

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



Site Number	Location	Name	Hwy	km
PH031	Judah Hill	Michelin Slides	744:04	57.664
Legal Description		UTM Co-ordinates (NAD 83)		
NE¼ 20-083-21 W5M		11V E 483226	N 6229678	

	Date	PF	CF	Total
Previous Inspection:	May 17, 2023	13	7	91 (Slide Risk Rating)
Current Inspection:	May 28, 2024	13	7	91 (Slide Risk Rating)
Road WAADT:	840		Year:	2023
Inspected By:	Tyler Clay, Cole Szakacs (Thurber). Rocky Wang, Robert Senior (TEC)			
Report Attachments:	<input checked="" type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input type="checkbox"/> Maintenance			

Primary Site Issue:	Slope instability affecting road and downslope area, including a 50 m wide slide at km 57.8 during the summer of 1997. In 1997, the highway was shifted into the hill on a lightweight (shredded tire) embankment and the west side was buttressed with a tied-back pile wall. Shear key, toe buttress and lightweight shredded tire fill slide repairs were carried out in 1998. Cracking and continued movement was noted at the south end of the site. Additional slope movement was noted at north end of site, between the km 57.8 slide and the repairs conducted for the 'Makeout Slide'. New slide movement was noted on the east side of Hwy 744 towards the Heart River since 2014. Landslide activity is now occurring in opposing directions, leaving the road on a narrow ridge.		
Dimensions:	KM 57.8 slide – 50 m to 70 m wide. Slide movement now extending between Michelin and Makeout slides, suggesting a much larger slide zone possibly 500 m wide and extending downslope towards the Peace River. The backscarp of the slide in the Heart River Valley is about 120 m wide along the ATCO Gas pipeline right-of-way (line abandoned and partially removed within the slide area).		
Date of any remediation:	1997 – realignment and embankment construction with lightweight fill. 1998 – shear key, toe buttress and lightweight fill.		
Maintenance:	Highway was closed from May to December 2013 due to the Sunshine Landslide failure at km 58.2 and no maintenance has been performed since then other than ancillary work performed in the surrounding areas as part of Contract CON0015153, such as the regrading of the NBL ditch, the profiling of the inlet to the 2005 NBL ditch subdrain pipe and the grading of the landslide scarp feature below the 1997 pile wall below the SBL.		
Observations:	Description:	Worsened?	
		Yes	No
<input checked="" type="checkbox"/> Pavement	Cracks in the road at km 57.65 were similar to the 2023 pavement condition but there was some increased settlement at the road shoulder. The dip across the road at km 57.83, just north of cracking near SI 10-07 did not have significant change compared to the 2023 conditions. (Photos 1 and 7).	<input type="checkbox"/>	<input checked="" type="checkbox"/>

<input checked="" type="checkbox"/> Slope Movement	<p>The west upper sideslope had no major visible changes (Photos 8 and 9). At the old pile wall maximum soil drop was unchanged from the 2023 condition and measured up to 1.8 m below top of pile (Photo 5).</p> <p>Some more movement was visible (relative to the 2023 condition) at the slide located on the lower valley slope on the west side, offset approximately 70 m from the road (Photo 9).</p> <p>Active erosion within the backscarp and ongoing minor movement within disturbed slide mass at the landslide through the ATCO R/W towards the Heart River. No major retrogression or expansion was apparent within the main scarp. Increased buildup of soil beneath the vertical, southernmost segment of the scarp. Similar visible changes as per the 2023 inspection. (Photo 4)</p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> Erosion	<p>Erosion damage appeared worse (deeper) in the east ditch between km 57.675 and 57.75 (Photo 2).</p> <p>Erosion gully from drainage off the road near km 57.75 was expanded relative to the 2023 condition (Photo 3).</p> <p>Erosion rill has formed downslope of the old pile wall due to concentrated runoff from the road near km 57.8 (Photo 5).</p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Seepage		<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Bridge/Culvert		<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Other		<input type="checkbox"/>	<input type="checkbox"/>

Instrumentation:

Instruments were read on May 22, 2024.

