

ALBERTA TRANSPORTATION AND
ECONOMIC CORRIDORS GRMP
NORTH CENTRAL (ATHABASCA AND FORT
MCMURRAY DISTRICTS)
2024 SITE INSPECTION



Site Number	Location	Name	Hwy	km
NC071	1 km east of Colinton	Little Pine Creek Slide	663:04	6.98
Legal Description		UTM Co-ordinates (NAD 83)		
S.E.15&S.W.14& N.E.10-65-22-W4M		12 N 6054582	E 355785	

	Date	PF	CF	Total
Previous Inspection:	May 16, 2023	11	5	55 (For highway)
Current Inspection:	June 3, 2024	11	5	55 (For highway)
Road WAADT:	680	Year:		2023
Inspected By:	José Pineda, Tarek Abdelaziz (Thurber) Arthur Kavulok, Rocky Wang (TEC)			
Report Attachments:	<input checked="" type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input type="checkbox"/> Maintenance Items			

Primary Site Issue:	Slowly creeping deep-seated translational landslide, resulting in diagonal cracks and slight depression along both highway lanes; depression is more pronounced along the flanks of the slide.		
Dimensions:	Approximately 150 m wide (parallel to highway) by approximately 300 m long to the south of the highway.		
Site history:	The highway was constructed as a side-hill cut and fill section at this location; the road section was upgraded in the 70's and raised by 2 m; original landslide occurred prior to 1978 and extended from the uphill ditch of the highway to the existing bridge over the Little Pine Creek located approximately 300 m to the south of the highway; test holes (completed with 2 slope inclinometers and 3 standpipe piezometers) were drilled downslope of the highway prior to 1978; Drainage pipes were installed on May 12, 1980 to reduce ground water levels; slope inclinometers were sheared off in December 1980; slope inclinometers and piezometers were installed by Thurber in 2012.		
Maintenance:	<p>TEC placed ACP patches at the flanks of the slide for a few years prior to 2019.</p> <p>In 2019 the highway surface was milled, and overlaid; re-grading of the north ditch, and the installation of a HTCBL on the south side of the highway also took place in 2019; Culvert C3 was grouted by others and a new 760 mm diameter replacement pipe was auger bored 26.2 m from the original location. A 9 m long half pipe was welded to the culvert C3 outlet to convey the water down the side slope to the tree line. Riprap was provided around and at the outlet of the half pipe extension.</p> <p>ACP patch on a previous 50 mm dip on the highway WBL shoulder and driving lane above the inlet of the C3 Culvert</p>		
Observations:	Description	Worse?	
<input checked="" type="checkbox"/> Pavement Distress	A bit of twist on the highway surface near the flanks of the landslide; 10 mm dip on the eastbound lane by the eastern flank of the landslide	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/> Slope Movement	Western flank crack is showing reflective cracks 15 to 20 mm wide, 5 mm drop; 10 to 30 mm wide cracks within the	<input checked="" type="checkbox"/>	

	middle section of the landslide; eastern flank cracks are 30 mm wide with 10 mm drop.	
<input checked="" type="checkbox"/> Erosion	Erosion gully (18 m long x 1 m wide x 0.5 m deep) developed in 2022 within the north ditch upstream of culvert C3 remains unchanged; erosion rills along the highway side slope to the west of the access road; sink hole (800 mm long x 500 mm wide x 600 mm deep) to the west of C3 inlet location was filled with water.	<input type="checkbox"/>
<input type="checkbox"/> Seepage		<input type="checkbox"/>
<input checked="" type="checkbox"/> Bridge/Culvert Distress	A void was noted under the half pipe extension of C3 outlet location; Culvert C1 is sagging, and water is ponding inside the culvert;	<input type="checkbox"/>
<input checked="" type="checkbox"/> Other	Highway north ditch: the highway side slope and the ditch to the west of the access road are bare of vegetation	<input type="checkbox"/>
Instrumentation: (5SIs, 8PNs, 4 SPs)		
<p>Between the fall of 2023 and the spring of 2024: No discernible movement was noted in SI12-4 (located near the bottom of the slope); movement rates ranging from less than 1 to 6 mm per year in SI12-1, SI12-2, SI12-3, and SI12-9 (located to the south of the highway).</p> <p>The operational piezometers showed a change in ground water levels ranging from about 10 mm to 1.27 m.</p>		
Assessment (Refer to attached Drawing):		
<p>The site condition did not change significantly since the 2023 site visit.</p> <p>The landslide will continue to cause progressive deterioration to the highway condition with time. The deterioration may take place quickly between the spring and the fall seasons since the landslide tends to move at high rates within this period based on historical data.</p> <p>The existing twist on the highway surface near the flanks of the landslide still creates a rough ride to motorists.</p> <p>The absence of vegetation in the highway north side slope and ditches, to the west of the access road, has resulted in the development of an erosion gully around and upstream of culvert C3 inlet location and erosion rills on the highway north side slope.</p> <p>The sink hole and the previously noted crack in the vicinity of the inlet of C3 culvert replacement pipe reflect poor compaction of the reception pit, and this may result in stability issues of the slope and impact the performance of the new pipe.</p> <p>It is suspected that a void exists below the highway's WBL/shoulder and the north side slope upslope of the C3 culvert inlet location. Inadequate grouting of old pipe is likely the main cause of the void and the previously dip noted in the highway surface. The ACP patch placed by TEC between 2023 and 2024 to eliminate the dip on the highway surface above the void is an interim measure. It is anticipated that the dip will re-occur and become worse with time, due to the progressive collapse of the existing void, and this may cause a severe future distress on the highway WBL surface.</p> <p>Culvert C1, located under the access road, is separated and hence this will likely impede the surface drainage within the north ditch, resulting in elevated groundwater levels within the landslide mass.</p> <p>The void below the half pipe downstream of C3 outlet location is due to improper subgrade preparation. The surface flow around the pipe may undermine the subgrade, potentially resulting in the development of a severe erosion gully below and around the extension pipe.</p>		

