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

THURBER ENGINEERING LTD.

Site #	Location	Name	Hwy	km
NC008	15.6 Km North of Hwy 63 & 55 Intersection	La Biche River (0.8 to 0.9 km North of Bridge)	63:02	15.6
Legal Description		**UTM Co-ordinates (NAD 83)**		
3-69-17 W4		12 N 6089536 E 403480		

	Date	PF	CF	Total
Previous Inspection:	May 17, 2023	11	4	44 (New Landslide)
Current Inspection:	June 4, 2024	11	4	44 (New Landslide)
Road WAADT:	3,970		**Year:**	2023
Inspected By:	José Pineda, Tarek Abdelaziz (Thurber) Rocky Wang (TEC)			
Report Attachments:	☑ Photographs ☑ Plans ☐ Maintenance Items			

Primary Site Issue	An Active landslide within the western side slope of the highway southbound lanes, causing severe drop and deterioration to western half of the highway southbound lanes
Dimensions:	About 90 m wide (parallel to the highway alignment) and 40 m long (perpendicular to the highway alignment)
Site History:	The current landslide area (NC008-2) is to the south of the NC08-1 landslide site, which was repaired in the fall of 1997. Available information suggests that this stretch of the highway (along previous Highway 63 lanes prior to the implementation of the twinning project) has been showing slide movements since 1987. Initial attempts in the year 1990 to improve the highway condition consisted of the installation of a cut-off drain along the east side of the highway with the intention of intercepting the seepage from the swampy area to the east. However, after some time this drain was covered with silt and became non-functional. A subsequent attempt to repair the slide consisted of the installation of a centre line culvert in 1996 to allow runoff water from the east swampy area to drain out toward the oxbow lake. During the fall of 1997, additional repairs were conducted at the NC008-1 site. The repair consisted of (a) excavating and replacing a 100 m long section of the roadway with compacted clay and granular backfill, (b) placing a 600 mm thick granular drainage layer below replacement zone to reduce pore pressure build up, (c) constructing a 230 m long toe berm along the toe of the slope to the south of the ALPAC road , (d) regarding the east ditch and installing a 900 mm diameter culvert across ALPAC road to the north of the site, and (e) abandoning centre line culverts below original highway 63. The highway was twinned between 2014 and 2015 and the old highway, where previous and current instabilities took place, became

	the new southbound lanes of the current highway. There is a new centerline culvert (Culvert C2) below the southbound lanes that may have been installed during the highway twinning projects. It also appears that the OH powerlines may have been relocated to the west side of the southbound lanes during the implementation of the highway twinning project. A geotechnical investigation, consisting of drilling three test holes along with the installation of a slope inclinometer and four piezometers, was completed in 2020. The test holes indicated that the stratigraphy within the slope consists of 3 to 4 m of high plastic clay fill underlain by a high plastic firm clay foundation to 21 m depth. The native clay was noted to be stiffer 14 to 16 m below existing ground surface.	
Maintenance/Repairs:	Cracks were spray patched by TEC in 2020; the beaver dam to the north of the culvert C1 outlet location and beaver dam 1 to the east of the culvert inlet location were cleared by the County in 2020. ACP patch was placed in 2022 along the section of the highway being impacted by landslide movement.	
Observations:	**Description**	**Worse?**
☑ Pavement Distress	New landslide (NC008-2): reflective landslide cracks up to 70 mm wide and up to 10 mm drop in the western half of the highway south bound lane for a distance of about 90 m; 10 to 15 mm dip on the highway surface	☐
☑ Slope Movement	New landslide (NC008-2): Multiple reflective head scarp cracks reappeared shortly after the 2022 ACP patch; toe bulge in the oxbow lake continues to narrow the oxbow lake at the landslide location	☐
☐ Erosion		☐
☑ Seepage	Oxbow lake downslope of the highway; higher water level noted in 2024	☐
☐ Bridge/Culvert Distress		☐
☑ Other	Three beaver dams were previously noted within the Oxbow Lake. Beaver dam 1 was cleared in 2020; Beaver rebuilt NE corner of Dam 2 and water appears higher in 2024. Beaver Dam 3 has been exposed since 2022.	☐

Instrumentation Readings (2SIs, 1 SPs, 2VWs; Spring 2024):

SI1B showed a rate of movement of 1.4 mm/yr over 4.8 m to 8.4 m since the fall of 2023 readings. SI20-2 showed a rate of movement of 1.4 mm/yr over 3.8 m to 7.4 m depth since the fall of 2023.

