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

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy	km
PH044-1 (A) PH044-2 (B)	North of Manning, AB	Meikle River Slides A and B	35:08	26.14 25.82
Legal Description		**UTM Co-ordinates**		
Slide A: SW7-94-22-W5M		11 E 467,665	N 6,333,024	

	Date	PF	CF	Total
Previous Inspection:	3-June-2022	Slide A: 11 Slide B: 11	3 2	33 22
Current Inspection:	30-May-2024	Slide A: 11 Slide B: 11	3 2	33 22
Road AADT:	1600		**Year:**	2024
Inspected By:	Rocky Wang, TEC Robert Senior, TEC		Ken Froese, Thurber Tyler Clay, Thurber	
Report Attachments:	☒ Photographs	☒ Plans	☒ Maintenance	

Primary Site Issue:	Sideslope slumping of high embankment into oxbow of the Meikle River.	
Dimensions:	Slide A: 34 m length of highway, 18 m high embankment Slide B: 65 m length of highway, 24 m high embankment	
Date of Remediation:	1993, Slide B: Pile wall installed	
Maintenance:	2008: spray-patch of cracks. 2016: Overlay and chip seal of Highway 35 including these sites. High tension steel cable barrier (HTSC) installed. 2019: HTSC replaced with W-Beam guardrail	
Observations (Slide A):	**Description**	**Worsened?**
☒ Pavement Distress	No distress observed since overlay in 2016.	☐
☒ Slope Movement	The backscarp is 5.8 m from the highway and minimal change was observed since last inspection.	☒
☒ Erosion	Increased erosion around the culvert outlet. A gully is forming north of the outlet and a scarp was observed in 2024.	☒
☒ Seepage	Salt-staining observed in face of highest scarp in 2015 not visible.	☐
☒ Bridge/Culvert	Culvert outlet became obstructed by toe roll in 2017 but exposed again in 2019. Concrete lining downslope entirely destroyed. Slumping causing outlet to be undermined.	☒
☐ Other		☐
Observations (Slide B):	**Description**	**Worsened?**
☒ Pavement Distress		☐
☒ Slope Movement	The backscarp is about 0.8 m from the back of the post of the new W beam guardrail. North flank of the landslide continues to be active.	☒
☒ Erosion	Erosion rills between the highway shoulder and the backscarp have progressed exposing some of the piles in the pile wall. Gully on the north side of landslide bowl was not worse.	☒

☒ Seepage	Wet zone in the center part of the landslide bowl was still present and similar in size.	☐
☒ Bridge/Culvert	Gully forming below abandoned culvert south of landslide resulting in one segment detaching and appears to be stabilizing as there is no flow in the culvert.	☒
☐ Other		☐

Instrumentation (as of Spring 2024):

Slide A	Two slope inclinometers (SI-27 and -45) remain operational with continued slow deep-seated creep movement (annual movement rates of less than 1.0 mm) has been detected in the inclinometers between 31.5 m and 37.8 m depth. SI-23 sheared off 27.4 m depth
Slide B	One slope inclinometer (SI-42 installed to a depth of 44 m) remains operational and has registered no discernible movement since installation in 1996.

Note: The instruments at these two sites are located outside the limits of the active landslide zones.

Assessment:

SLIDE A (km 26.14, was STATION 0+650) – See Drawing 32121-PH044-1-1:

The landslide movement consists of a rotational landslide with two blocks occurring on an 18 m high embankment inclined at an overall angle of 18°. The headscarp has ravelled in the past and has been relatively stable since 2019. However, the lower slope continues to be active with an extension of a tension crack observed on the east side, large extensions of the active scarp on the west side and continued movement below the hanging culvert outlet. The pavement surface does not appear to be currently affected by the movements at Slide A. It is believed that the landslide has occurred due to a gradual loss of cohesion of the clay embankment fill due to surface weathering (similar at Slide B). The crest of the landslide has retrogressed about 1.7 m since 2009 and evidence of seepage (salt staining) was previously noted in the backscarp about 1 m below the crest. Measurements of the offset between the guardrail and the slide crest indicate the crest has not regressed toward the road since 2020, and remains about 5.8 m. There is a significant erosion channel developing below the culvert outlet which is causing continued slumping at the toe of the slope which has regressed upslope and above the culvert.

