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

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy	km
PH006-1	North of Paddle Prairie	Tompkins Landing	697:02	16.97-17.62
Legal Description		**UTM Co-ordinates**		
NW30-103-19-W5M / E25-103-20-W5M		11U E 491,100	N 6,425,466	

	Date	PF	CF	Total
Previous Inspection:	28-Apr-2022	11	4	44
Current Inspection:	26-Jun-2024	12	5	60
Road AADT:	270		**Year:**	2023
Inspected By:	Don Proudfoot, Thurber		Robert Senior, TEC	
Report Attachments:	☑ Photographs	☑ Plans	☐ Maintenance Items	

Primary Site Issue:	Deep-seated, valley wall slope movements	
Dimensions:	500 m of highway affected by, or adjacent to, active movement.	
Date of Remediation:	None	
Maintenance:	2004: Overlay of highway 2006: Silt fence repair at the west end of the site 2010: Asphalt patch over southwest portion 2015: Asphalt patch (50m long) 2017: Gravel placed along north shoulder and asphalt patch on road 2020: Asphalt patching, 150t	
Observations:	**Description**	**Worsened?**
☑ Pavement Distress	Diagonal cracks and dips in the road over the slide blocks increasing in width and differential, especially Crack B. Cracks at A are forming into a landslide scarp with a dip developing in the shoulder of the highway.	☑
☑ Slope Movement	Ongoing slope movement.	☑
☑ Erosion	Several active erosion gullies in the upslope ditch and below culvert outlets	☑
☑ Seepage	Seepage previously observed from the GBC between Sta. 17+300 and 17+400	☐
☑ Bridge/Culvert Distress	800 mm CSP downpipe in southwest site is being pulled apart by slope movement. Adjacent 600 mm CSP centerline culvert inlet becoming obstructed and invert badly corroded. Inlet of N 600 mm CSP culvert at 17+400 covered with dirt; inlet and outlet of S CSP badly corroded.	☑
☐ Other		☐
Instrumentation (as of Spring 2024):		
Destroyed	SI02-2, -3, -4, and -5 sheared off between 2004 and 2009. PN02-4 was destroyed in 2005, PN02-1 in 2008 and PN02-05 in 2021. SI-1 was blocked or sheared at 3m below ground surface in 2024.	
Inclinometers	SI-5 showed a movement rate of 7.7 mm/yr over 0.1 m to 11.1 m depth since the spring of 2023 readings. This rate is consistent with a long term trendline of the movement rate	

	since 1999. There are periods of time where movement rates exceed or fall short of the long term trendline. Since the fall of 2020 the movement rate is about 19 mm/yr. SI13 showed a rate of movement of 20.4 mm/yr over 1.7 m to 14.5 m depth compared to the overall rate of 13.1 mm/year. From installation in 1998 to the spring of 2020, the overall movement rate was 10.4 mm/yr. Since the fall of 2020, the overall rate has accelerated to 24.8 mm/yr. This accelerated movement coincides with the acceleration observed in SI-5 and an increase in groundwater level as noted below. Based on previous instrument readings and site observations, it appears that the two operational SIs at this site were installed too shallow to intercept the main slip surface of the slide but are, nonetheless, moving significantly within the overall slide blocks.
Piezometers	The groundwater level decreased in pneumatic piezometer PN02-3 by 0.25 m since the spring of 2023. PN02-3 had shown a trend of increasing groundwater levels since the fall of 2020 readings; however, the current readings are still within the historic range of the instrument.

Assessment:

The highway is situated on a deep-seated rotational slide. This large-scale movement is likely based in clay shale bedrock near the bottom of the river valley with the slide initially triggered, and kept moving, by river erosion at the toe of the slope. TEC personnel have indicated that the slide seems to accelerate when river levels are low. There may also be contribution from water-bearing sand and gravel layers providing water to the slip surface further reducing the shear strength of the soils. Through this site, the depth of the shear plane seems to be 20 m or deeper with intermediate scarps creating graben features. It is anticipated that this large-scale slide will continue to move with rates dependant on seasonal rainfall and the water level in the river. As the movement is deep-seated, remediating the slide will be difficult and may be limited to controlling localized issues. As shown on the drawings, there continues to be ongoing deterioration of the site. Erosion of the north ditch is an ongoing occurrence despite past regrading efforts using gravel fill. A sinkhole has formed over one of the culverts at Sta. 17+400. The slide movements are also creating increasing undulation of the pavement surface.

An interpretation of the major landslide blocks and movement directions is shown on Dwg. 32121-PH006-1-2.

Slide movements have accelerated this month prompting the request for this call-out due to concerns by the MCI (Paul Catt) about the pronounced drop in the pavement downhill of Crack B. During the call-out visit, cracks and a depressed shoulder at Location A suggest that a landslide block is retrogressing into the shoulder of the highway at this location.