Standpipe piezometers SP20-1 showed groundwater depth of 1.4 m corresponding to a decrease in groundwater level of 0.25 m since the piezometers were last read in the fall of 2023.

Vibrating wire piezometers VW20-2A and VW20-2B showed groundwater depths of 2.34 m and 2.43 m, respectively.

Assessment and Observations (Refer to attached Figures and Photos)**:**

The site condition has not changed significantly since the 2023 site inspection visit.

Fill placement on the top of the weak high plastic clay foundation and high groundwater levels within the clay fill and native clay are the main triggers for the landslide movement. It is likely that the presence of beaver dams within the oxbow lake resulted in high ground water levels within the landslide mass and aggravated the situation in the past.

The observed water levels in the oxbow lake between 2022 and 2024 were much lower than in the past, and this appears to have reduced the rate of movement of the landslide over the past few years.

The ACP patch placed in 2022 improved the highway driving condition within the NC008-2 landslide area. However, landslide cracks reflected on the highway surface and these cracks are expected to get worse and will contribute to faster deterioration of the highway surface condition until long-term repairs take place.

Although the new landslide is currently creeping, accelerated landslide movement may occur in the future resulting in a partial road closure and a major detour. Power and phone services may also get impacted by additional landslide movements.

Recommendations:

This site should be visited again in the spring of 2025.

In the short term, the local MCI should:

(a) Monitor the highway surface periodically for signs of distress and watch closely for the development of additional cracks and highway dip (particularly after prolonged rainfall events). The highway surface cracks at NC008-2 location should be sealed to prevent surface water infiltration into the landslide mass.

(b) Consideration should be given to placing ACP patch within the limits of the NC008-2, if the existing dip becomes worse, to improve highway rideability.

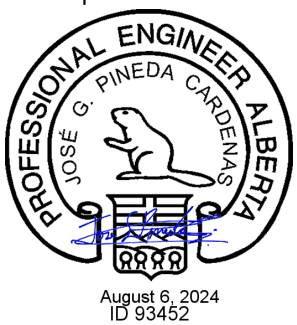
(c) Consider removing all beaver dams within the oxbow lake to further reduce water levels within the highway embankment.

Based on a preliminary engineering assessment prepared by Thurber in 2024, TEC has selected a long-term repair option consisting of two rows of driven steel pile walls parallel to the highway alignment. The estimated cost to construct the pile walls is in the range of $ 3,500,000.

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



PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE: _____
RM APEGA ID #: 91085
DATE: August 6, 2024
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

José Pineda, M.Eng., P.Eng.
Associate | Senior Geotechnical Engineer
/sls

THURBER

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.

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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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.

