

**ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION (PEACE RIVER DISTRICT)
2023 INSPECTION**



Site Number	Location	Name	Hwy	km
SH034	East of Arcadia	Near Arcadia Embankment Slide	2:50	44.42
Legal Description		UTM Co-ordinates		
NE9-74-14-W5		11U N 6,139,489	E 557,842	

	Date	PF	CF	Total RISK LEVEL
Previous Inspection:	29-June-2021	11	3	33
Current Inspection:	5-June-2023	10	3	30
Road AADT:	1998	Year:	2023	
Inspected By:	Kristen Tappenden, TEC Max Shannon, TEC		Ken Froese, Thurber Mark Gallego, Thurber	
Report Attachments:	<input checked="" type="checkbox"/> Photographs		<input checked="" type="checkbox"/> Plans	<input checked="" type="checkbox"/> Maintenance Items

Primary Site Issue:	Shallow slide in WBL.	
Dimensions:	50 m length of highway affected.	
Date of any remediation:	None	
Maintenance:	2017: Milled and overlay Prior to 2023: Asphalt patch	
Observations:	Description	Worsened?
<input checked="" type="checkbox"/> Pavement Distress	Longitudinal cracks in WBL within and east of patched area. Longitudinal cracks in EBL (26 m long).	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Slope Movement	Slight dip near north shoulder; toe roll in ditch below.	<input checked="" type="checkbox"/>
<input type="checkbox"/> Erosion		<input type="checkbox"/>
<input checked="" type="checkbox"/> Seepage	Ponded water present in the north ditch.	<input checked="" type="checkbox"/>
<input type="checkbox"/> Culvert Distress		<input type="checkbox"/>
<input type="checkbox"/> Other		<input type="checkbox"/>
Instrumentation:	None.	

Assessment:

The site was added to the list of geohazard sites after a 2020 call-out inspection.

The site is located on the north side of Highway 2:50 east of High Prairie near Arcadia about 9.3 km east of Highway 750 and 285 m west of Township Road 143. The highway embankment is about 1.7 m in height with sideslopes inclined at 2.7H:1V. The ditch bottom is about 3.3 m wide and the backslope on both sides rises to slightly higher than the embankment. Based on information from the AT Map, the highway structure following the overlay undertaken in 2017 is 430 mm of ACP over 150 mm of cement-stabilized base over predominantly high plastic clay.

The surrounding terrain is level and the ditch gradients relatively flat. Presumably, the general grading is towards the creek about 850 m further east along the highway. Published geological mapping indicates that the site is located within a glaciolacustrine unit which are typically flat-lying and predominantly clay in composition. The estimated depth to bedrock is between 5 m and 10 m. The underlying bedrock is marine shales and siltstones of the Puskwaskau Formation.

During the call-out inspection in 2020, approximately 21 m length of the west-bound lane (WBL) had an arch-shaped crack in the middle of the lane with a dip between the crack at the south shoulder. This main crack was up to 50 mm in width and 40 mm of height differential. There was a secondary crack near the shoulder on the north side of the dip which was up to 30 mm wide with 30 mm of differential. There appeared to be a toe roll in the lower part of the sideslope. The crack in the centre of the lane continued an additional 30 m east indicating that a greater extent of movement was likely.

Prior to the 2021 inspection, a 70 m long section of the WBL was patched. A similar length was patched between the 2021 and 2023 inspections (date unknown). During the 2021 and 2023 inspections, it appeared that the features observed during the call-out inspection were starting to reflect through the corresponding patch. According to the MCI, the site has a long history of being patched (since 1995). The cracking continues to the east beyond the area that was patched.

The site appears similar to other failures seen in the general area such as at SH030 and SH031 thus a similar mechanism is expected: higher-than average precipitation over a few years prior to and including 2020 resulting in elevation of the groundwater table or saturation of the high plastic foundation soils leading to shallow rotation failure. Given the terrain, it will be difficult to improve the drainage. Thus, mitigation will need to either reduce the loading on the foundation soils or improving the embankment strength. The types of repairs used at SH030 and SH031 are also appropriate for this site:

Recommendations:**Short-Term:**

- Road maintenance should continue as necessary to maintain an even, safe roadway surface and may consist of milling, patching, and crack sealing of the pavement. The site was patched after the call-out inspection in 2020 and annual inspection in 2023, but the cracks have reflected through and vertical displacement is anticipated as the slide continues to move. The cracks should be sealed to avoid surface water infiltration into the tracks and additional patching as needed to maintain a safe highway surface.

Medium-Term:

- A geotechnical drilling investigation should be considered particularly if it can be combined with other projects in the area to reduce mobilization costs. A design could be done for this low-height embankment without an investigation, but it would, by necessity, be more conservative and would have to be flexible should conditions encountered during construction does not match the assumptions made during design.

