

**ALBERTA TRANSPORTATION  
GEOHAZARD ASSESSMENT PROGRAM  
NORTH CENTRAL REGION – ATHABASCA &  
FORT MCMURRAY DISTRICTS  
2021 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
<b>Previous Inspection:</b>	June 5, 2020	11	5	55 (For highway)
<b>Current Inspection:</b>	June 23, 2021	11	5	55 (For highway)
<b>Road AADT:</b>	700		<b>Year:</b>	2020
<b>Inspected By:</b>	José Pineda, Tarek Abdelaziz (Thurber) Arthur Kavulok, Kristen Tappenden, Bernard Ching (Alberta Transportation)			
<b>Report Attachments:</b>	<input checked="" type="checkbox"/> Photographs <input type="checkbox"/> Plans <input type="checkbox"/> Maintenance Items			

<b>Primary Site Issue:</b>	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.		
<b>Dimensions:</b>	Approximately 150 m wide (parallel to highway) by approximately 300 m long to the south of the highway.		
<b>Site history:</b>	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.		
<b>Maintenance:</b>	AT placed ACP patches at the flanks of the slide for a few years prior to 2019.  In 2019 the highway surface was milled, and overlaid; re-grading of the north ditch, and the installation of a HTCB on the south side of the highway also took place in 2019.		
<b>Observations:</b>	<b>Description</b>	<b>Worse?</b>	
<input checked="" type="checkbox"/> Pavement Distress	N/A	<input type="checkbox"/>	
<input checked="" type="checkbox"/> Slope Movement	Western flank crack is not visible; 5-10 mm wide cracks within the middle section of the landslide; eastern flank cracks are 5 – 30 mm wide with no drop	<input type="checkbox"/>	
<input checked="" type="checkbox"/> Erosion	Sinkhole (1.4 m dia. x 0.4 to 0.7 m deep) noted in 2020 on the WBL near the CSP culvert C3 inlet was repaired by	<input checked="" type="checkbox"/>	

	grouting the sink hole and placement of cold mix asphalt at the highway surface. However, there is a 50 mm dip within the sinkhole's patched area and cracks are developing around the patched area	
	2.2 m deep scour noted at the outlet of culvert C3	
<input checked="" type="checkbox"/> Seepage	North ditch appears to be draining properly to culvert C3 after ditch reprofiling was completed in 2019	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Bridge/Culvert Distress	Culvert C2 appears to have been plugged or grouted by others in late 2019; culvert C3 appears to be separated and the inlet is higher than the ditch bottom	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Other	North ditch side slope and ditch are bare of vegetation	<input type="checkbox"/>

**Instrumentation: (5SIs, 8PNs, 4 SPs)**

Between the Fall of 2020 and the Spring of 2021: No discernible movement was noted in SI12-1 (located in the highway north ditch) and SI12-4 (located near the bottom of the slope); Creep rates of movements ranging from less than 0.1 to 8 mm per year in SI12-2, SI12-3, and SI12-9 (located to the south of the highway).

The operational piezometers generally showed a change in ground water levels ranging from -1.5 to 0.2 m below existing ground surface.

**Assessment (Refer to attached Drawing):**

The site conditions did not change significantly since last year with the exception of the ongoing issue with the highway sinkhole at culvert C3 location.

The 2019 pavement overlay masked the majority of the landslide features and created a smooth ride along the highway surface.

The landslide is currently moving at a slow rate, but landslide cracks will keep reflecting through the highway surface with time. Despite moving at a slow rate, the landslide will likely 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 be at high rates within this period based on historical data.

The separation of culvert C3 near its inlet location, and the presence of a dip within the patched area above the previously noted sinkhole in 2020 indicate that the repairs (completed by others in late 2020) are not adequate. This issue, unless dealt with in a timely manner, can result in stability/settlement issues of the highway embankment at this location. In addition, the culvert inlet is higher in elevation than the ditch bottom, and hence the ditch flow will either seep under the culvert floor or pond at the culvert inlet location and saturate/erode the highway embankment fill.