Recommendations:

This site should be visited again in Spring of 2025.

Short-Term

The local MCI should continue to monitor the site (particularly between the spring and the fall seasons) and seal any open cracks to reduce surface water infiltration into the highway fill. Consideration should be given in the future to placing an ACP patch near the flanks of the landslide to provide a smooth ride to motorists.

The following items should also be dealt with in the short-term:

- The north ditch to the west of the access road should be properly graded to eliminate gully erosion gully. The side slope should also be track-packed to fill erosion rills. After the ditch/side slope repairs are completed, all disturbed areas within the north ditch should be topsoiled and seeded. The ditch bottom and side slopes should be covered with Type C TRM to reduce future erosion potential.
- The distressed area above C3 culvert should be excavated to properly fill the existing void in this area. Care should be taken during the excavation to avoid damaging the new culvert. An excavator with a ripper tooth attachment may be needed to complete the excavation. Once the void is located, the base of the excavation should be inspected to remove damaged/collapsed section of the old pipe, debris, and soft /loose materials. Attempts should be made to re-grout the old pipe if the inspection reveals that the exposed section of the pipe has not been filled with grout. The excavation should then be backfilled with compacted crushed gravel to ground surface to re-build the highway surface and the side slope. The side slope should be capped with at least 300 mm of clay at ground surface. The closure of the highway WBL will likely be required to complete this repair.
- The area around Culvert C3 inlet should also be scarified, repacked, and contoured to eliminate the existing crack, and the sinkhole to the west of the culvert should be backfilled with compacted fill.
- Culvert C1 should also be replaced to reduce the amount of ponding water within the highway ditch.
- The void below the half pipe culvert, downstream of the outlet of the C3 culvert, should be filled with fillcrete.

Long-Term

In the long-term, the following options may be considered to remediate the landslide:

- a) Unload the landslide through partial removal of highway fill, either by lowering the highway profile or replacing highway embankment fill with lightweight fill (e.g., EPS foam). The estimated cost of this option would range from \$3,000,000 for the grade lowering option to \$4,500,000 for the EPS foam replacement option.
- b) Re-align the highway to the north of its current location outside the limits of the active landslide. The estimated cost of this option would be in the range of \$2,000,000.
- c) Reinforce the slip surface of the landslide by constructing a tied-back pile wall within the eastbound lane side slope. The estimated cost of a pile wall would be in the range of \$9,000,000.

A geotechnical desktop study was completed in 2015 to investigate the feasibility of a new truck route around Athabasca. Two of the three investigated routes include a major realignment of the existing roadway to the north of its location at the landslide site. However, the final route has not been selected and the project timeline is still indeterminate.

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.

Yours very truly,
Thurber Engineering Ltd.
Tarek Abdelaziz, Ph. D, P.Eng.
Partner | Senior Geotechnical Engineer

José Pineda, M.Eng., P.Eng.
Associate | Senior 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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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.

