ALBERTA TRANSPORTATION AND ECONOMIC CORRIDORS
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION (PEACE RIVER DISTRICT)
2024 INSPECTION

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy	km
PH081	Shaftesbury Trail	Shaftesbury Trail North Slides	684:02	28.4
Legal Description		**UTM Co-ordinates (NAD 83)**		
NW¼ 19-083-021 W5M		11U E 481381	N 6230300	

	Date	PF	CF	Total
Previous Inspection:	May 18, 2023 South Slides	11	2	22 (Slide Risk Rating)
	North Slide	9	4	36 (Slide Risk Rating)
Current Inspection:	May 29, 2024 South Slides	11	2	22 (Slide Risk Rating)
	North Slide	9	4	36 (Slide Risk Rating)
Road WAADT:	840		**Year:**	2023
Inspected By:	Don Proudfoot, Tyler Clay, Cole Szakacs (Thurber). Rocky Wang, Erwin Kurz, Robert Senior (TEC)			
Report Attachments:	☒ Photographs ☒ Plans ☐ Maintenance			

Primary Site Issue:	**South Slides:** Two landslide features are present to the east of Hwy 684:02 in the crest of the steep high riverbank slope above an arm in the Peace River. The backscarps have sharp 3 m drop offs and are retrogressing into the highway right-of-way (Photos 1 to 3). Both landslides have failed down to the sandy till ledge which is about 5 m below the existing ground surface. There is a marked gas utility pipeline at the backscarp of Slide 1. **North Slide:** A landslide (first observed in 2019), evidenced by a dip and cracking in the pavement, was observed to the north of Slides 1 and 2. The location of this slide is above a subdivision at km 28.6. (Photo 4).
Dimensions:	Slide 1 is about 13 m wide, with a 3 m drop off along the backscarp which is about 3.2 m east of the NBL guardrail. Slide 2 is about 14 m wide, with a 3 m drop off along the backscarp which is about 7.6 m east of the NBL guardrail. The slide at km 28.6 is approximately 25 m wide. Tension cracking had been observed to the highway centreline prior to the 2021 overlay.
Date of any remediation:	None.
Maintenance:	The road was repaved, and new guardrail installed in 2021.

Observations:	Description:	Worsened?	
		Yes	No
☒ Pavement	There are no signs of any cracking in the pavement structure above Slides 1 and 2. Transverse cracks were visible in the asphalt north and south of the km 28.6 slide across both lanes (Photo 4). Previous tension cracks were not observed since road was repaved in 2021 and there was no apparent expansion from the previous inspection.	☐	☒
☒ Slope Movement	Active slumping is occurring at the south landslides with bare backslopes (Photos 1 to 3). Slide 1 has shown some signs of minor ravelling and retrogression in the southern flank since 2023. The minimum offset from the headscarp to the guardrail reduced by approximately 0.2 m since 2023 and measured 3.2 m. The gas pipeline marker post has now fallen into the slide bowl. The backscarp at Slide 2 did not appear to have significant change and there is a 7.6 m offset to the guardrail which is unchanged from the 2023 inspection. The vertical dip in the pavement and guardrail at the slide at km 28.6 since the 2021 repaving appeared unchanged from the 2023 condition (Photo 4).	☒	☐
☐ Erosion		☐	☐
☐Seepage		☐	☐
☐ Bridge/Culvert		☐	☐
☒ Other	There is a marked natural gas utility pipeline that appears to cross beneath the highway from west to east at the south end of Slide 1 and could possibly be affected by Slide 1. Thurber did not find any record of the pipeline.	☐	☒

Instrumentation:

Spring 2024 data from instrumentation installed during the 2020 geotechnical investigation is summarized below.

Slide 1:
TH20-7 Vibrating Wire (VW) – the VW tip is approximately 18 mbgs and has been dry since installation.

TH20-7 Slope Inclinometer (SI) – showed a cumulative movement of 12.4 mm over 0.3 m to 13.7 m depth, with a rate of movement of 1.9 mm/yr.