The absence of vegetation on the highway north side slope and a few spots of the ditch may result in future erosion issues within the ditch bottom and instability of the north side slope.

**Recommendations:**

It is recommended to visit this site again in the spring of 2022.

**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, and clean or undertake minor grading to the north ditch (when required) to improve its drainage characteristics. Topsoil and seeding of areas bare of vegetation within the highway north side slope and ditch is encouraged to promote vegetation growth and reduce erosion potential.

The ongoing issue at culvert C3 inlet location should be investigated and repaired. The repairs will likely require: (a) excavating the north side slope to remove the separated section of the culvert (including the sinkhole area on the highway WBL), (b) installing a new pipe section and backfilling the highway side slope, (c) re-surfacing the excavated section of the highway between the white line and edge of pavement, (d) topsoiling and seeding the re-constructed highway side slope and placement of salvaged riprap at the inlet of the new pipe.

Consideration should also be given to repairing previously noted erosion at the C3 culvert outlet location. This may require excavating and backfilling the eroded area with clay and placing a Class 1 heavy rock riprap (underlain by non-woven geotextile Type C) at the outlet location to prevent further erosion issues. It is unknown though whether the recommended erosion repair is within AT ROW, and this should be checked prior to planning the work.

### **Long-Term**

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

1. 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.
2. 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.
3. 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.  
Principal | Senior Geotechnical Engineer

José Pineda, M.Eng., P.Eng.  
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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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.

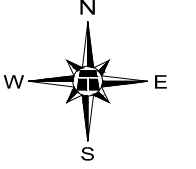
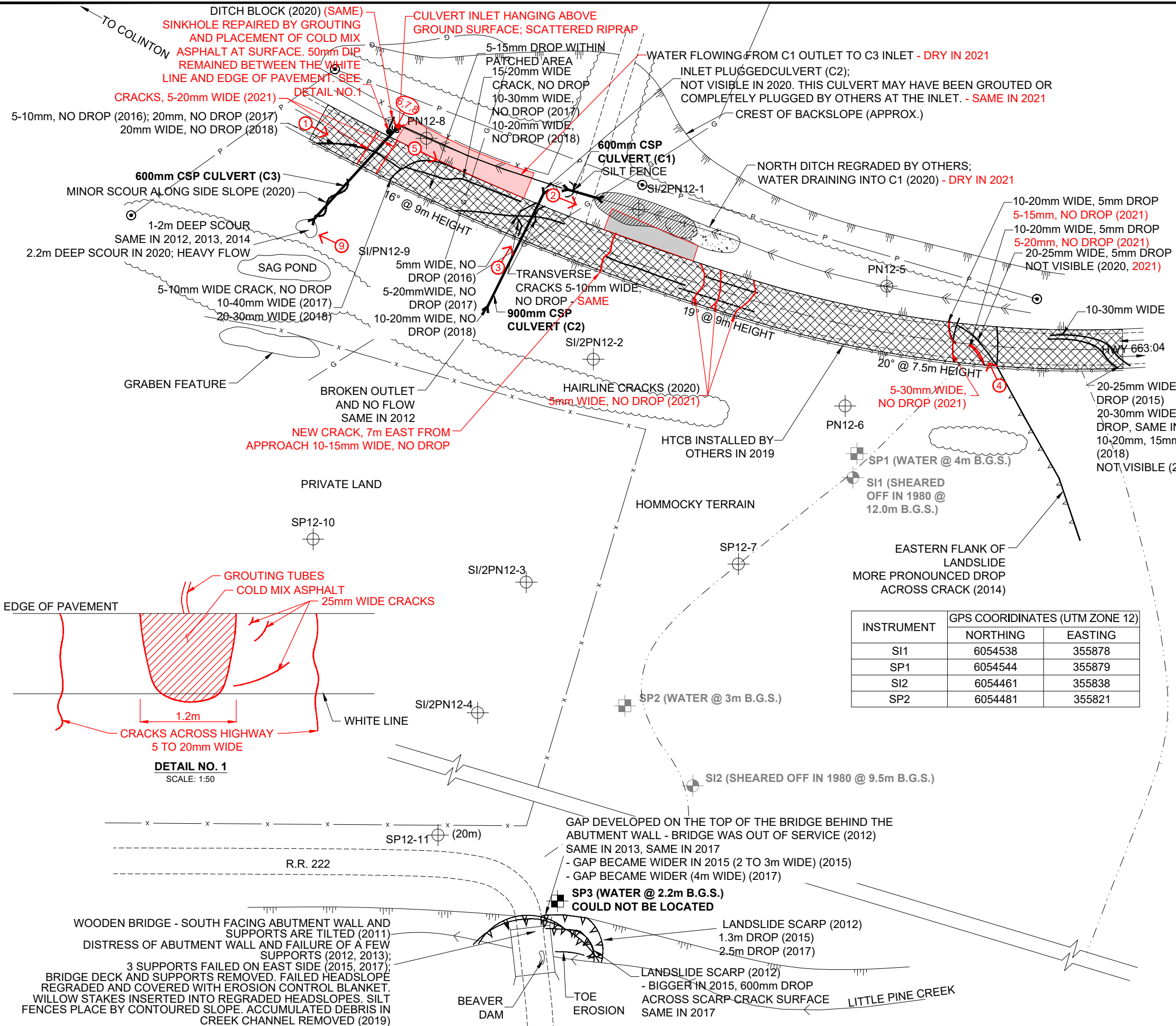
### 6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