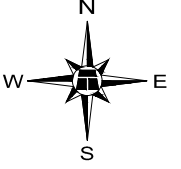
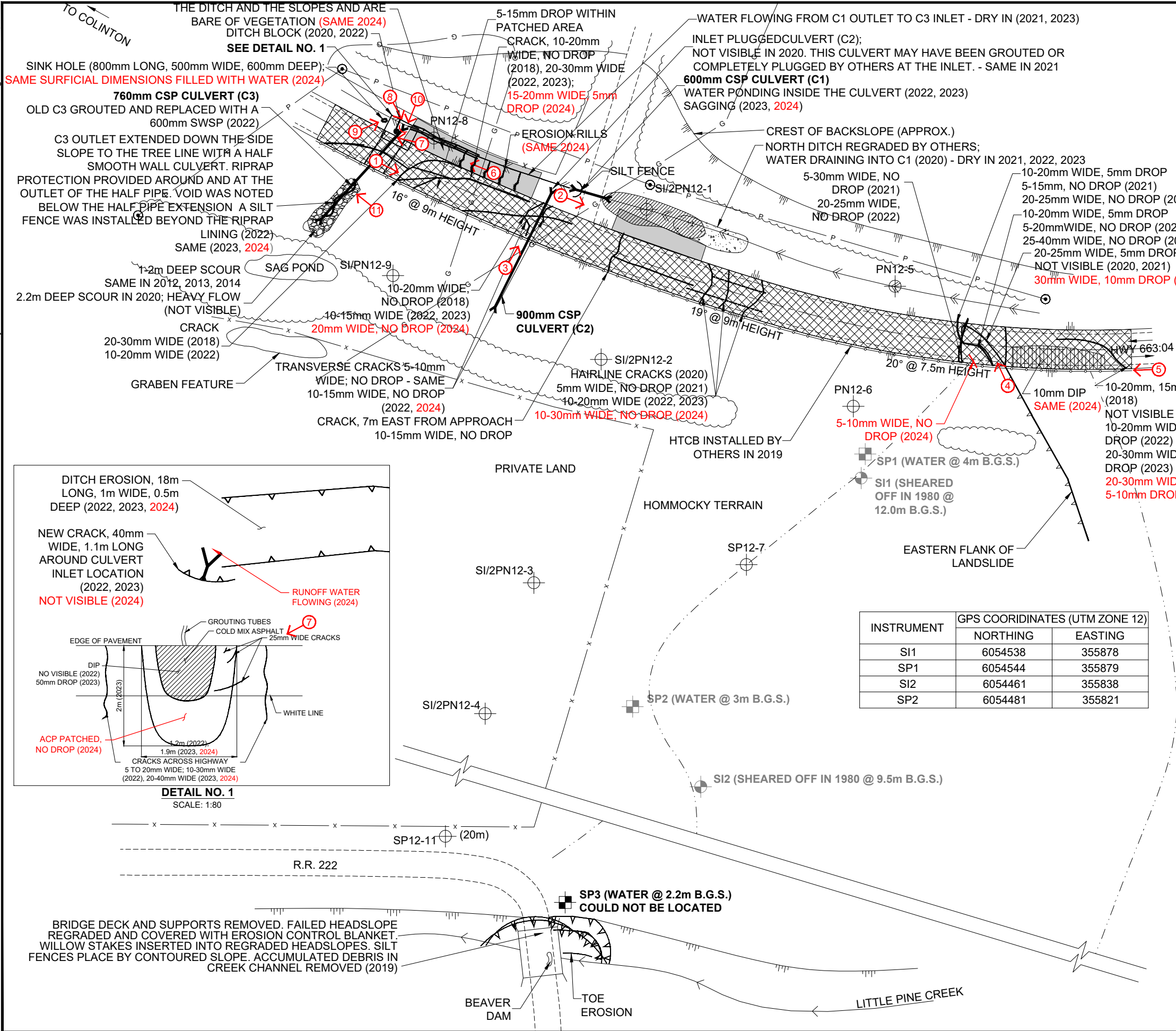
6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

