

**ALBERTA TRANSPORTATION AND
ECONOMIC CORRIDORS
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION -SWAN HILLS
2024 INSPECTION**



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:	5-Jun-2023	9	5	45
Current Inspection:	5-Jun-2024	9	5	45
Road AADT:	517		Year:	2023
Inspected By:	Rishi Adhikari, TEC Robert Senior, TEC		Ken Froese, Thurber Roger Skirrow, Thurber	
Report Attachments:	<input checked="" type="checkbox"/> Photographs		<input checked="" type="checkbox"/> Plans	<input type="checkbox"/> Maintenance Items

Primary Site Issue:	A landslide, despite previous stabilization efforts, is affecting both lanes of the highway; original landslide occurred with a 7.5 m high sidehill embankment fill and extended 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; a 5 m deep subdrain was also installed 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 Fall 2022: Overlay	
Observations:	Description	Worsened?
<input checked="" type="checkbox"/> Pavement Distress	The main scarp crack is approximately 35 m long affecting the SBL has reflected through since 2022 overlay. Portions of the NBL was recently patched.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Slope Movement	Back-tilt of the top of the toe berm may indicate rotational failure of embankment. The resulting crack pattern has partially re-established through the 2022 overlay. Backslope of highway is also actively slumping over 90 m length with toe rolls near the bottom of the east ditch.	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Erosion	50 m long gully at the north side of existing berm and ditch on west side of highway.	<input type="checkbox"/>
<input checked="" type="checkbox"/> 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.	<input type="checkbox"/>
<input checked="" type="checkbox"/> Bridge/Culvert	BF09208 appears unaffected by slide movement.	<input type="checkbox"/>
<input checked="" type="checkbox"/> Other	Possible intermediate scarps, or old equipment ruts, exist near crest of toe berm downslope edge	<input type="checkbox"/>

Instrumentation (Spring 2024):	
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: 1.87 m BGL in Spring 2024. Was previously 2.13 m BGL from 2016 to Fall 2023
SI23-1	SI23-1 has a rate of movement of 17.4 mm/yr over 0 m to 2.4 m depth since the fall 2023 readings. This corresponds to an incremental movement of 10.6 mm, and a change in the rate of movement of 18.8 mm/yr.

Assessment:

This landslide site has a long history of slope 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 the occurrence of the landslide, 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 the construction of the remedial measures. 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 until 2013.

After being dormant for several years, slide crack/dip re-appeared in the roadway in the spring of 2019. A call-out inspection was undertaken in June 2019, followed by an annual Geohazard inspection in June 2020, and a second call-out was undertaken 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 was about 33 m in length with an approximately 20 m long dip on the west side of the crack that had dropped about 30 mm. Crack widths were typically 20 mm to 30 mm wide. These cracks were mostly obscured by the 2022 overlay. The main crack reappeared and was 15 mm wide and had 10 mm of vertical displacement. The movements were 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 was evidenced by a previous 115 m long full width pavement patch that spans from the north approach to 30 m south of the extent of the main crack. During the 2024 inspection, there were smaller patches within this area, north of the main crack. It is possible that movement on the lower slide block may be contributing to this greater extent. There were a few long patches observed along the northbound lane, south of the main crack during the 2024 inspection.

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 2024 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. The main scarp was 1.9 m from the fence and a tension crack upslope of the main scarp was 0.5 m from the fence. The fence appears to be leaning slightly. The power pole was previously observed to be vertical, however, it was observed to have a 3 degree tilt to the west during the 2024 inspection. 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. Observed conditions of the backslope during the 2023 inspection were similar to 2022. There appears to be more movement observed during the 2024 inspection with more tension cracks developing and scarps widening.

Higher-than average rainfalls in the area over the last two or three years prior to 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. The recent Spring 2024 water level in SP02-3 was higher compared to Fall of 2023, where it had been stable since 2016.

The smaller shallow-based landslide will continue to move, and the rate of movement is predominantly dependent on rainfall and groundwater levels, and the slide may become larger with time. Further observation and monitoring is required to verify:

- The overall slide extent at this site (which may be in the order of 150 m long measured parallel to the highway).
- Whether the backslope movements are linked to the slide movements or separate.

Recommendations:

Short-Term:

- The MCI should regularly monitor this area for further movements or enlargement. Crack sealing and patching should be undertaken as required.

Long-Term:

- As per 2008 preliminary engineering report, dewatering with slope flattening or increased toe berm options are less-effective options. The feasible repair option at this site (as described in more detail in the 2019 call-out report) may include: (a) the installation of a cast-in-place concrete cantilever retaining wall (estimated cost of \$1.6M), or (b) the construction of a shear key along with slope regrading (estimated cost of \$1M). However, the shear key option has significant regulatory hurdles (see Spencer Environmental assessment included the Preliminary Engineering Report prepared in 2009) as Salt Creek is classified as a 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.
- A test hole was drilled downslope of the highway in the west ditch to install a slope inclinometer in 2022 as summarized in a data report. A topographic survey of the site was also carried out during this phase. Additional test holes would be 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 deep-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, 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.

Roger Skirrow, P.Eng.
Senior Geotechnical Engineer

Mark Gallego, P.Eng.
Geotechnical Engineer



STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

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.

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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.