Slide 2:
TH20-8 VW - the VW tip is approximately 12 mbgs and has recorded groundwater depth range between approximately 5 to 6.1 mbgs. There has been a notable downward trend of 0.5 to 1.0 m depth since March 2023.

KM 28.6 Slide:
TH20-6 VW (x2) – the upper VW tip is installed approximately 8.5 mbgs was found to be dry since January 2024, and the lower VW tips is installed approximately 20 mbgs and the recorded groundwater depth is approximately 19 mbgs. Groundwater depths have been relatively consistent since installation with variance below 2.0 m.

TH20-6 SI - showed a cumulative movement of 1.4 mm over 6.6 m to 8.4 m depth, with no discernible movement since the Spring 2023 readings.

Assessment (Refer to Drawings PH081-1-1 to PH081-1-5)**:**

Intermittent movement and retrogression is occurring at Slides 1 and 2 and the headscarps are expected to continue to move toward the highway. The newer slide at km 28.6 previously caused distress in the old pavement and guardrail and is located above a residential subdivision with a higher consequence of failure. Based on vertical deflection of the guardrail at the slide location it appears slide movement is ongoing; however, SI data shows that movement is at intermittent or very slow rates.

It is possible that the landslides are caused by fluctuations in a perched groundwater table that is within the alluvial terrace soils that sit above of the harder/denser soil and bedrock layers, combined with softening and weathering of the very steep riverbank slope. The surface soils overlie hard bedrock at the new north landslide. If a failure occurred, the landslide at km 28.6 could slide over the steep face of the bedrock and into the backyards of the residences.

Recommendations:

Monitoring:
Annual inspections should continue with the next inspection occurring in the Spring of 2025.

Maintenance:
- No immediate maintenance measures required at this time.

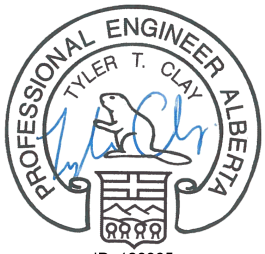
Short-term Measures:
- Regularly inspect the road and crest of the riverbank to check for cracks and possible backscarp retrogression.
- Post slide warning signs and be prepared to build an emergency detour in the upslope ditch if the landslides retrogress closer to within a few meters of the NBL of the highway.

Long-term Measures:
- The most feasible remedial solution is likely a pile wall at each of the south landslide locations to protect the road from the landslides given the proximity of the highway to the steep riverbank slope, and the presence of private residences on the west side of the highway. ($1M - 2M)
- At the north landslide, a concrete pile wall anchored into bedrock is a potential remedial option. ($1M)

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.

Don Proudfoot, P.Eng.
Principal | Senior Geotechnical Engineer



ID: 120965
October 15, 2024

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE: Don Proudfoot
RM APEGA ID #: 51674
DATE: October 15, 2024
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Tyler Clay, P.Eng.
Geological Engineer

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.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

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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5. INTERPRETATION OF THE REPORT

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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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.