Recommendations:

Immediate Term:

It is understood that the immediate concern to TEC is that the ferry is scheduled to open soon and there are safety concerns about opening the roadway to traffic due to the recent more-aggressive movements creating the sharp drop off across the road surface at Location B. The usual approach to deal with this, from a maintenance point of view, would be to add more asphalt on the downhill side of the crack to temporarily level out the road surface; however, the MCI has correctly raised concerns about adding additional load to the moving landslide block. To address the immediate need to open the road, it is recommended to cut down the highway starting with zero at a point of 15 m uphill of Crack B to a maximum depth of about 0.5 m right at the crack to remove the hump that has been created by the drop off on the downhill side. This will involve removing about 15 m of pavement on the uphill side and 5 m of pavement on the downhill side. The cut will likely expose the road subgrade so the subgrade will need to be subcut to allow room for new GBC and ACP to patch the cut section. TEC's records indicate that the pavement structure at this site consists of 100 mm of ACP over 300 mm of GBC in undisturbed/unaltered areas. Alternatively, this section could be left with just a gravel surface if TEC is willing to conduct frequent grading to repair ruts and washboards that could develop due to having a short stretch (20 m long parallel in direction of road centreline) of road turned to gravel. The subcut surface of the subgrade should be sloped toward the river to drain any water away from the road subgrade. Bump warning signs should be placed to warn traffic of the developing hazard at Location A. If this area subsides more rapidly consideration could be given to temporarily widening the north shoulder of the highway partly into the ditch and placing delineators around the affected area.

Short to Medium Term:

Until long-term repairs can be made, the hill section of the highway could be converted to gravel so that ongoing slide movements could be graded out (with a grader) to maintain a smoother road surface. The current road surface has some severe undulations because of slide movements over several years, so the first step would be to survey the road profile and adjacent ditches and design a new profile that is lower than existing (to avoid adding extra load to the slide), smooths out the humps, and corrects the cross-fall. This will also provide an opportunity to fix eroded ditches. This will consist of removing the asphalt and GBC from southwest of Location A all the way to the northeast end near the ferry docking area, completing embankment grading to establish a new subgrade surface, and then placing back surfacing gravel. The ditches should be graded and then lined with erosion control products consisting at a minimum of TRM and synthetic ditch barriers plus riprap at each inlet and outlet of the culverts, after backfilling the downhill erosion gullies. The culverts should also be replaced, and the downpipe should be fixed. Excess material should be removed offsite to a flat-lying stable location away from the valley. The asphalt will need to be disposed in an environmentally friendly manner, such as at a recycling plant or landfill.

A pile wall (possibly driven steel) should be installed along the edge of the highway to support the roadway along retrogressing slide at Location A.

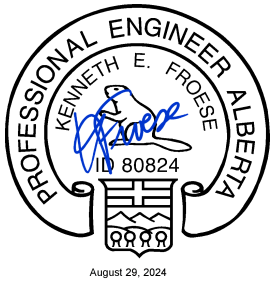
Long-Term remediation options:

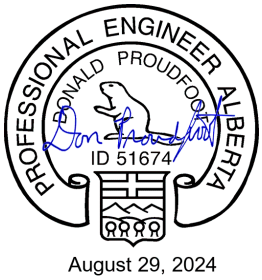
A major re-alignment of the valley section of the highway that avoids landslide areas or is designed to better deal with them (such as going perpendicular down the valley with a big cut to unload the crest and stabilization measures to buttress the bottom of slope) would be the best long-term solution. It is understood that there is consideration being given to constructing a bridge over the river to replace the ferry and that some preliminary planning has been completed to select a more stable route.

Closure

It is a condition of this report that Thurber's performance of its professional services will be subject to the attached Statement of Limitations and Conditions.

Don Proudfoot, M.Eng, P.Eng.
Partner | Senior Geotechnical Engineer





PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE: Don Proudfoot
RM APEGA ID #: 51674
DATE: August 29, 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

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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