A silt deposit noted in 2022 on the southeast side of the upslope culvert outlet is now grassed over. In 2024, a scarp and toe roll were noted on the east side of this gully. The gully in the upslope ditch appears to be migrating westward towards the ditch check at PH045.

SLIDE B (km 25.82 was STATION 0+500) - See Drawing 13351-PH044-2-1:

The landslide movement consists of a rotational landslide located downslope of the pile wall. Although the wall appears to be protecting the highway, there is increasing raveling and eroding of the slope adjacent to the highway. After being relatively stable for the previous few years, the new movement observed in 2020 continued to deteriorate in 2022: tension cracks are forming near the headscarp, an intermediate scarp formed in the main scarp, and the skin landslide extension to the north has extended further. Although it does not appear to have expanded further in 2024, there were indications that it was sliding further downslope such as leaning trees near the toe of the valley.

Downcutting in the gully below the abandoned culvert south of the landslide, which resulted in a segment of the culvert becoming detached, has not yet stabilized despite that the inlet was blocked off in 2016 but as 2024, vegetation has begun to grow and further downcutting appears to have stopped.

It is believed that the landslide has occurred due to a gradual loss of cohesion of the clay embankment fill due to surface weathering. Ongoing slope movement could eventually reduce the support to the back of the pile wall and result in distress to the wall and highway. Ravelling in 2024 has exposed some of the pile tops. File review undertaken during preliminary engineering work at the PH045 pile wall further upslope encountered details of the piles installed at this PH044 Slide B site which were reported to consist of 30 m-long span of 16 x 24 inch-dia. concrete piles installed at 2 m center-to-center spacing to a depth of 12 m reinforced with 9 M25 bars in a 20 inch-dia. cage. This wall was installed in 1993 at the same time a subdrain was installed in the upslope ditch over a length of about 70 m running about 70 m northwest from the culvert at the southeast end of the site. The subdrain consisted of 100 mm-dia. plastic pipe installed up to 4 m deep with a 1 m clay cap at the top of the trench.

Recommendations:

Medium-Term:

- Slide A: Consideration should be given to lining the culvert and welding a downpipe to the outlet to direct culvert flow to the bottom of the slope into a dissipation bowl. This could reduce some of the driving force on the landslide and minimize issues that may arise from the reduced culvert flow due to the covered outlet. An inspection of the culvert should be undertaken to confirm that it is intact.
- Slide A: The upslope ditch erosion should be mitigated to reduce the risk of slumping of the highway sideslope. This could be done by reshaping the ditch which may require importing material and lining the reshaped ditch with erosion protection such as a TRM or Class 1M riprap. The ditch flow could be further improved by discharging into a proper riprap apron and directed into the culvert inlet. A similar treatment could be used for the gully north of the inlet but there is less risk to the highway and the heavy vegetation and steeper slopes would make it more difficult to repair.
- Slide B: Drainage water should be prevented from running onto the landslide area. An asphalt curb could be used to direct surface runoff away from the landslide, which will also reduce the ravelling of the embankment between the highway and pile wall.