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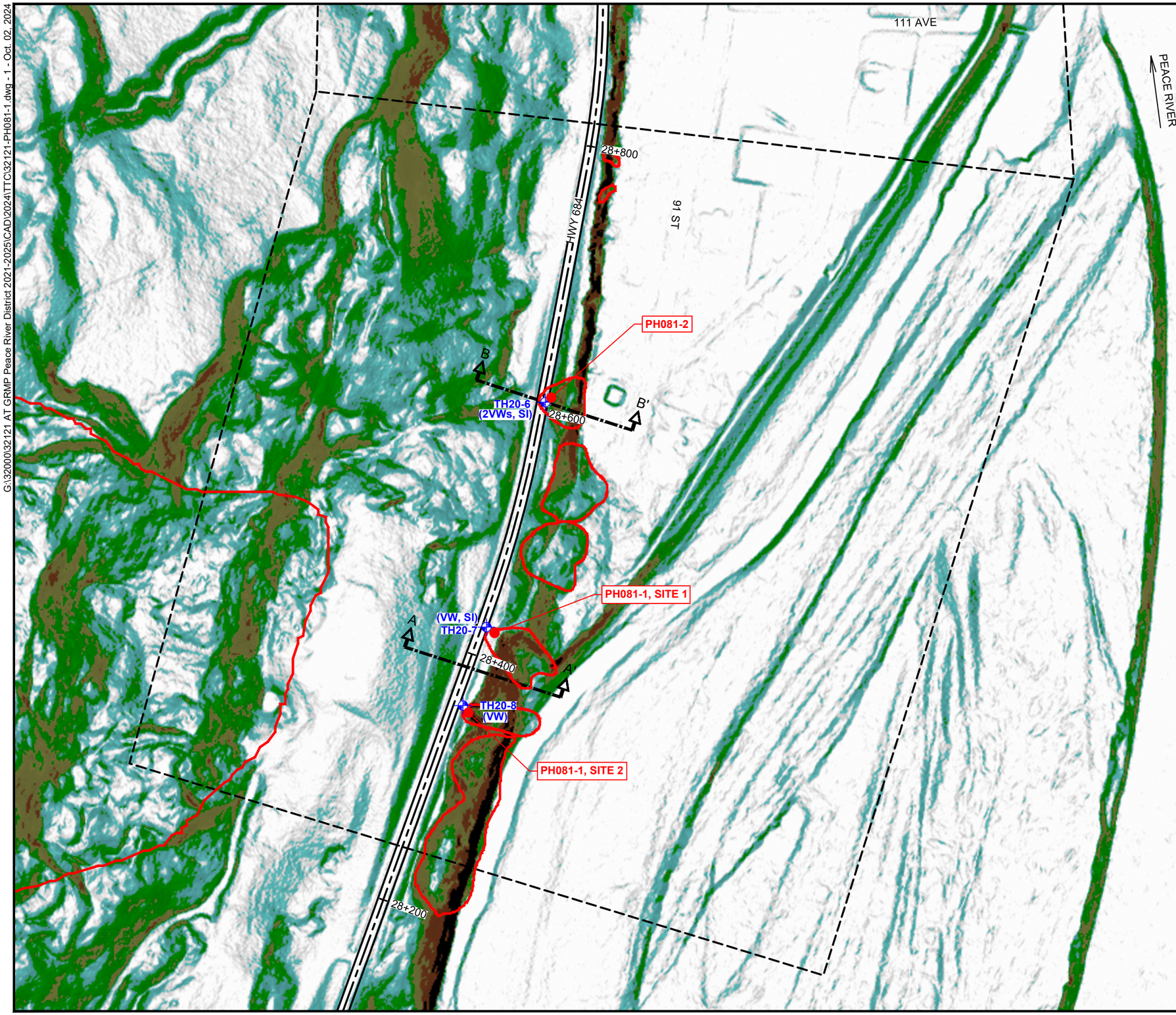

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LEGEND

- APPROXIMATE TEST HOLE LOCATION
- APPROXIMATE INSTRUMENT LOCATION
- VW — VIBRATING WIRE PIEZOMETER
- SI — SLOPE INCLINOMETER
- ACTIVE LANDSLIDE BOUNDARY
- PH053 — GEOHAZARD SITE NUMBER
- A A' — SLOPE STABILITY ANALYSIS CROSS - SECTION LOCATION

SLOPE (DEGREE)

50°
40°
30°
20°
10°
0°

0 25 50 75 100 150 200 m
SCALE 1:3000

DRAWING BASED ON 2007 LIDAR WITH 1m POINT GRID

Alberta

PEACE REGION (PEACE RIVER DISTRICT)