Long-Term:

There are three remedial options that could be considered at this site based on successful repair of similar sites:

- **Slope flattening:** flatten the highway sideslope to a minimum of 4H:1V using imported low plastic or granular fill. This would require shifting the ditch further away from the embankment; however, there appears to sufficient distance to do this without impacting the overhead power line. Ideally, the main slide mass should also be excavated and replaced to reduce the amount of highway distress before the slope flattening slows or halts movement.
- **Toe berm:** stabilized the north sideslope with a 3 m to 4 m wide toe berm constructed halfway up the embankment. This option would also require imported fill and realigning the ditch. The long term performance would also be improved with full or partial excavation of the slide mass.
- **Gravel replacement:** The failed portion of the highway embankment should be excavated with slopes no steeper than 1H:1V and to about 0.5 m deeper than the ditch with a 1 m deep and 1.5 m wide shear key excavated at the toe of the embankment. The excavation should be backfilled with Des. 2-20 gravel compacted to at least 95 percent SPMDD separated from the embankment and native soils by a non-woven geotextile.

All of these options will involve excavation and hauling of material. The gravel wedge would maintain the existing shape of the embankment and ditch but is likely more expensive due to the higher-cost material. The toe berm or slope flattening options will require ditch realignment but can be readily extended further east or west if more of the embankment fails. Checks on available right-of-way should be done for the slope flattening and toe berm options. The estimated costs are in the order of \$250,000 to \$350,000.

Inspection:

This site should be inspected every two years as currently scheduled in the current contract.

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.

Tarek Abdelaziz, Ph.D., P.Eng.
Partner | Senior Geotechnical Engineer

Mark Gallego, M.Eng., P.Eng.
Geotechnical Engineer



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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.

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The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

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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.

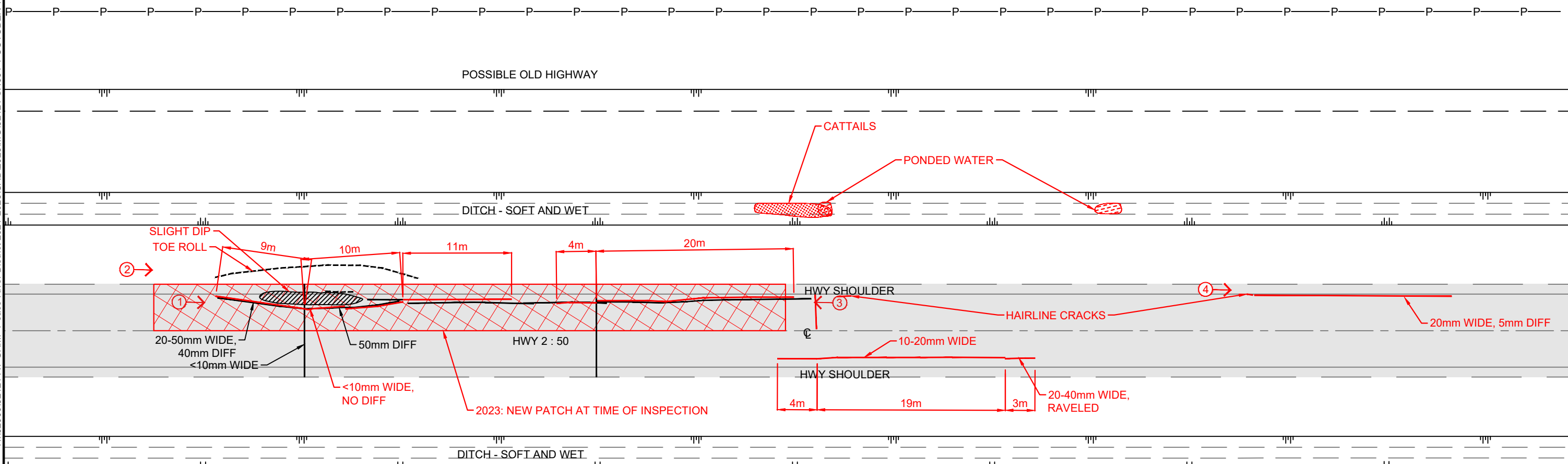
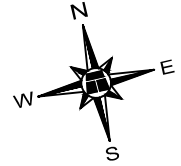
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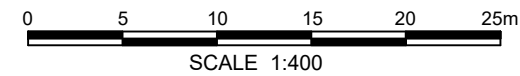


LEGEND

- CRACK
- POWER LINE
- PHOTOGRAPH NUMBER, AND APPROXIMATE DIRECTION AND LOCATION

NOTES

1. FEATURE LOCATIONS ARE APPROXIMATE.
2. JUNE 2023 OBSERVATIONS SHOWN IN RED.



PEACE REGION (PEACE RIVER DISTRICT)

**SH034-1 HWY 2:50 KM 44.4, EAST OF ARCADIA
2023 SITE INSPECTION PLAN**

DWG No. 32121-SH034-1

DRAWN BY	ML
DESIGNED BY	MG
APPROVED BY	TSA
SCALE	1:400
DATE	OCTOBER 2023
FILE No.	32121



THURBER ENGINEERING LTD.



Photo 1 – Looking east along the WBL at the main landslide’s head scarp crack and highway dip.



Photo 2 – Looking east at the sideslope below the main crack where a toe roll is present in the ditch.



Photo 3 – Looking west at the main area of distress.



Photo 4 – Looking east along the WBL where cracks are starting to form east of the patched area.