
Road AADT:	440		**Year:**	2022
Inspected By:	Ed Szmata, TRANS Max Shannon, TRANS Rishi Adhikari, TRANS Rodney Johnston, TRANS		Ken Froese, Thurber Mark Gallego, Thurber	
Report Attachments:	☑ Photographs ☑ Plans		☐ Maintenance Items	

Primary Site Issue:	A landslide is affecting both lanes of the highway of an original 7.5 m high sidehill embankment fill and extends downslope across the west highway embankment.	
Dimensions:	40 m along highway on west side	
Date of Remediation:	1988: 120 m long by 9 m wide by 3 m high toe berm with two 150 mm-diameter subdrains installed against west side of highway embankment and 5 m deep subdrain in east ditch.	
Maintenance:	Crack sealing and patching, as required 115 m long patch done in mid-2010s. 2019: 40 m long patch in SBL and portion of NBL	
Observations:	**Description**	**Worsened?**
☑ Pavement Distress	The main scarp crack is approximately 35 m long with affecting all of the SBL (20 m dip) and the inner wheel path of the NBL	☐
☑ Slope Movement	20 m long settled area may be related to movement of toe berm. The crack pattern has re-established through the 2019 patch including some differential. Backslope of highway is also actively slumping over 90 m length with toe rolls near the bottom of the east ditch.	☑
☑ Erosion	50 m long gully at the north side of existing berm and ditch on west side of highway. Damage in the east ditch from phone line installation.	☑
☑ Seepage	Seepage and wet area exist near the CSP outlets and along part of the fence on the west side of the highway. Subdrains at north end of toe berm were dry; terrain beyond wet and soft.	☑
☑ Bridge/Culvert Distress	BF09208 appears unaffected by slide movements.	☐
☑ Other	Possible intermediate scarps, or old equipment ruts, exist near crest of toe berm downslope edge	☐

Instrumentation (Spring 2022):	
Damaged/ Destroyed	SI02-2 sheared in 2005 at 4.7 m in clay below fill SI02-4, paved over in 2005, was moving at 5.2 m in native clay just below fill SP02-4 damaged.
SP02-3	At fence line on top of berm; 2.13 m BGL

Assessment:

This landslide site has a history of instability going back to 1988, when an 80 m wide slide occurred on the west side of the highway on an approximate 7.5 m high embankment fill. Following a brief test pit investigation shortly after this, a 120 m long by 9 m wide by 3 m high toe berm was constructed to remediate the slide, which included installation of two 150 mm diameter subdrains. Cracks and movements in the pavement and downslope were documented after this. In 2002, a geotechnical investigation and instrumentation installation was undertaken. In 2008, a preliminary engineering report was prepared that outlined potential repair options. This site was annually inspected as part of the GRMP from 2001 up until 2013.

The site was reactivated in the GRMP after the slide crack/dip re-appeared in the roadway in the spring of 2019 after being dormant for the last several years. A call-out inspection was undertaken in June 2019, an annual Geohazard inspection in June 2020, and a second call-out in July 2020 after which the site has been inspected annually.

The 2002 geotechnical investigation encountered up to 4.5 m of fill (predominant clay fill containing organics and organic layers), overlying a 2 m to 4 m thickness of highly plastic clay, overlying clay till containing extensive sand layers.

Based on previous information, the slide appears to be moving at two levels: an upper block in high plastic clay which is moving out onto the top of the toe berm and pushing out the fence; and a lower deep seated block also in high plastic clay that extends below the toe berm. The overall height and inclination of the highway embankment and toe berm fills is too great for the existing relatively weak and wet clay foundation soils. Ingress of water can also influence the rate of slide movement.

As shown on Drawing 32121-SH014-1, the old inclinometer movement vectors show the slide is moving along an azimuth of about 242 degrees, nearly perpendicular to the general creek alignment and at a 50° skew to the highway.

The dominant crack is about 33 m in length with an approximately 20 m long dip on the west side of the crack that has dropped about 30 mm. Crack widths were typically 20-30 mm wide. These movements are likely attributed to the upper, shallower slide block. There is some concern that the extent of the overall slide may be larger than previously thought and affecting a greater length of paved roadway. This is evidenced by a previous 115 m long full width pavement patch, and the intermittent crack that straddles the outside wheel path of the southbound lane through and beyond that patch. It is possible that movement on the lower slide block may be contributing to this greater extent.

There was a linear feature just below the crest of the toe berm that appeared somewhat indicative of a forming scarp. However, it could also be related to equipment rutting. Vegetation has grown in the area since. During the 2022 inspection, observed conditions downslope of the highway embankment were similar to the previous inspection.