PH081-1: HWY 684:02, KM 28.4
SHAFTESBURY TRAIL NORTH SLIDES -
SLOPE SHADER OVERALL PLAN MAP

DWG No. 32121-PH081-1-1

DRAWN BY	ML
DESIGNED BY	TCC
APPROVED BY	DWP
SCALE	1:3000
DATE	OCTOBER 2024
FILE No.	32121

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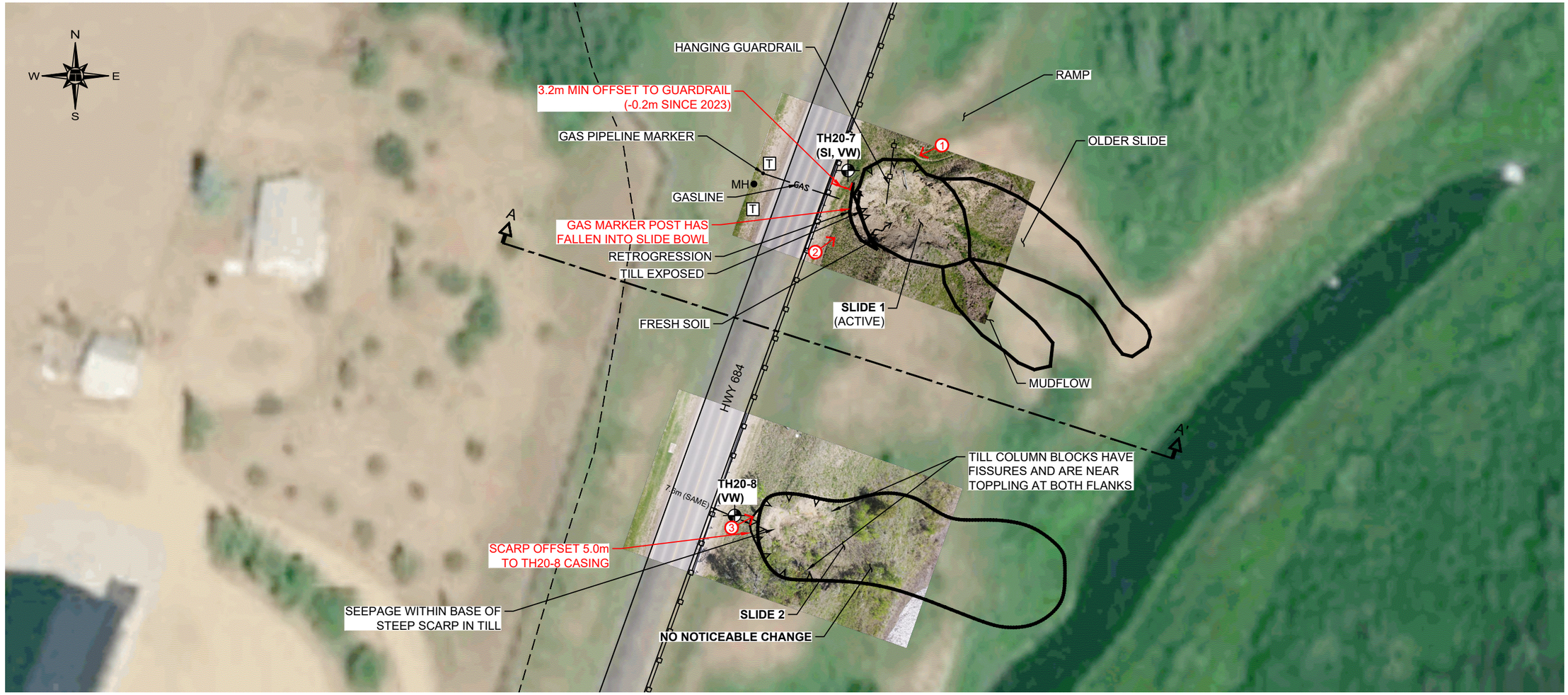

0 10 20 30 40 50m

SCALE 1:750

SATELLITE IMAGERY FROM ESRI WORLD IMAGERY (DOWNLOADED 2022-09-28)