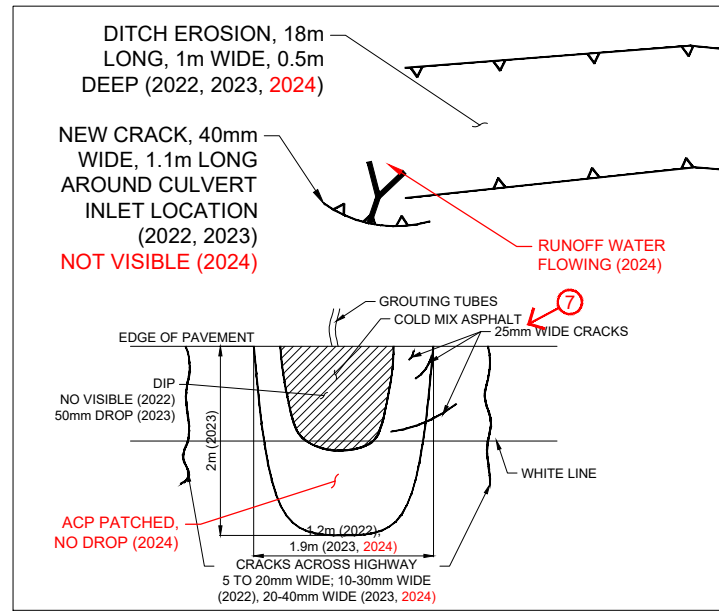
7. INDEPENDENT JUDGEMENTS OF CLIENT

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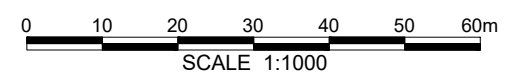


- LEGEND**
- APPROXIMATE LOCATION OF 2012 INSTRUMENTS
 - SI SLOPE INCLINOMETER
 - PN PNEUMATIC PIEZOMETER
 - SP STANDPIPE PIEZOMETER
 - SP STANDPIPE PIEZOMETER INSTALLED IN THE 1970's
 - SI SLOPE INCLINOMETER INSTALLED IN THE 1970's
 - ACP OVERLAY
 - SCARP CRACK
 - POWER POLE
 - OVERHEAD POWER LINE (APPROXIMATE)
 - GAS LINE (APPROXIMATE)
 - APPROXIMATE LOCATION OF FENCE LINE
 - HIGH TENSION CABLE BARRIER (HTCB)
 - BUSH LINE (APPROXIMATE)
 - APPROXIMATE LOCATION OF EXISTING TRAILS
 - PHOTOGRAPH NUMBER, AND APPROXIMATE DIRECTION AND LOCATION
 - GROUND SURFACE SCARCE OF VEGETATION



INSTRUMENT	GPS COORDINATES (UTM ZONE 12)	
	NORTHING	EASTING
SI1	6054538	355878
SP1	6054544	355879
SI2	6054461	355838
SP2	6054481	355821

- NOTES**
1. WATER LEVELS IN STANDPIPE PIEZOMETERS ARE BASED ON THE AVAILABLE INFORMATION PROVIDED BY TRANS
 2. JUNE 3, 2024 SITE OBSERVATIONS ARE SHOWN IN RED.



**NORTH CENTRAL REGION
(ATHABASCA AND FORT McMURRAY DISTRICTS)
2024 GEOHAZARD ASSESSMENT**

NC071: HWY 663:04 LITTLE PINE CREEK SLIDE (km 6.98)

DWG NO. 32122-NC071-1

DRAWN BY	ML
DESIGNED BY	JGP
APPROVED BY	TSA
SCALE	1:1000
DATE	JULY 2024
FILE No.	32122

THURBER ENGINEERING LTD.



Photo 1. Looking at (15-20 mm wide, 5 mm drop) diagonal crack on the highway surface from the western limit of the site.



Photo 2. Highway's north ditch to the east of the approach.



Photo 3. Looking north at a transverse crack (10 - 15 mm wide with no drop).



Photo 4. Looking northwest at the eastern flank reflective diagonal cracks



Photo 5 Diagonal cracks located about 15 m east of the landslide western flank



Photo 6. Looking west at the regraded section of the ditch in 2019; side slopes and sections of the ditch bottom are still bare of vegetation; note the presence of erosion rills along the side slope and a deep erosion gully in the ditch.



Photo 7. Looking southwest at the sinkhole previously developed within the northern edge of pavement of the highway above the original 600 mm diameter culvert (C3); Original pipe was grouted and a new 760 mm diameter SWSP was auger bored in 2021; cold mix patch placed on the highway surface (2022), larger ACP patch was noted in 2024.



Photo 8. C3 inlet; Water flowing; side slope is bare of vegetation; erosion developing upstream of the inlet within the ditch.



Photo 9. A sink hole (800 mm long x 500 mm wide x 600 mm deep) developed to the west of C3 culvert inlet.



Photo 10. Looking inside culvert C3 outlet.



Photo 11. Outlet of culvert C3, installed in 2021. There is a void below the half pipe extension piece.