Long-Term:

- Slide A
  - The landslide material (predominantly clay till) could be removed, and the slope reconstructed at a flatter angle with well-compacted, moisture-conditioned clay benched into the intact fill slope. The culvert should be replaced or repaired following excavation of the slumped material and extended to a flatter area downslope where a dissipation bowl should be constructed. Extending the outlet may allow sufficient room for a small toe berm so the slope could be flattened somewhat. In addition, the area surrounding the culvert inlet should be regraded and protected with a high-flow soil covering.
  - Alternatively, a pile wall could be constructed at the shoulder to protect the highway similar to the approach taken at Slide B.
- Slide B
  - Consideration could be given to excavating and replacing the landslide material below the wall and reconstructing the slope at a flatter angle with well-compacted, moisture-conditioned clay benched into the intact fill. Soil nailing could be considered as an alternative to stabilize the upper portion of the landslide.
  - The concrete ditch liner at the north end of the landslide is cracked and could be repaired with fillcrete, which would prolong the useful life or replaced. Consideration should be given to installing a half-culvert to convey the water to the toe of the slope rather than spilling onto the fresh movement area.

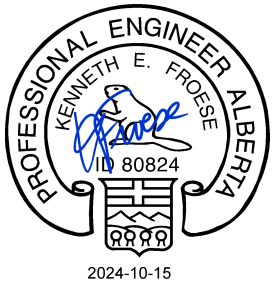
Ongoing Investigation:

- It is recommended that the twice-per-contract Geohazard inspection should continue as scheduled (2026).
- If a drill rig is in the area on other work, it is suggested that one or two additional inclinometers be installed at each of these sites as the existing instrumentation is outside active movement areas.

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.

Roger Skirrow, M.Sc., P.Eng.
Senior Geotechnical Engineer



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

Ken Froese, P.Eng.
Associate | Senior Geotechnical 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.

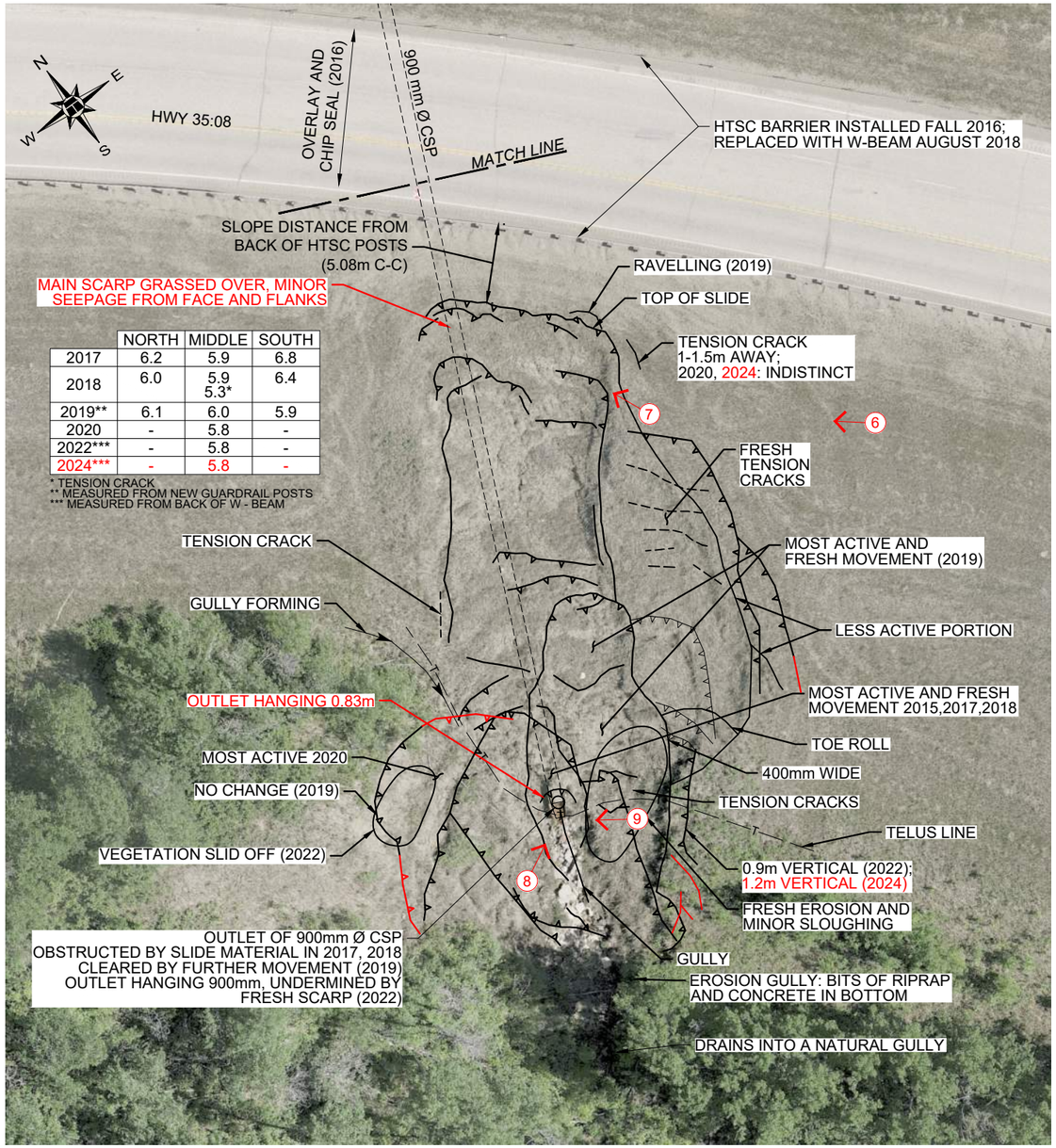
d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted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