LEGEND

- TOP OF BACKSLOPE
- GUARDRAIL
- T — TELUS PEDESTAL
- MH — MANHOLE
- SEEPAGE
- SCARP CRACK
- DIRECTION AND NUMBER OF PHOTO
- APPROXIMATE TEST HOLE LOCATION
- SI — SLOPE INCLINOMETER
- VW — VIBRATING WIRE PIEZOMETER

NOTES :

1. FEATURE LOCATIONS ARE APPROXIMATE
2. MAY 29, 2024 OBSERVATIONS SHOWN IN RED.
3. BASE IMAGERY OF SLIDE AREAS FROM THURBER DRONE IMAGERY COLLECTED MAY 2022.

Alberta

PEACE REGION (PEACE RIVER DISTRICT)

PH081-1: HWY 684:02, KM 28.4
SHAFTESBURY TRAIL NORTH SLIDES
2024 SITE INSPECTION PLAN

DWG No. 32121-PH081-1-2

DRAWN BY	ML
DESIGNED BY	TTC
APPROVED BY	DWP
SCALE	1:750
DATE	OCTOBER 2024
FILE No.	32121

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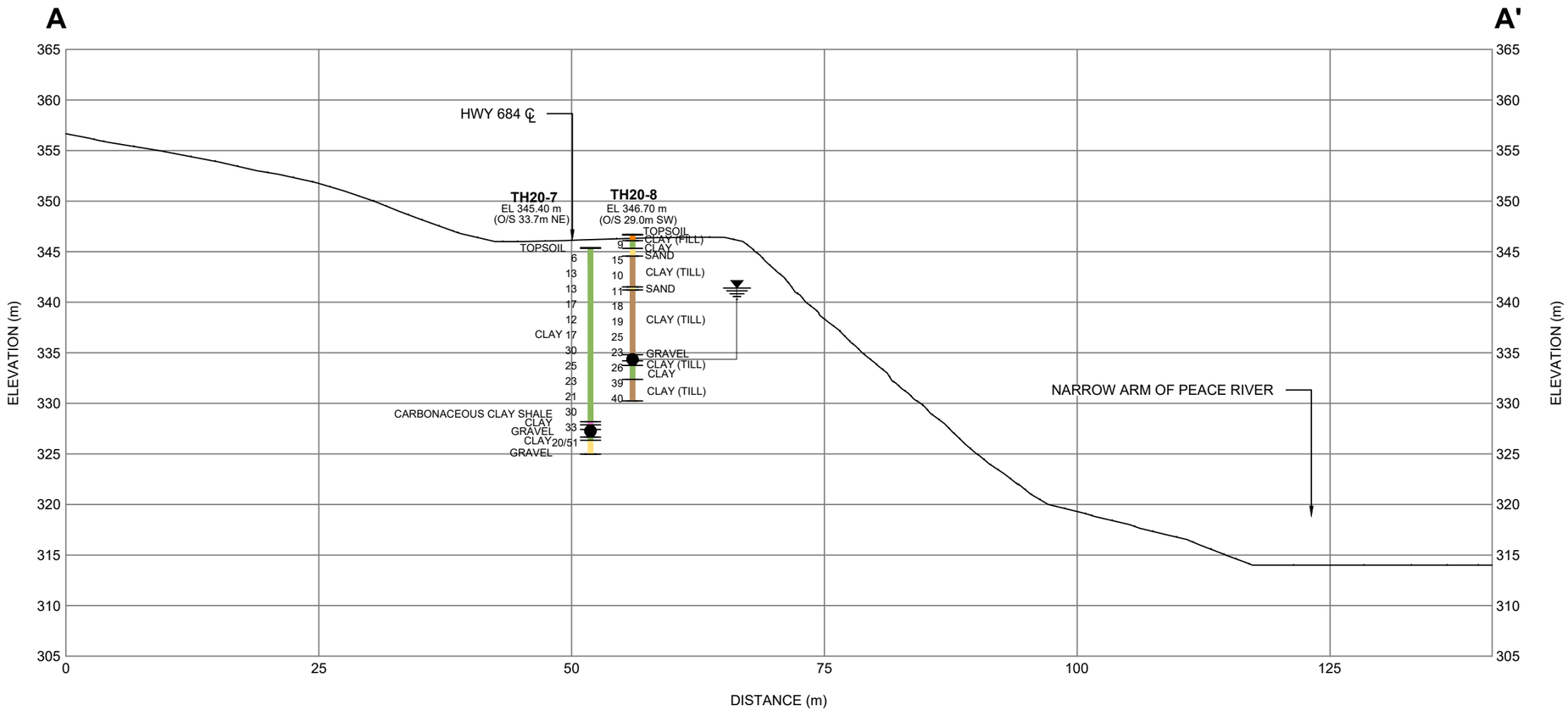