- SI98-10i (installed at the toe of Michelin Slide repair) - Movement rates are between 0 to 2 mm/yr within six distinct shear planes. Movement rates have fallen since 2021 where a maximum rate up to 13.5 mm/yr was measured around 25 m depth.
- SI94-43i (installed approximately 450 m downslope of the road, approximately 100 m below road elevation) - Not read during the Spring 2023 readings. The Spring 2021 readings showed no discernible movement.
- SI10-4 (installed on the east / Heart River side of highway) - SI10-4 showed rates of movement below 2.0 mm/yr since Fall 2023. The movement is in the direction of the active landslide in the Heart River valley slope. SI10-5 is sheared at 2.1 m depth (2011) and SI10-6 is sheared at 3 m depth (2014).
- SI10-7 (installed on the crest of slope west side of the road) - SI10-7 showed rates of movement below 2.0 mm/yr within three movement zones since the fall of 2023 readings. Reduced movement rates have generally been observed since 2020.
- SI10-8 – SAA - (installed on the crest of slope west side of the road) - The manual readings for SAA10-8 showed an incremental movement of approximately 1.0 mm over 15.0 m to 16.5 m depth since the fall of 2023 readings, corresponding to an average rate of movement just below 2.0 mm/yr over this zone. The overall trend of movement in the SAA seems to indicate that the average movement rate in the instrument has decelerated since the beginning of 2018, compared

to the first three years of measurements. The battery powering the SAA's datalogger was found to be stolen in 2020 but was replaced during the Spring 2023 readings.\

- SI10-9 - (installed on the crest of slope west side of the road) - SI10-9 showed rates of movement at or below 1 mm/yr over 6.5 m to 7.7 m depth and over 11.9 m to 14.4 m depth since the fall of 2023 readings. Reduced rates of movement have generally been measured since 2013.
- Three pneumatic piezometers (PN10-4, PN10-8, and PN10-9) showed decreases in groundwater level between 0.01 m and 0.88 m since the fall of 2023 readings. PN10-6 and PN10-7 showed increases in groundwater level of 0.52 m and 0.78 m, respectively, since the fall of 2023 readings. Vibrating wire piezometer VW17-1 showed a decrease in groundwater level of 0.20 m since the fall of 2023. VW17-2 has been dry since initialization.
- Shear Wave Guide Trail adjacent to SI10-8 (2013) – No longer actively monitored. Refer to paper *Nancy Berg et al "Correlation of Acoustic Emission with Patterns of Movement in an Extremely Slow Moving Landslide at Peace River, Alberta, Canada", dated Feb.6, 2018.*

Assessment (Refer to Drawings PH031-1):

Continued landslide creep near the km 57.8 repair is expected to be ongoing however damage to the highway has not significantly worsened. Minor erosion damage is occurring in localized areas.

Slope movement in the area west of the highway between the Michelin and Makeout landslides is ongoing at similar or slightly reduced rates that have been measured and observed in the past. Water being shed off the road on the inside of the bend may be contributing to the problem. Cracking and slope movement downslope of the pile wall is ongoing at similar or slightly reduced rates. The existing pile wall is still providing some support to the highway. The instruments on the west side of the highway show ongoing movement at rates previously observed or slightly reduced.

Intermittent movement and active erosion within the backscarp of the slide that is moving toward the Heart River indicates that the road is at risk from both eastward and westward movement. No accelerating movement trends were measured at S10-4 indicating a slide plane has not retrogressed further towards the highway beyond the visible scarp. As first mentioned in 2012, there is no room to move the road at this location and because of the severity and rapidity of movement, design for a pair of tied-together retaining walls should be conducted to limit the extent of work required.