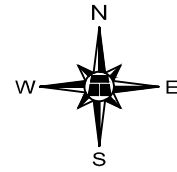
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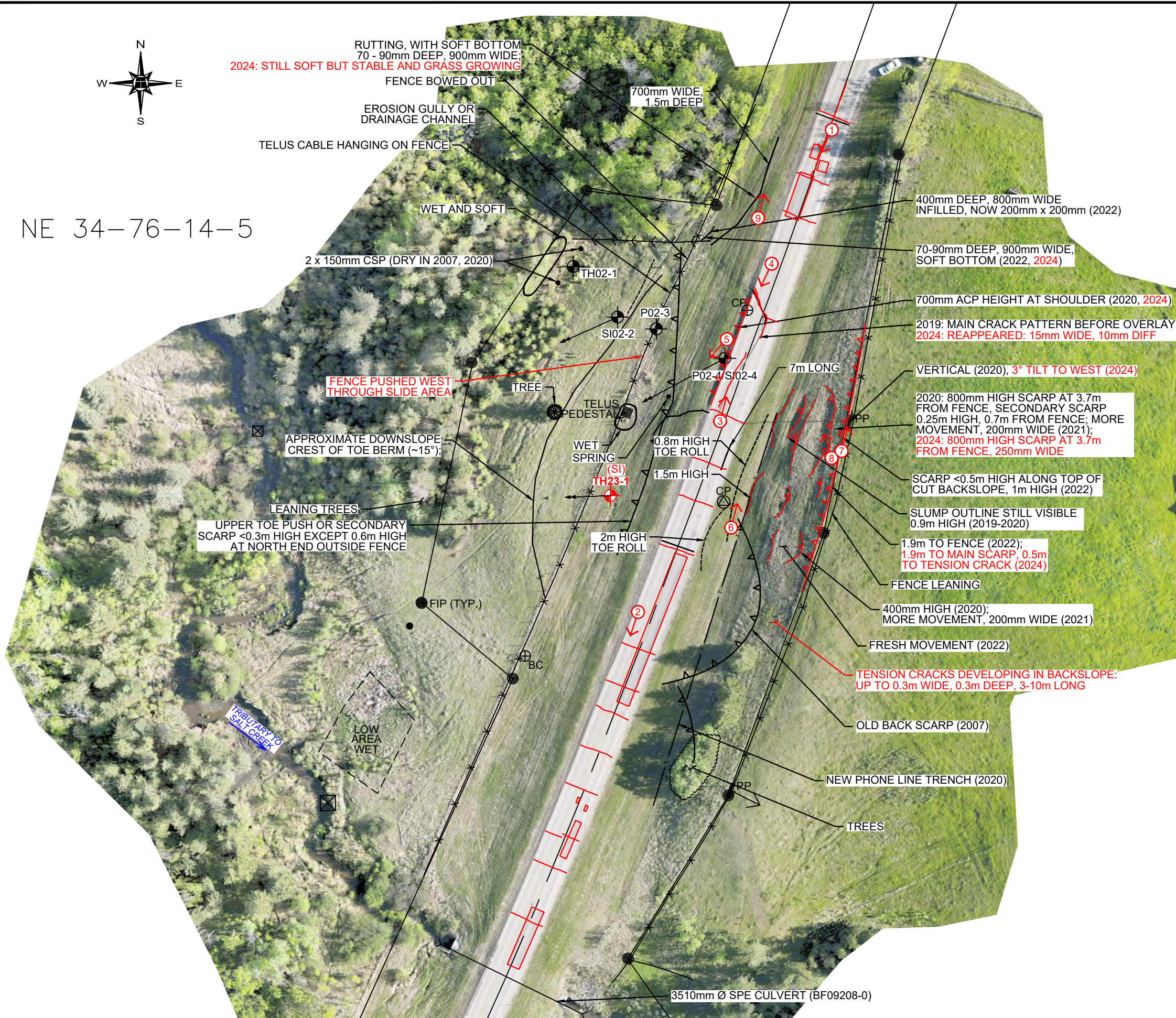
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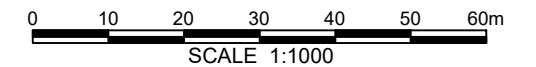


LEGEND

- SCARP
- TOE ROLL
- TENSION CRACK
- APPROXIMATE INSTRUMENT LOCATION
- MOVEMENT VECTOR DIRECTION
- (SI) SLOPE INCLINOMETER
- PP POWER POLE
- FENCE
- 1** DIRECTION AND NUMBER OF PHOTO

NOTES:

1. SITE FEATURES ARE APPROXIMATE AND DRAWING WAS RESET IN 2024. CONSULT 2023 DRAWING FOR HISTORICAL INFORMATION
2. SITE SURVEY PERFORMED BY EXH ENGINEERING IN APRIL, 2006.
3. **JUNE 2024 OBSERVATIONS SHOWN IN RED**
4. HWY 750 WAS OVERLAID FALL 2022 (40% RAP MIX)
5. 2024 ORTHOMOSAIC DERIVED FROM UAV IMAGERY FLOWN BY THURBER IN MAY 2024



PEACE REGION (PEACE RIVER DISTRICT)

SH014-1: HWY 750:02 SALT CREEK SLIDE
2024 SITE INSPECTION PLAN

DWG No. 32121-SH014-1-1

DRAWN BY	KLP
DESIGNED BY	MG
APPROVED BY	DWP
SCALE	1:1000
DATE	SEPTEMBER 2024
FILE No.	32121





Photo 1 – Looking south at the highway surface from the northern limit of the site.



Photo 2 – Looking south at patches along the NBL towards the south end of site.



Photo 3 – Looking north at the highway surface at south extent of main crack. Significant thickness of asphalt is visible at the edge of the road.



Photo 4 – Looking southeast at a main crack that has resurfaced near the north end of the site.



Photo 5 – Looking southwest downslope of the highway surface.



Photo 6 – Looking north at highway east ditch and backslope slumps.



Photo 7 – Looking north at backslope scarp and tension cracks upslope of crack adjacent to fence.



Photo 8 – Looking northwest from the backslope at the observed subsiding area in the pavement.



Photo 9 – Looking north at rutting in west ditch at the north end of the site.