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

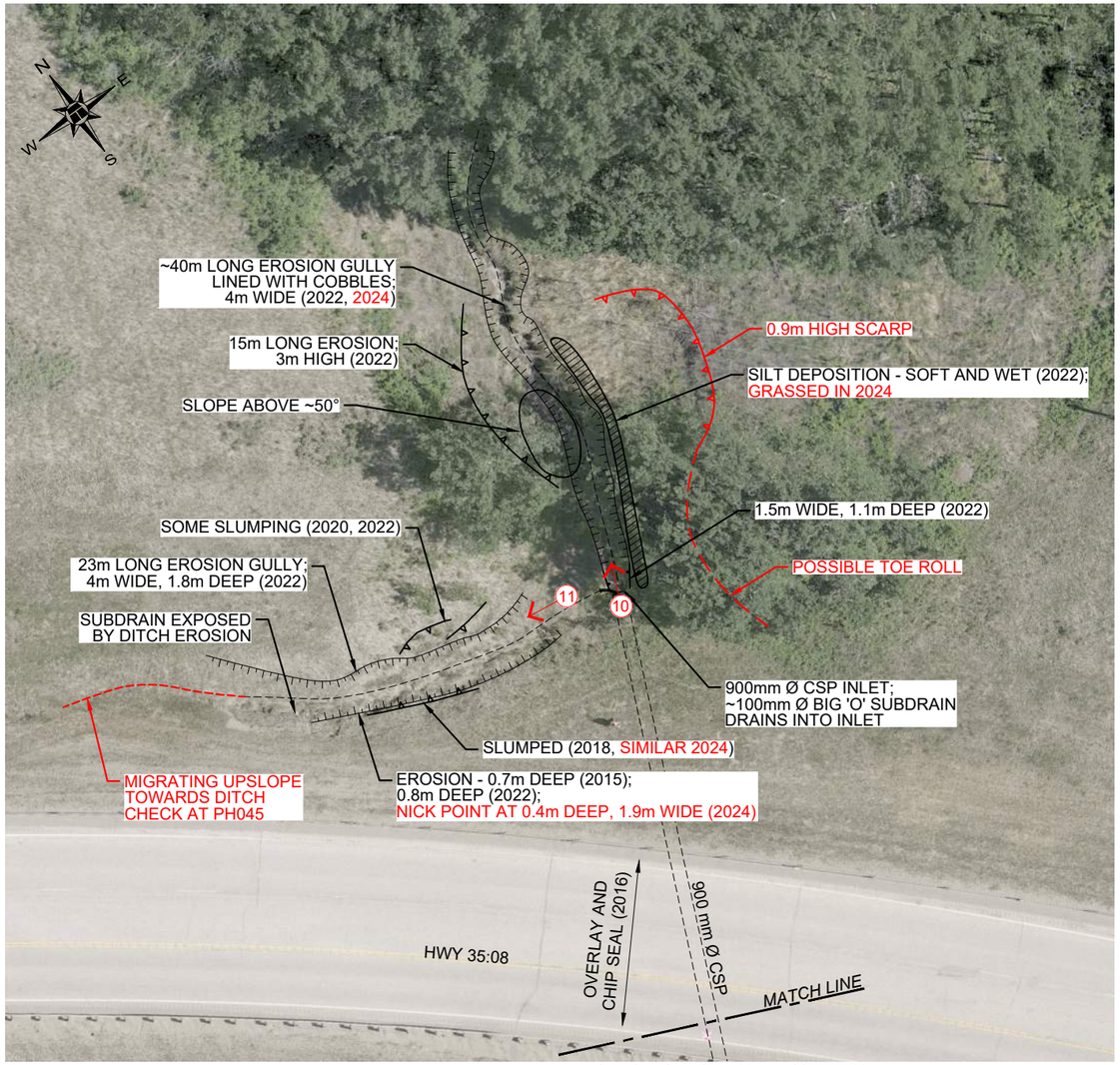
The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or 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.