Scarps and tension cracks have formed along the top of the east backslope and are with a 2 m of the fence line. Although the fence appears to be leaning slightly, the power pole is still vertical. It is not clear if the east backslope movements are linked to the movements at and below the roadway or if they have merely been triggered by the same cause. In 2021, movement was observed at both scarps and the scarp cracks have widened to 200 mm. In 2022, a few smaller tension cracks opened up just downslope of the main scarps and the toe rolls became more obvious.

Higher-than average rainfalls in the area over the last two or three years leading into 2020 have likely contributed to the more active landslide movements by raising the local water table(s) reducing the

effective stress in the foundation soils, highway embankment, and toe berm. However, the water level measured in P02-3 is within the stable, historical range indicating that it may not be within the critical zone.

The smaller, shallow-based landslide will continue to move, the rate predominantly dependent on rainfall and groundwater levels, and could become larger with time. The overall slide extent at this site may be in the order of 150 m long along the pavement, and requires further observation and monitoring to clarify this, and whether the backslope movements are linked to the slide movements or independent.

Recommendations:

Short-Term:

- The MCI should regularly monitor this area for further movements or enlargement. Crack sealing and patching should be undertaken as required. If conditions worsen to the point where the slide affects traffic, barricades and/or warning/speed reduction signs may need to be erected around the distressed area in conjunction with constructing a temporary detour on the east side of the highway until repairs are undertaken.

Long-Term:

- As per 2008 preliminary engineering report, dewatering with slope flattening or increased toe berm options are less-effective options. The two other options for consideration (described in more detail in the 2019 callout report) are installation of a cast-in-place concrete cantilever retaining wall (estimated cost of $1.6M) or a shear key with slope regrading (estimated cost of $1M) but which has significant regulatory hurdles (see Spencer Environmental assessment included in 2009 Preliminary Engineering Report) as Salt Creek is classified as fish-bearing stream in addition to potential impacts to migratory birds, wildlife, and navigable waters.

Ongoing Investigation:

- It is recommended that the annual Geohazard inspection should continue as scheduled.
- Supplementary geotechnical investigation is needed for detailed design of selected option and to determine if the east backslope movements are linked to the downslope side and to confirm if the extent of the deeper seated slide block has expanded since 2007. Slope inclinometers and piezometers should be installed in the test holes to determine the depths of movement(s) and ground water conditions. LiDAR should also be obtained, the topographic site survey updated, and detailed slope stability analyses carried out to further investigate potential remedial measures.

Closure:

It is a condition of this letter report that Thurber's performance of its professional services will be subject to the attached Statement of Limitations and Conditions.

Renato Clementino, P.Eng.
Principal | Senior Geotechnical Engineer

PROFESSIONAL ENGINEER ALBERTA
MARK LESTER GALLEGO
ID 127449

October 17, 2022

PROFESSIONAL ENGINEER ALBERTA
RENATO V. CLEMENTINO
ID 72376

October 17, 2022

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE: _____
RM APEGA ID #: 72376
DATE: October 17, 2022
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Mark Gallego, P.Eng.
Geotechnical Engineer

THURBER

STATEMENT OF LIMITATIONS AND CONDITIONS

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This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

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a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.

b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.