LEGEND

15 SPT N VALUE

WATER LEVEL IN PIEZOMETER (MAY 10, 2021)

VIBRATING WIRE PIEZOMETER TIP

NOTES:

1. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT THE TEST HOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN TEST HOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN.
2. CROSS-SECTION CUT FROM 2007 LIDAR WITH 1m GRID ACCURACY

Alberta

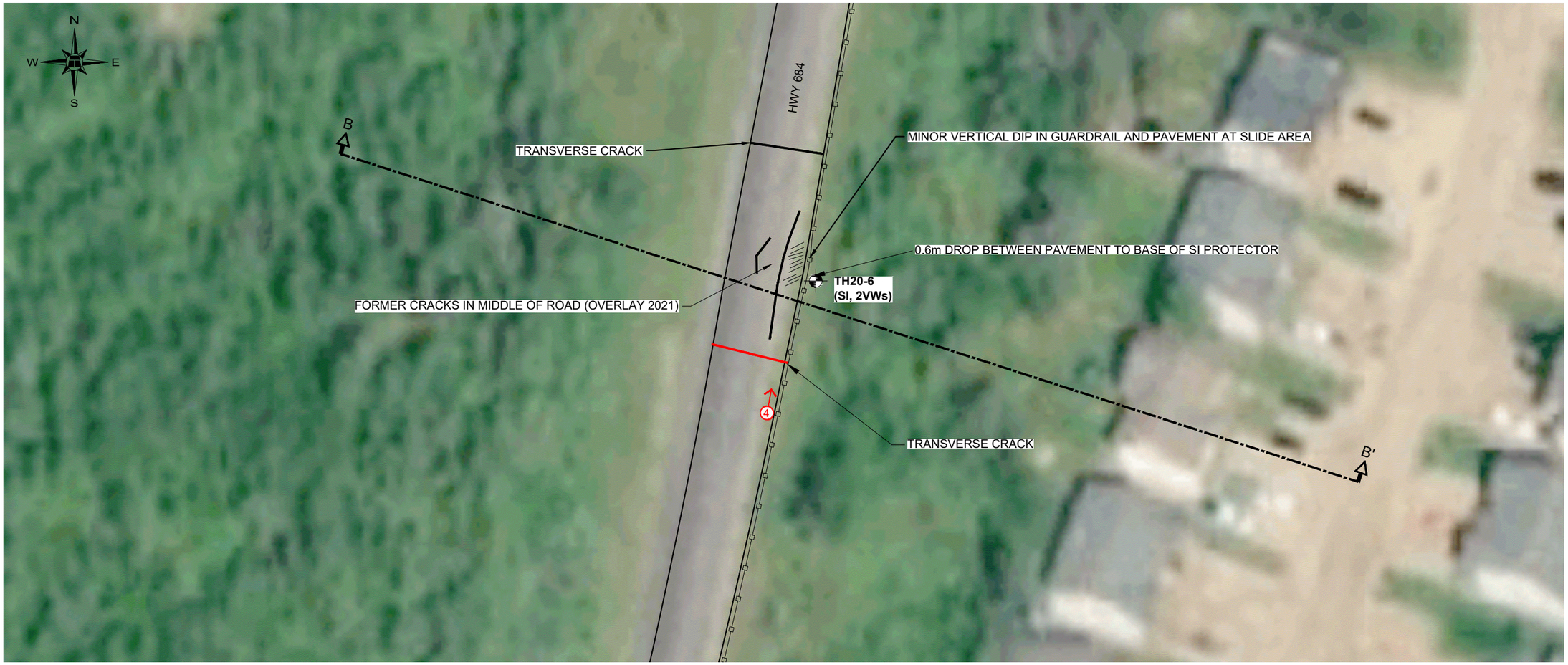
PEACE REGION (PEACE RIVER DISTRICT)