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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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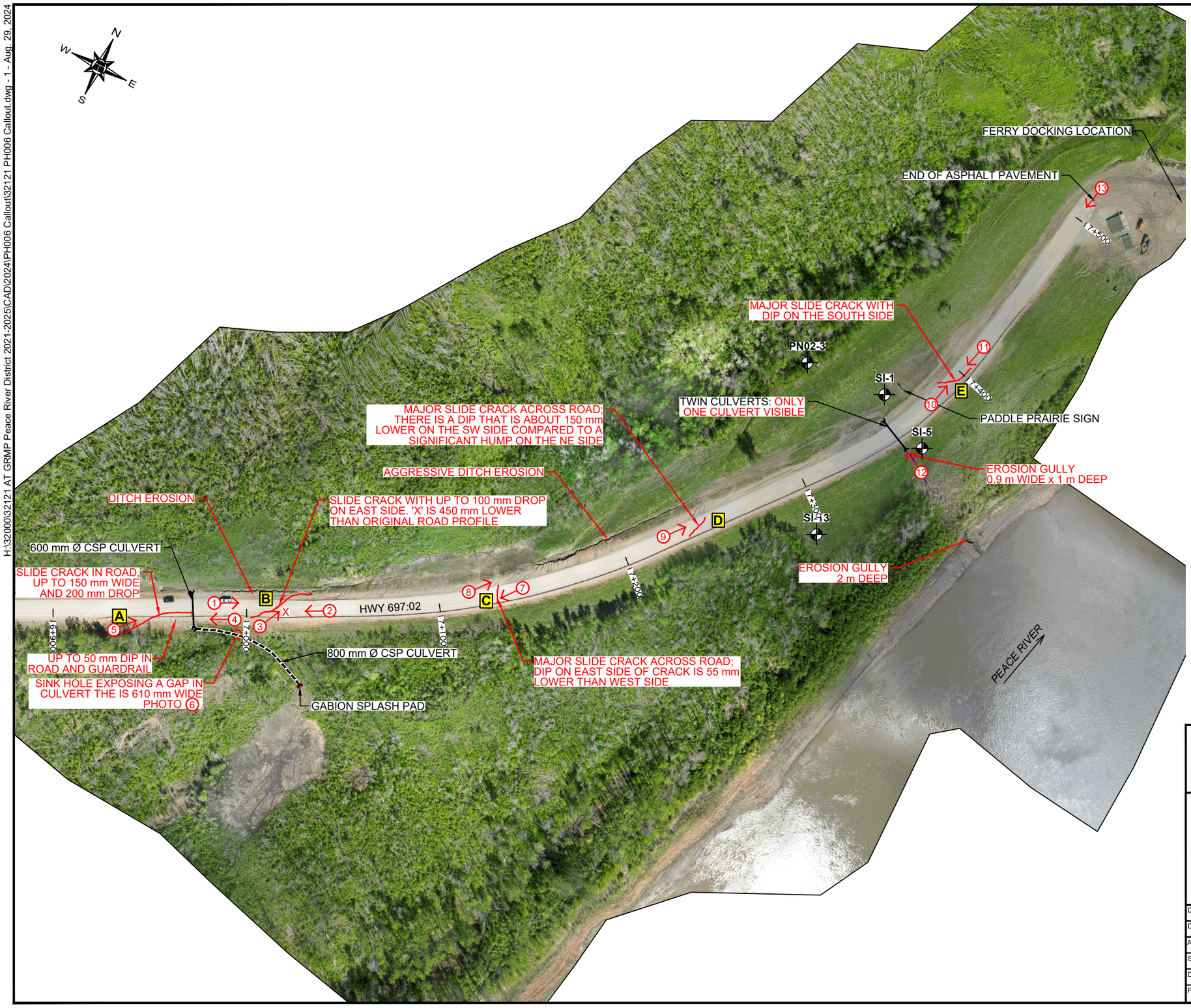

LEGEND

- SLIDE CRACK IN ROAD
- CULVERT DOWNPIPE
- GEOTECHNICAL INSTRUMENT
- (1) DIRECTION AND NUMBER OF PHOTO

NOTES:

1. AUGUST 26, 2024 OBSERVATIONS SHOWN IN RED.
2. 2024 ORTHOMOSAIC DERIVED FROM UAV IMAGERY FLOWN BY THURBER IN MAY 2024

0 20 40 60 80 100 120m

SCALE 1:2000

Alberta

PEACE REGION (PEACE RIVER/HIGH LEVEL)
PH006-1: HWY 697:02 - TOMPKINS LANDING SLIDE

SITE PLAN SHOWING SITE OBSERVATIONS ON AUGUST 26, 2024

DWG No. 32121-PH006-1-1

DRAWN BY	KLP
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	1:2000
DATE	AUGUST 2024
FILE No.	32121

THURBER ENGINEERING LTD.