d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

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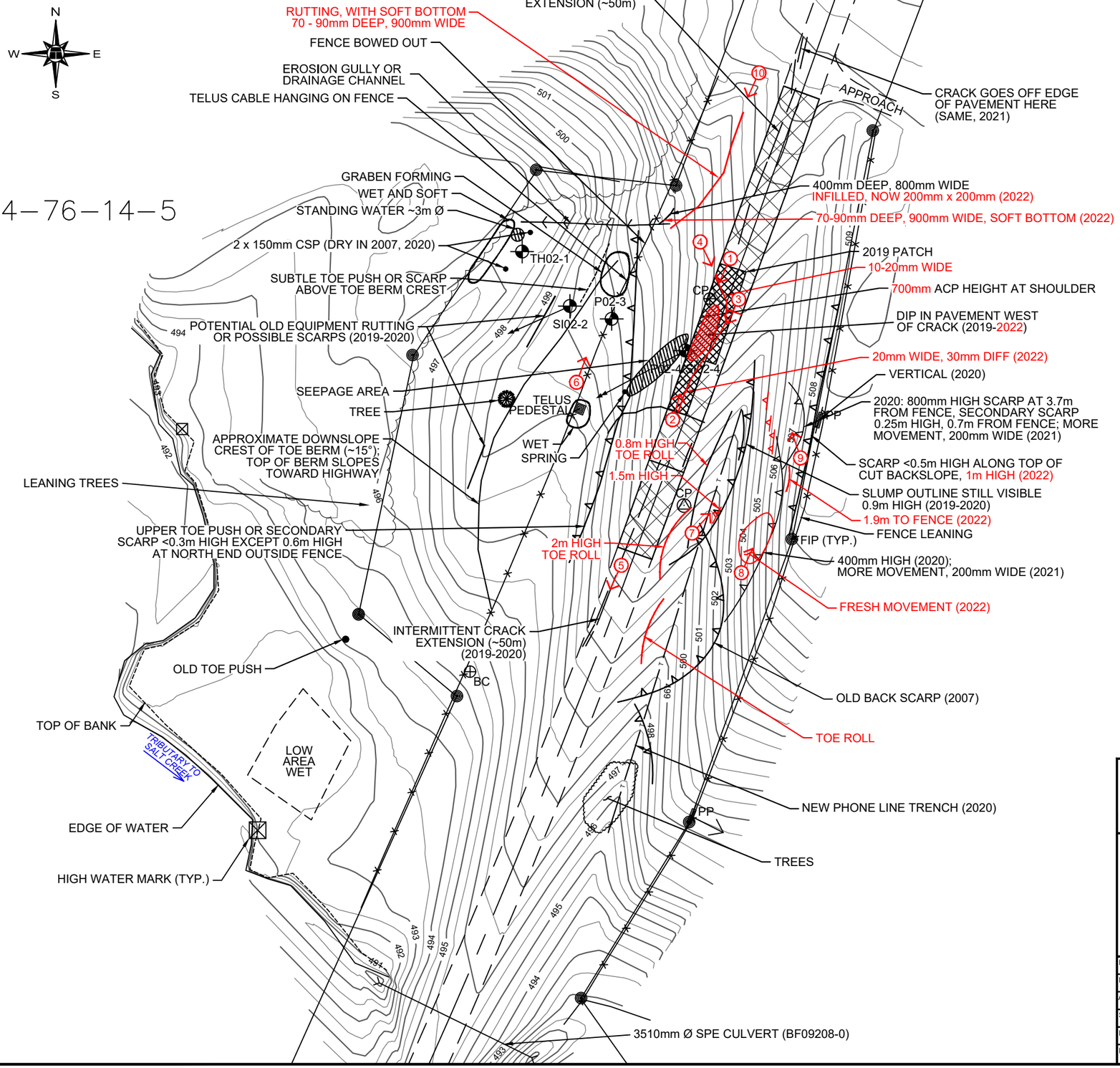

LEGEND

- SCARP
- TENSION CRACK
- TREE LINE
- ASPHALT PATCH
- PP POWER POLE
- FENCE
- APPROXIMATE INSTRUMENT LOCATION
- MOVEMENT VECTOR DIRECTION
- DIRECTION AND NUMBER OF PHOTO

NOTES:

1. SITE FEATURES ARE APPROXIMATE
2. SITE SURVEY PERFORMED BY EXH ENGINEERING IN APRIL, 2006.
3. JUNE 2022 OBSERVATIONS SHOWN IN RED

0 10 20 30 40 50 60m

SCALE 1:1000

Alberta

PEACE REGION (PEACE RIVER DISTRICT)

SH014-1: HWY 750:02 SALT CREEK SLIDE
2022 SITE INSPECTION PLAN

DWG No. 32121-SH014-1

DRAWN BY	ML
DESIGNED BY	MG
APPROVED BY	RVC
SCALE	1:1000
DATE	SEPTEMBER 2022
FILE No.	32121

THURBER ENGINEERING LTD.

Photo 1 – Looking south at main crack and dip area that was patched. Significant thickness of asphalt visible at the edge of the pavement.

Photo 2 – Looking north at main crack and dip in highway surface.

Photo 3 – Looking south at differential across crack near SI02-4 (no longer functional).

Photo 4 – Looking southeast at north end of crack pattern.

Photo 5 – Looking south at potential extension of slide-related cracks.

Photo 6 – Looking north at where soil was wet and had rutting from livestock.

Photo 7 – Looking northeast at backslope slumps just south of the power pole.

Photo 8 – Looking north at slumping backslope below power pole with open tension cracks.

Photo 9 – Looking northwest from the backslope at the subsiding area in the pavement.

Photo 10 – Looking south at rutting in west ditch at the north end of the site.