PH081-1: HWY 684:02, KM 28.4
SHAFTESBURY TRAIL NORTH SLIDES
STRATIGRAPHIC CROSS - SECTION A - A'

DWG No. 32121-PH081-1-2

DRAWN BY	ML
DESIGNED BY	TTC
APPROVED BY	DWP
SCALE	1:750
DATE	OCTOBER 2024
FILE No.	32121

THURBER ENGINEERING LTD.



LEGEND

- SCARP CRACK
- GUARDRAIL
- DIRECTION AND NUMBER OF PHOTO
- APPROXIMATE TEST HOLE LOCATION
- SI — SLOPE INCLINOMETER
- VW — VIBRATING WIRE PIEZOMETER

NOTES :

1. FEATURE LOCATIONS ARE APPROXIMATE
2. MAY 29, 2024 OBSERVATIONS SHOWN IN RED.

0 5 10 15 20 25 30m

SCALE 1:500

SATELLITE IMAGERY FROM ESRI WORLD IMAGERY (DOWNLOADED 2022-09-28)

Alberta

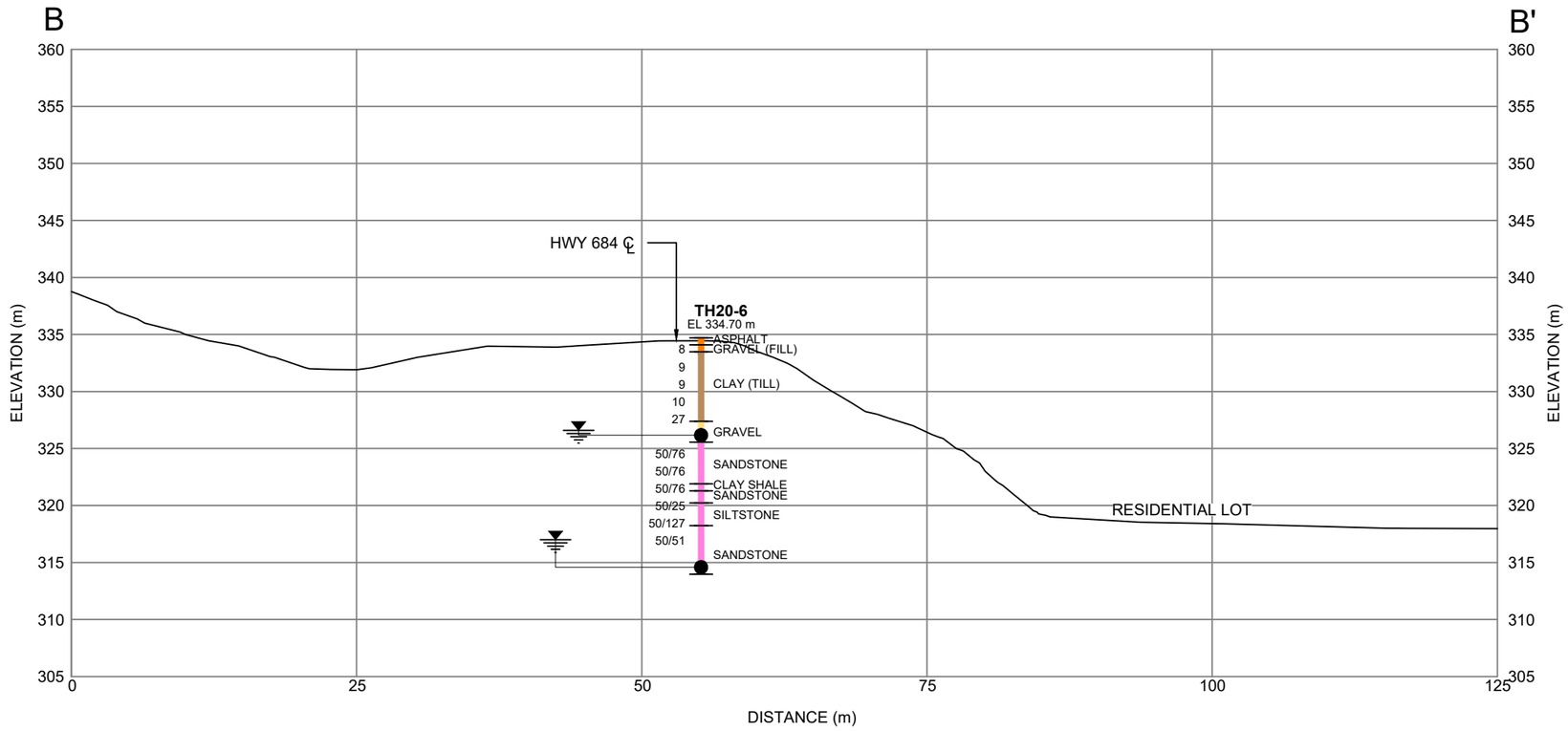
PEACE REGION (PEACE RIVER DISTRICT)