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.

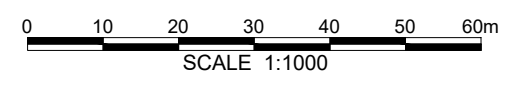
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- LEGEND**
- APPROXIMATE LOCATION OF 2012 INSTRUMENTS
  - SI SLOPE INCLINOMETER
  - PN PNEUMATIC PIEZOMETER
  - SP STANDPIPE PIEZOMETER
  - SP STANDPIPE PIEZOMETER INSTALLED IN THE 1970's
  - SI SLOPE INCLINOMETER INSTALLED IN THE 1970's
  - ACP OVERLAY
  - 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 BARE OF VEGETATION
  - GROUND SURFACE SCARCE OF VEGETATION
- NOTES**
1. WATER LEVELS IN STANDPIPE PIEZOMETERS ARE BASED ON THE AVAILABLE INFORMATION PROVIDED BY TRANS
  2. JUNE 23, 2021 SITE OBSERVATIONS ARE SHOWN IN RED.



*Alberta*

**NORTH CENTRAL REGION  
(ATHABASCA AND FORT MCMURRAY DISTRICTS)  
2021 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	SEPTEMBER 2021
FILE No.	32122

**THURBER ENGINEERING LTD.**



Photo No. 1 – Looking at the highway surface from the western limit of the site



Photo No. 2 – Looking east at highway north ditch to the east of the approach; scarce vegetation on the highway side slope



Photo No. 3 – Looking north at a transverse crack (5 to 10 mm wide with no drop)



Photo No. 4 – Looking northwest at the eastern flank reflective diagonal cracks (5 – 20 mm wide with no drop)



Photo No. 5 – Looking east at ditch regraded in 2019 by WSP; the north ditch has been regraded from culvert C1 outlet to culvert C3 inlet; culvert C2 appears to have been abandoned; side slopes and sections of the ditch are bare of vegetation



Photo No. 6 – Sinkhole developed above culvert C3 near the north edge of pavement appears to have been fixed in 2020 by grouting the void and placing cold mix patch at the surface; there is a 50 mm dip within the patched surface of the original sinkhole and cracks are developing around the patched area





Photo No. 7 – Looking south at culvert C3 inlet; note that the inlet invert is hanging above ground and the presence of a scattered riprap



Photo No.8 – Looking inside culvert C3 inlet; note culvert separation and rusting at the base



Photo No. 9 – Looking west at culvert C3 outlet; note 2.2 m deep scour at the culvert outlet