	NORTH	MIDDLE	SOUTH
2017	6.2	5.9	6.8
2018	6.0	5.9 5.3*	6.4
2019**	6.1	6.0	5.9
2020	-	5.8	-
2022***	-	5.8	-
2024***	-	5.8	-

* TENSION CRACK
** MEASURED FROM NEW GUARDRAIL POSTS
*** MEASURED FROM BACK OF W - BEAM

SOUTH SITE PLAN
SCALE 1:400



NORTH SITE PLAN
SCALE 1:400

UAV ORTHOIMAGE FLOWN BY McINTOSH PERRY IN 2023

LEGEND
- SLIDE BACKSCARP
- (1) PHOTO AND DIRECTION

NOTES
1. SEE DWG No. 32121-PH044-2-1 FOR SITE MAP AND SITE LOCATION PLAN
2. FEATURE LOCATIONS ARE APPROXIMATE.
3. PREVIOUS OBSERVATIONS SHOWN IN BLACK AND RESET IN 2018
4. MAY 2024 OBSERVATIONS SHOWN IN RED

0 5 10 15 20 25m
SCALE 1:400

Alberta

PEACE REGION (PEACE RIVER / HIGH LEVEL)

PH044-1: HWY 35:08 - MEIKLE RIVER km 26.14, SLIDE AREA A
2024 GEOHAZARD ASSESSMENT

DWG No. 32121-PH044-1-1

DRAWN BY	KLP
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	1:400
DATE	OCTOBER 2024
FILE No.	32121

THURBER ENGINEERING LTD.