PH081-1: HWY 684:02, KM 28.4
SHAFTESBURY TRAIL NORTH SLIDES
2024 SITE INSPECTION PLAN AND CROSS-SECTION

DWG No. 32121-PH081-1-4

DRAWN BY	ML
DESIGNED BY	TTC
APPROVED BY	DWP
SCALE	AS SHOWN
DATE	OCTOBER 2024
FILE No.	32121

THURBER ENGINEERING LTD.



LEGEND

15 SPT N VALUE

WATER LEVEL IN PIEZOMETER (MAY 10, 2021)

VIBRATING WIRE PIEZOMETER TIP

NOTES:

1. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT THE TEST HOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN TEST HOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN.
2. CROSS-SECTION CUT FROM 2007 LIDAR WITH 1m GRID ACCURACY

Alberta

PEACE REGION (PEACE RIVER DISTRICT)

PH081-1: HWY 684:02, KM 28.4
SHAFTESBURY TRAIL NORTH SLIDES
STRATIGRAPHIC CROSS - SECTION B - B'

DWG No. 32121-PH081-1-5

DRAWN BY	ML
DESIGNED BY	TTC
APPROVED BY	DWP
SCALE	1:750
DATE	OCTOBER 2024
FILE No.	32121

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PHOTOS

	**Photo 1.** Looking southwest from the north flank of Slide 1. Some fresh soil was visible in the upper scarp/south flank and there was 0.2 m retrogression since 2023. Minimum offset from the main scarp to the guardrail was measured at 3.2 m. Gas marker post has now fallen into the slide area.
	**Photo 2.** Looking northeast from the south side of the main scarp of Slide 1. Minor lateral expansion of the north slide flank since 2023.

	**Photo 3.** Looking east and downslope from the top of the main scarp of Slide 2. Ongoing erosion within the exposed and disturbed soils but no significant expansion or retrogression towards the highway since 2023. Main scarp was offset 7.6 m from the guardrail.
	**Photo 4.** Looking north at the slide at km 28.6. No visible changes to the slope below the road. No change to pavement damage or dip at the guardrail except for a new transverse crack noted south of the road section with previous cracking prior to the 2021 overlay.