Recommendations:

Monitoring:

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

Maintenance:

- The battery powering the SAA in SI10-8, VW17-1 VW17-2 and the datalogger for these instruments was replaced in Spring 2023 with a smaller battery. The battery for this datalogger has been stolen twice, so a more secure enclosure and battery system should be considered to prevent future thefts.
- Granular fill should be used to fill the upper erosion gully near km 57.75 to reduce rates of further pavement and guardrail post undermining.
- Class 1M riprap should be added to the east ditch to reduce rates of erosion between km 57.675 and 57.75. Alternatively, the ditch should be cleaned out, regraded, and have ECB and synthetic check dams installed. Existing rock can be salvaged and placed back around the outlet and inlet areas of the culverts.

Long-term Measures:

- Long-term repair using ~ 230 m of tied back retaining walls. Approximately 80 m would be required on the Heart River side and 150 m on the Peace River side, extending south from the km 58 wall. (\$13M - \$15M)

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

Tyler Clay, P.Eng.
Geological 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.

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.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

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.

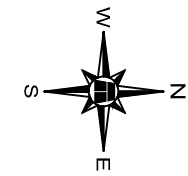
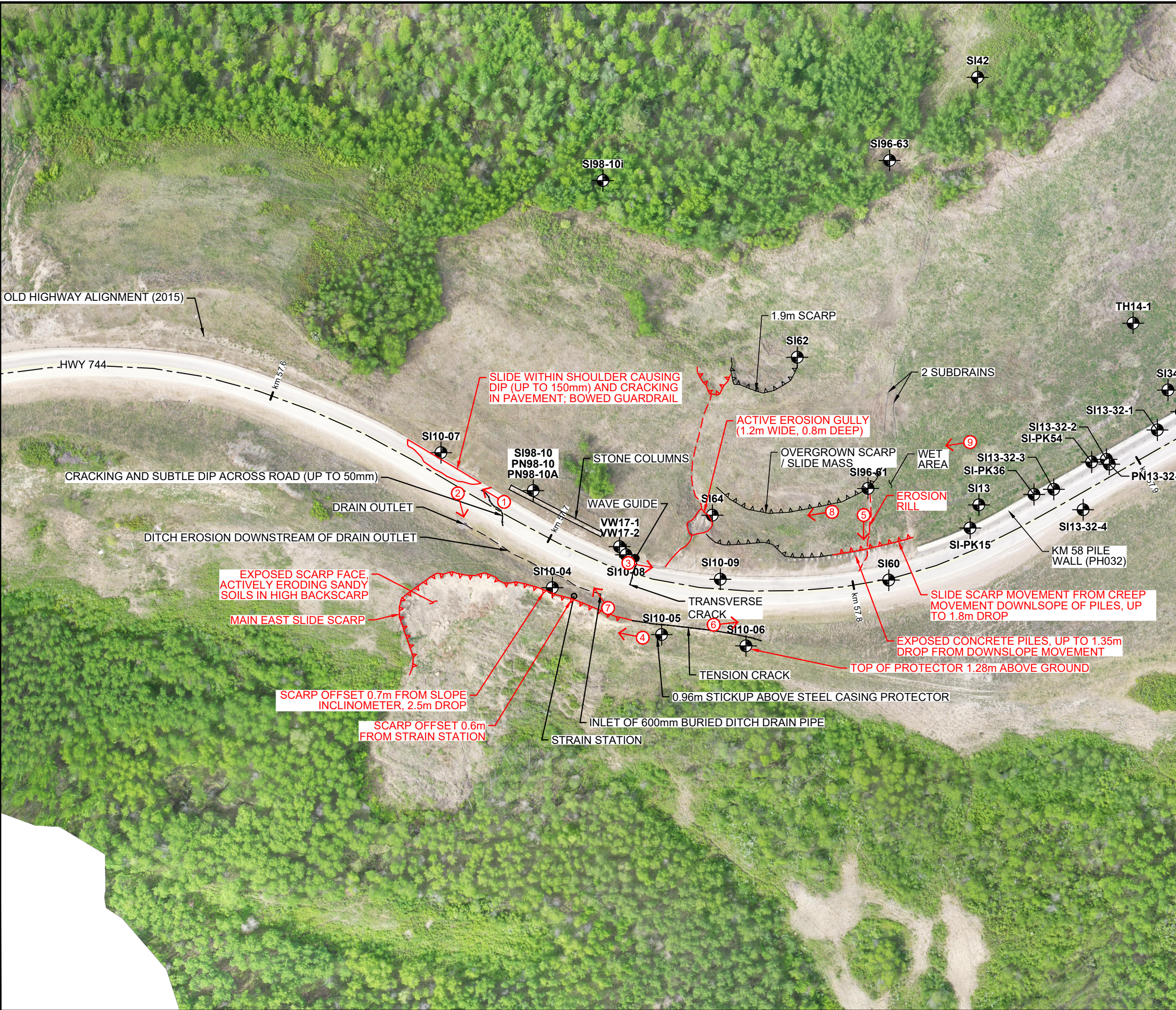
6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