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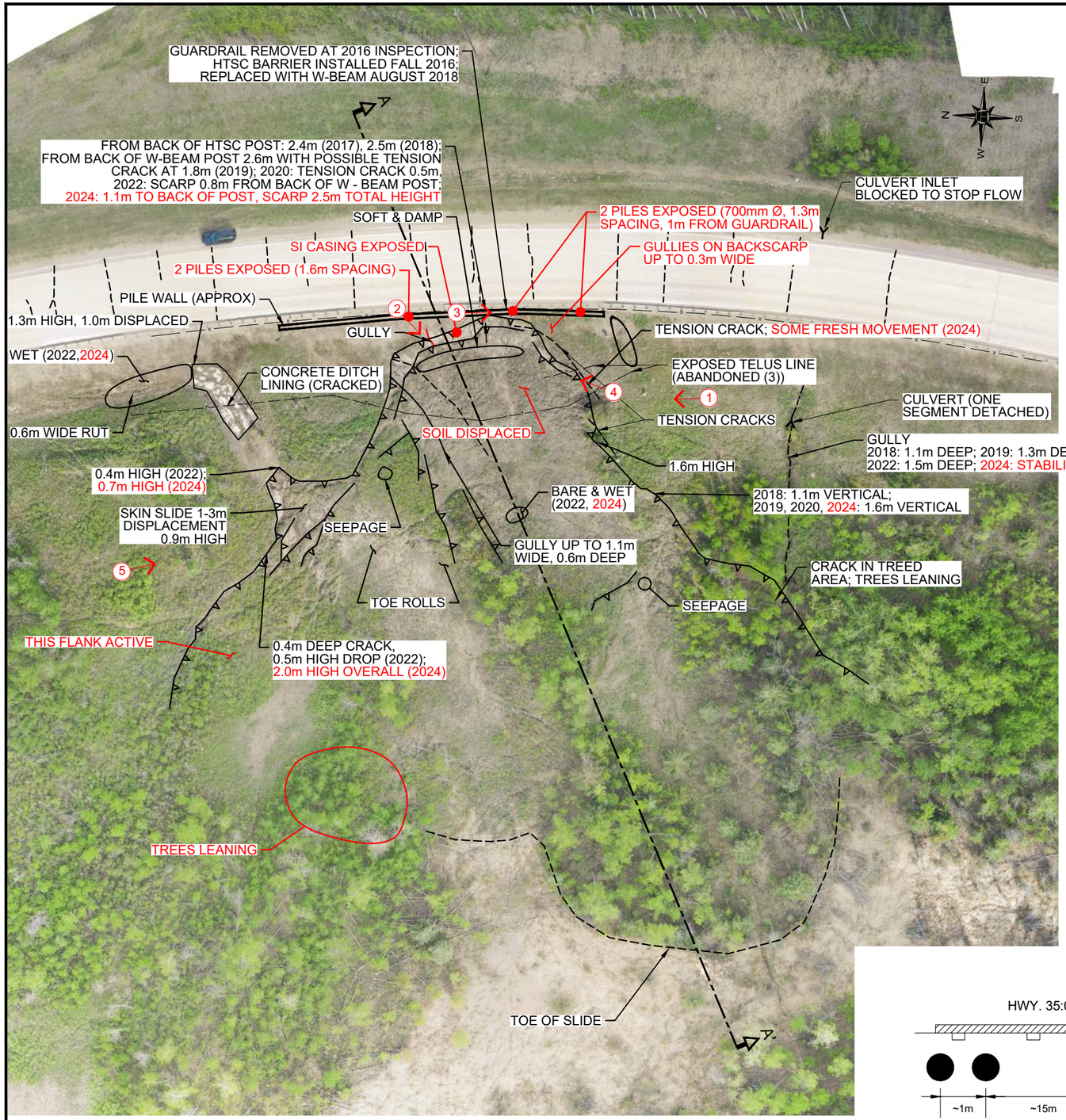