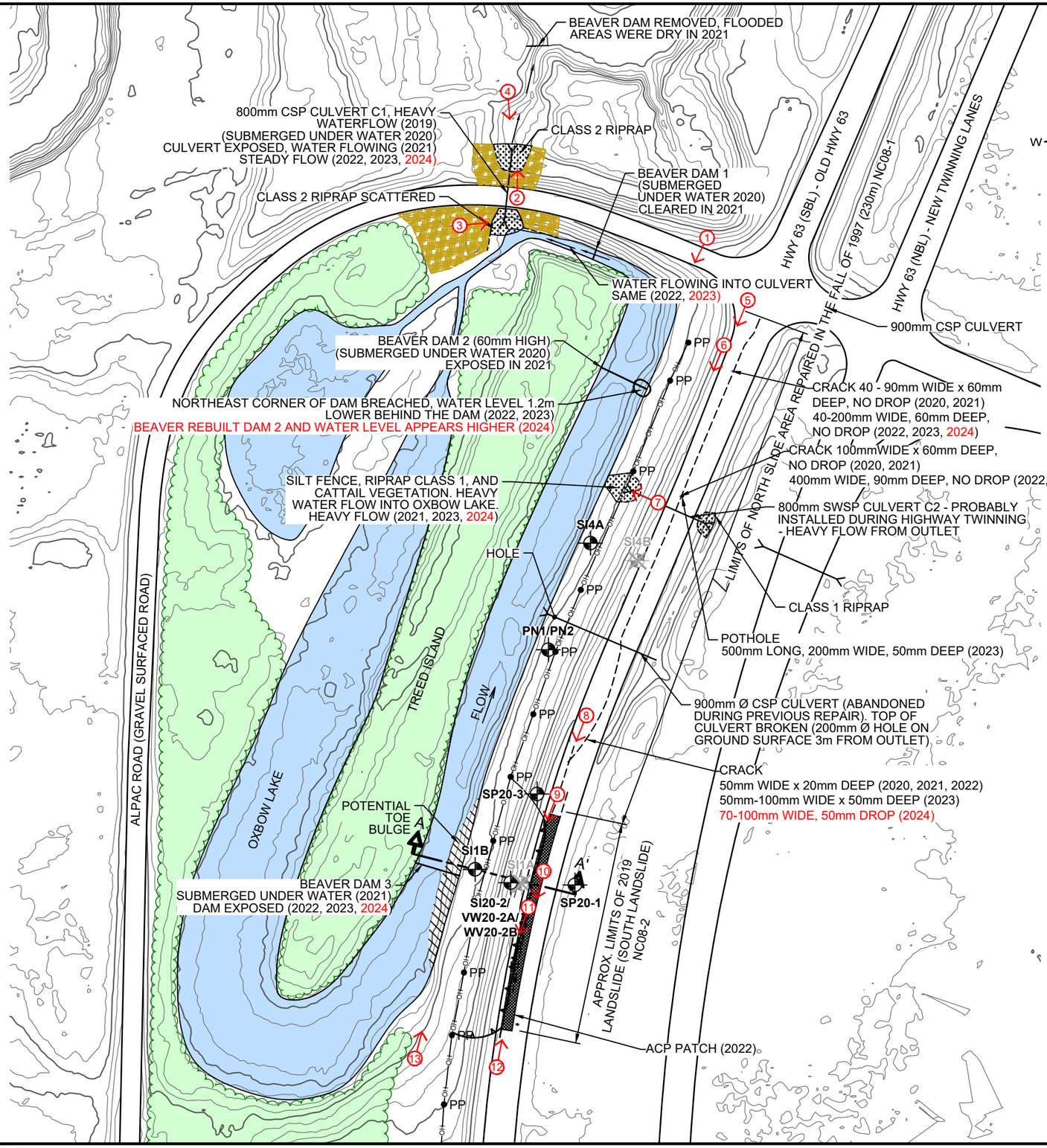
d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted 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

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.



LEGEND

- APPROXIMATE TEST HOLE LOCATION
- SI SLOPE INCLINOMETER
- VW VIBRATING WIRE PIEZOMETER
- SP STANDPIPE PIEZOMETER
- DESTROYED INSTRUMENT
- ACTIVE LANDSLIDE SCARP CRACK
- CRACK
- 540 GROUND SURFACE CONTOUR
- OH OVERHEAD POWERLINE
- PP POWER POLE
- CULVERT
- EROSION CONTROL BLANKET
- ① APPROXIMATE DIRECTION AND NUMBER OF PHOTO

NOTES:

1. SITE FEATURES ARE APPROXIMATE
2. TOPOGRAPHY IS BASED ON 2008 LIDAR DATA
3. JUNE 4, 2024 OBSERVATIONS SHOWN IN RED
4. OVERHEAD POWERLINES WERE RELOCATED TO THE WEST SIDE OF THE OLD HIGHWAY 63 DURING HIGHWAY TWINNING PROJECT