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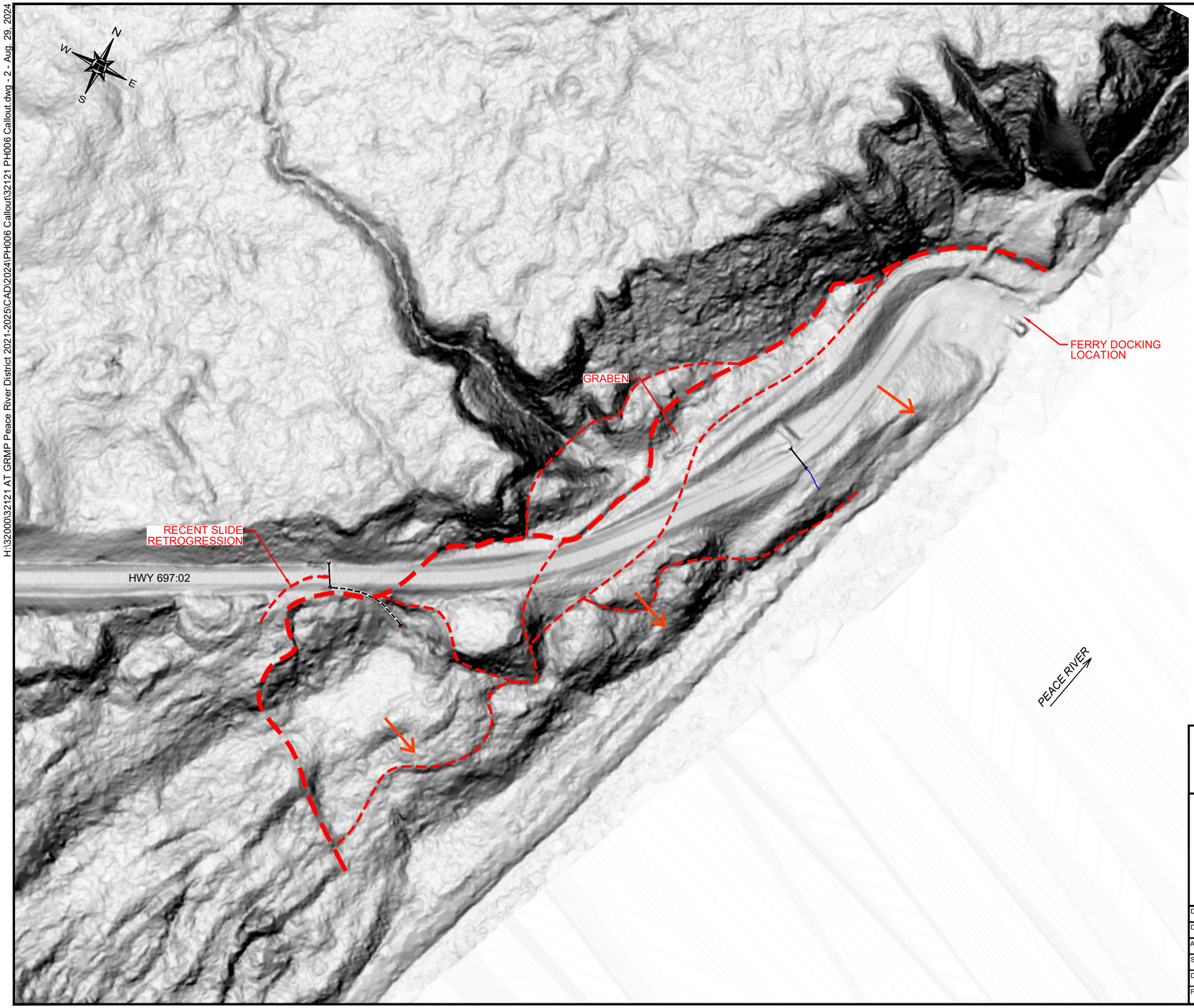

LEGEND

MAJOR LANDSLIDE CRACK

SLIDE MOVEMENT DIRECTION

0 25 50 75 100 150 200 m

SCALE 1:3000

Alberta

PEACE REGION (PEACE RIVER/HIGH LEVEL)
PH006-1: HWY 697:02 - TOMPKINS LANDING SLIDE

SHADED RELIEF PLAN SHOWING MAJOR LANDSLIDE CRACKS AND MOVEMENT DIRECTIONS

DWG No. 32121-PH006-1-2

DRAWN BY	KLP
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	1:3000
DATE	AUGUST 2024
FILE No.	32121

THURBER ENGINEERING LTD.

PHOTOS

Photo 1. Looking NE at slide Crack B.

Photo 2. Looking SW at slide crack B.

Photo 3. Looking north at Crack B.

Photo 4. Looking SW at slide Crack A.

Photo 5. Looking NE at slide crack A.

Photo 6. Separation in C.S.P. downpipe at slide crack

Photo 7. Looking SW at slide crack C.

Photo 8. Looking NE at slide crack C with graben in background.

Photo 9. Looking NE at slide crack D.

Photo 10. Looking north at slide crack E.

Photo 11. Looking south at slide crack E.

Photo 12. Erosion in sideslope downhill of culvert outlet.

Photo 13. Looking south at end of pavement