SITE PLAN
SCALE 1:750

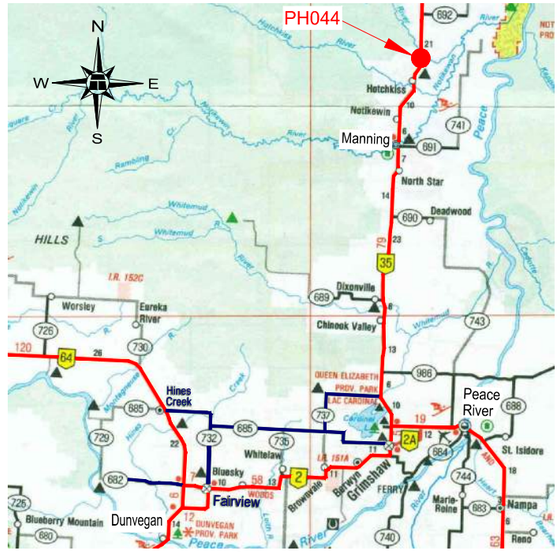
0 10 20 30 40 50m
SCALE 1:750

LEGEND

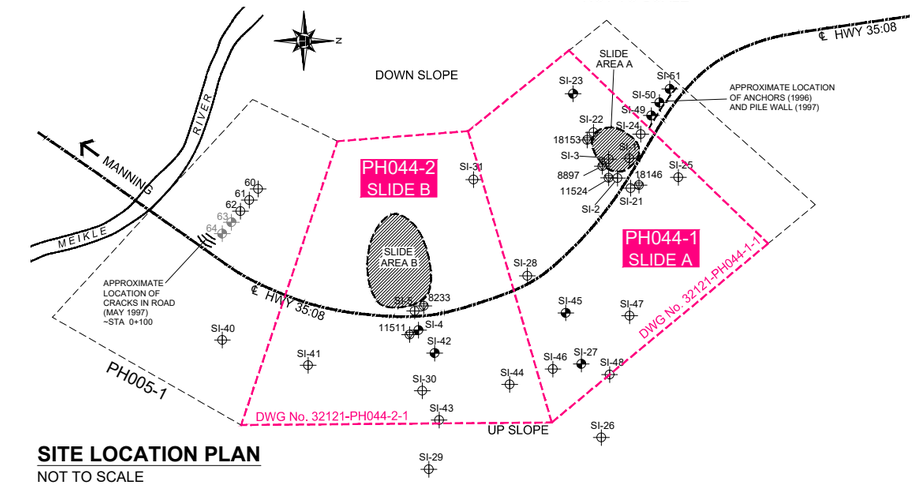
- SLOPE INCLINOMETER *(currently using)*
- SLOPE INCLINOMETER *(not in use)*
- PIEZOMETER *(not in use)*
- SLIDE BACKSCARP
- (1) PHOTO AND DIRECTION

NOTES:

1. SI's 40-48 INSTALLED JULY 1996
2. SI's 49-51 INSTALLED DEC. 1997
3. FEATURE LOCATIONS ARE APPROXIMATE.
4. PREVIOUS OBSERVATIONS SHOWN IN BLACK
5. MAY 2024 OBSERVATIONS SHOWN IN RED