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.

G:\32000\32121 AT GRMP Peace River District 2021-2025\CAD\2024\TTC\32121-PH031-1.dwg - Layout1 - Sep. 30, 2024

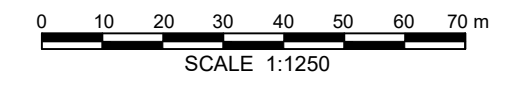


LEGEND

-  APPROXIMATE INSTRUMENT LOCATION
- SI** SLOPE INCLINOMETER
- VW** VIBRATING WIRE PIEZOMETER
- PN** PNEUMATIC PIEZOMETER
-  DIRECTION AND NUMBER OF PHOTO

NOTES:

1. SITE FEATURES ARE APPROXIMATE AND DRAWING WAS RESET IN 2024. CONSULT 2023 DRAWING FOR HISTORICAL INFORMATION
2. MAY 28, 2024 OBSERVATIONS SHOWN IN RED
3. 2024 ORTHOMOSAIC DERIVED FROM UAV IMAGERY FLOWN BY THURBER IN MAY 2024



PEACE REGION (PEACE RIVER DISTRICT)

**PH031-1 MICHELIN SLIDES
2024 SITE INSPECTION PLAN**

DWG No. 32121-PH031-1

DRAWN BY	KLP
DESIGNED BY	TTC
APPROVED BY	DWP
SCALE	1:1250
DATE	SEPTEMBER 2024
FILE No.	32121





Photo 1.
Looking southwest along the centerline of Hwy 744:04 at km 57.65 near the north end of the 2014-2015 realignment. Cracks have not significantly expanded but localized settlement (estimated up to 150 mm) is more apparent at the shoulder relative to the 2023 condition.



Photo 2.
Looking northeast along the east ditch near km 57.65 where there is ongoing ditch erosion that has become slightly worse since 2023.



Photo 3.
Looking north at gully erosion on the west side of the highway near km 57.75. The gully is up to 1.2 m wide and 0.8 m deep and is slightly worse from the 2023 condition.



Photo 4.
Looking south along the landslide backscarp at the top of the Heart River valley on Hwy 744:04 at km 57.85. There was a slightly larger buildup of soil at the base of the vertical scarp, indicative of ongoing erosion but no major lateral expansion or retrogression towards the highway since 2023.



Photo 5.
Looking north along the west side of Hwy 744:04 at protruding piles near km 57.9. Max drop of 1.8 m below top of pile (unchanged since 2023). An erosion rill has formed from runoff between the piles.



Photo 6.
Looking north along the east side of Hwy 744:04 at km 57.8 and upslope of the landslide movement towards the Heart River. No new cracks were apparent in the pavement or ditch area upslope from the backscarp.



Photo 7.
Looking southwest along Hwy 744:04 from km 57.85 at the crack and dip across the road. No significant visible change from the conditions observed in 2023.



Photo 8.
Looking south near km 57.8 along the west side slope of the below the highway with active gully erosion and old, vegetated slide scarps. No major visible difference in the slide terrain within the upper slope relative to the 2023 condition.



Photo 9.
Screen capture from the 2023 drone photogrammetry model looking south towards the west slope below the highway near km 57.85. Recent slide activity is most apparent within the earth flows in the lower slope.