0 20 40 60 80 100 120m

SCALE 1:2000

Alberta

NORTH CENTRAL REGEON
(ATHABASCA AND FORT MCMURRAY DISTRICTS)
2024 GEOHAZARD ASSESSMENT

NC008: HWY 63:02 LA BICHE RIVER (km 15.6)
SITE PLAN SHOWING EXISTING FEATURES

FIGURE NC008-A

DRAWN BY	ML
DESIGNED BY	JGP
APPROVED BY	TSA
SCALE	1:2000
DATE	JULY 2024
FILE No.	32122

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SOLID WHITE LINE
POTENTIAL EXTENT OF 2019 LANDSLIDE
PP
FLOW
TREED ISLAND
HWY 63
CRACK 80mmWIDE x 30mmTO 50mm DEEP (NO DROP) (2020) SAME IN 2021
LIMITS OF NORTH SLIDE REPAIRED IN THE FALL OF NC08-1
SP20-3
9
EDGE OF HWY
CRACK 10-20mm WIDE, NO DROP UP TO 100mm WIDE (2022, 2024)
CRACK 300mm WIDE x 30mm DROP (2020) SAME IN 2021
POTENTIAL TOE BULGE
CRACK 80mm WIDE x 30mm DEEP (NO DROP)(2020) SAME IN 2021
500mm WIDE x 60mm DROP(2020)
500mm WIDE x 30mmDROP (2021, 2022)
30mm-50mm WIDE, 10mm DROP (2023, 2024)
A
BEAVER DAM 3
SUBMERGED UNDER WATER (2021)
DAM EXPOSED (2022, 2023, 2024)
SI1B
CRACK 22m LONG,
25mm WIDE, NO DROP (2020)
40mm WIDE, NO DROP (2021, 2022)
20mm-40mm WIDE, <10mm DROP (2023)
10
SI20-2/
VW20-2A/
WV20-2B
SI1A
SP20-1
A'
APPROX. LIMITS OF 2019 LANDSLIDE (SOUTH LANDSLIDE) NC08-2
100mm WIDE x 60mm DROP (2020)
100mm WIDE x 30mm DROP (2021, 2022)
20mm - 30mm WIDE, <10mm DROP (2023)
11
30-40mm WIDE, NO DROP (2024)
OXBOW LAKE
400mm WIDE x 40mm DROP
(2020, 2021, 2022)
300mm WIDE x 50mm DROP (2020)
500mm WIDE x 50mm DROP
(2021, 2022)
20mm - 30mm WIDE, NO DROP
(2023, 2024)
ACP PATCH (2022)
30mm WIDE (2020)
30 - 60mm WIDE (2021, 2022)
NOT VISIBLE (2023)
40-60mm WIDE, 10mm DROP (2024)
POT HOLE (2.2m LONG x 400mm WIDE x 120mm DEEP)
SAME IN 2022
NOT VISIBLE (2023)
30 - 50mm WIDE,
NO DROP (2020, 2021)
30 - 70mm WIDE, NO DROP (2022)
30 - 70mm WIDE, UP TO 10mm DROP (2023, 2024)
POTENTIAL EXTENT OF 2019 LANDSLIDE
POT HOLE (700m LONG x 350mm WIDE x 100mm DEEP)
900mm x 400mm x100mm (2022)
12
13

N
W
E
S

LEGEND

- APPROXIMATE TEST HOLE LOCATION
- SI SLOPE INCLINOMETER
- VW VIBRATING WIRE PIEZOMETER
- SP STANDPIPE PIEZOMETER
- DESTROYED INSTRUMENT
- ACTIVE LANDSLIDE SCARP CRACK
- CRACK
- 540 GROUND SURFACE CONTOUR
- OH OVERHEAD POWERLINE
- PP POWER POLE
- 1 APPROXIMATE DIRECTION AND NUMBER OF PHOTO

NOTES:

1. SITE FEATURES ARE APPROXIMATE
2. TOPOGRAPHY IS BASED ON 2008 LIDAR DATA
3. JUNE 4, 2024 OBSERVATIONS SHOWN IN RED
4. OVERHEAD POWERLINES WERE RELOCATED TO THE WEST SIDE OF THE OLD HIGHWAY 63 DURING HIGHWAY TWINNING PROJECT
5. CRACKS WERE SPRAY PATCHED IN 2020.

0 5 10 15 20 25 30m
SCALE 1:500

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NORTH CENTRAL REGEON
(ATHABASCA AND FORT MCMURRAY DISTRICTS)
2024 GEOHAZARD ASSESSMENT