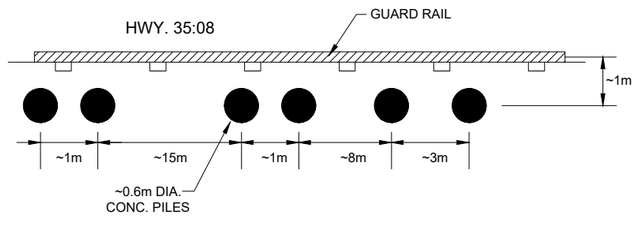


SITE MAP
NOT TO SCALE



SITE LOCATION PLAN
NOT TO SCALE

UAV ORTHOIMAGE FLOWN BY THURBER 2024



PILE WALL SCHEMATIC
NOT TO SCALE

Alberta

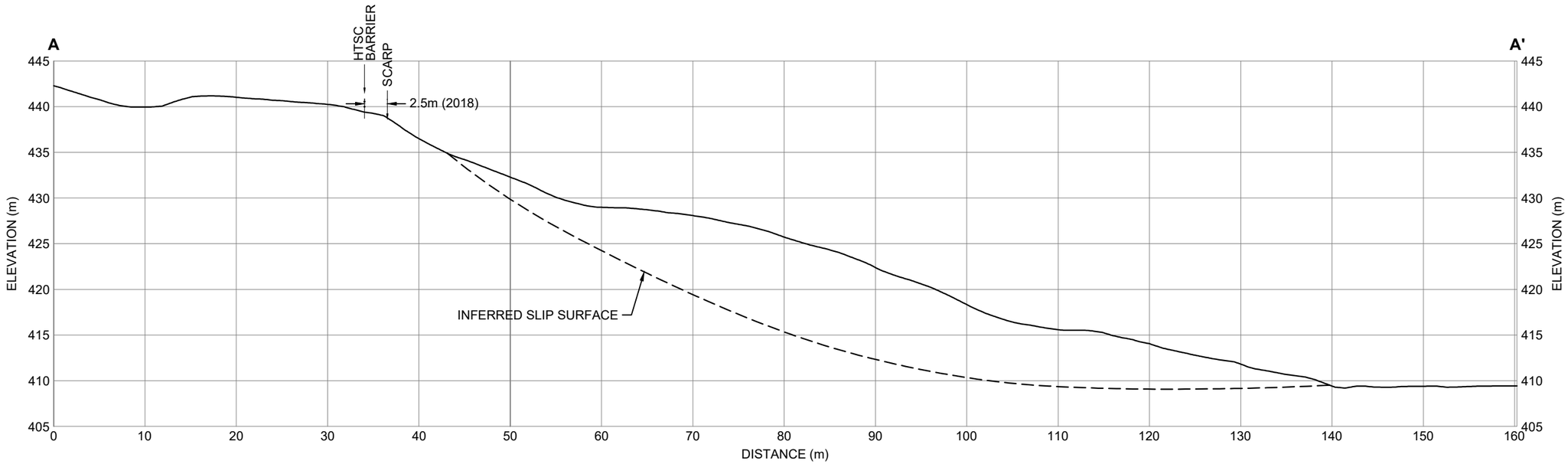
PEACE REGION (PEACE RIVER / HIGH LEVEL)

PH044-2: HWY 35:08 - MEIKLE RIVER km 25.82, SLIDE AREA B
2024 GEOHAZARD ASSESSMENT

DWG No. 32121-PH044-2-1

DRAWN BY	KLP
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	AS SHOWN
DATE	SEPTEMBER 2024
FILE No.	32121

THURBER ENGINEERING LTD.



NOTE:
1. GROUND PROFILE FROM LIDAR DATA (DATE UNKNOWN) PROVIDED BY ALBERTA TRANSPORTATION

PEACE REGION (PEACE RIVER / HIGH LEVEL)

PH044-2: HWY 35:08 - MEIKLE RIVER km 25.82, SLIDE AREA B
2018 GEOHAZARD ASSESSMENT

DWG No. 13351-PH044-2-2

DRAWN BY	ML
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	1:500
DATE	DECEMBER 2018
FILE No.	13351

THURBER ENGINEERING LTD.

H:\13000\13351 Geohazard Assessment - Peace River\High Level (CON0017602)\Drafting\2020\KEF\13351 PH044-2-1.dwg - PH44-1 (2) - Jun. 15, 2010

Photo 1 – Slide B: Backscarp and highway, looking north.

Photo 2 – Slide B: View of slope failure and landslide block, looking southwest.

Photo 3 – Slide B: Looking south at the south half of the backscarp including two recently-exposed piles in the foreground near the guardrail.

Photo 4 – Slide B: View of backscarp looking north.

Photo 5 – Slide B: Looking south at the developing extension on the north side of the landslide.

Photo 6 – Slide A: Looking northwest at the embankment sideslope.

Photo 7 – Slide A: Looking north at the embankment sideslope.

Photo 8 – Slide A: Looking east at the toe of the embankment.

Photo 9 – Slide A: Looking northwest across hanging culvert outlet and knoll beyond where some vegetation has slumped off the face.

Photo 10 – Slide A: Looking northeast at erosion gully north of the culvert inlet. Note fresh silt deposit in 2022 on the right-hand side has become grassed.

Photo 11 – Slide A: Looking north at an erosion gully in sideslope draining towards culvert inlet.