NC008: HWY 63:02 LA BICHE RIVER (km 15.6)
SITE PLAN SHOWING THE SOUTH SLIDE AREA

FIGURE NC008-B

DRAWN BY	ML
DESIGNED BY	JGP
APPROVED BY	TSA
SCALE	1:500
DATE	JULY 2024
FILE No.	32122

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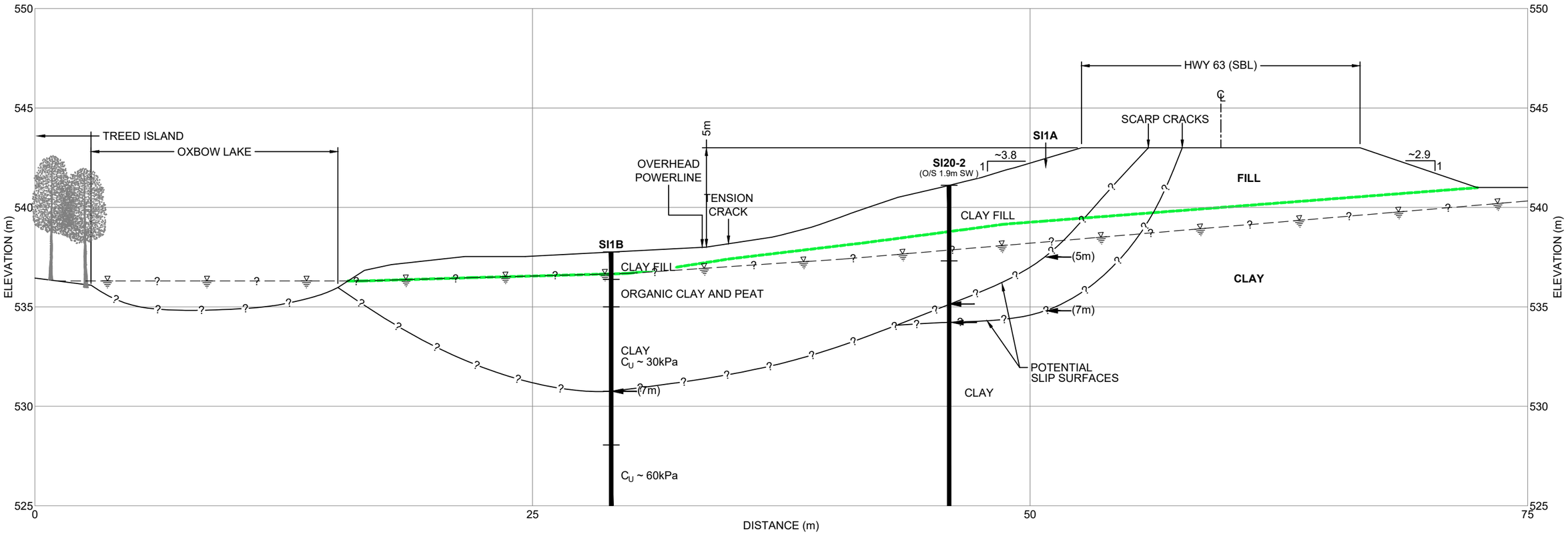
WEST

SECTION A-A'

EAST



LEGEND

C_U UNDRAINED SHEAR STRENGTH BASED ON POCKET PENETROMETER

(7m) ZONE OF MOVEMENT IN SLOPE INCLINOMETER (DEPTH)

POTENTIAL PIEZOMETRIC SURFACE

NOTES:

1. CROSS-SECTION IS APPROXIMATE, BASED ON 2008 LIDAR DATA AND JULY 3, 2019 OBSERVATIONS
2. SI1A STRATIGRAPHY IS NOT AVAILABLE

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NORTH CENTRAL REGEON
(ATHABASCA AND FORT MCMURRAY DISTRICTS)
2024 GEOHAZARD ASSESSMENT

NC008: HWY 63:02 LA BICHE RIVER (km 15.6)
CROSS-SECTION A-A'

FIGURE NC008-C

DRAWN BY	ML
DESIGNED BY	JGP
APPROVED BY	TSA
SCALE	1:200
DATE	JULY 2024
FILE No.	32122

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Photo No. 1 – Looking south at Oxbow Lake. NE corner of Beaver Dam 2 rebuilt; water levels appear higher behind the Dam in 2024

Photo No. 2 – Looking north at Culvert C1 outlet; water continues to flow freely along the channel

Photo No. 3 – Looking east towards CSP culvert C1 inlet

Photo No. 4 – Steady Water Flow at Culvert C1 outlet location

Photo No. 5 – Looking south at highway open cracks within the limits of the repaired area in 1997 (previously known as NC08-1)

Photo No. 6 – Looking south at highway open cracks and potholes within the limits of the NC08-1 repaired area

Photo No. 7 – Looking at the 900 mm diameter SWSP Culvert C2 outlet; heavy flow in 2024

Photo No. 8 – Looking south at the southern flank cracks of the NC08-1 repaired landslide

Photo No. 9 – Looking south at the northern flank of the new landslide (NC08-2); new ACP patch placed in 2022 showing reflective cracks (20 mm to 70 mm wide)

Photo No. 10 – Looking south at reflective cracks within the middle section of the NC08-2 landslide

Photo No. 11 – Looking south at, 30-40 mm wide with no drop, reflective cracks near the southern flank of the NC08-2 landslide

Photo No. 12 – Looking north at reflective cracks, 30-70 mm wide with 10 mm drop, near the southern flank of the NC08-2 landslide

Photo No. 13 – Looking north at Beaver Dam 3 and Landslide Toe Bulge