ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT
PEACE REGION (PEACE RIVER DISTRICT)
2023 INSPECTION

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy	km
PH075-1 PH075-2	North of Peace River	Whitemud River (km 44.4) Whitemud River (km 44.8)	743:02	44.4 44.8
Legal Description		**UTM Co-ordinates**		
NE2-88-21-W5M		11U E 486,395 486,112	N	6,273,737 6273,982

	Date	PF	CF	Total
Previous Inspection:	7-July-2021	PH075-1: 11 PH075-2: 9	4 6	44 54
Current Inspection:	16-May-2023	PH075-1: 13 PH075-2: 8	4 6	52 48
Road AADT:	163		**Year:**	2023
Inspected By:	Max Shannon, TEC Rocky Wang, TEC Pramaya Kannel, TEC		Don Proudfoot, Thurber Ken Froese, Thurber	
Report Attachments:	☑ Photographs	☑ Plans	☐ Maintenance Items	

Primary Site Issue:	PH075-1: Creek bank erosion and slumping of over-steepened slope above culvert inlet. PH075-2: Retrogressive landslide scarp through both lanes	
Dimensions:	PH075-1: 40 m of creek bank erosion PH075-2: 55 m wide along the shoulder, approx. 275 m wide at the creek and 160 m long from the highway to the creek.	
Date of Remediation:	2009: Culvert replaced and sideslopes rebuilt.	
Maintenance:	Highway closed on Jul 13, 2020, until detours opened in Fall 2020.	
PH075-1 Observations:	**Description**	**Worsened?**
☐ Pavement Distress	Highway is gravel-surfaced.	☐
☑ Slope Movement	Slump above culvert regressed significantly in 2018 and continues to move. There is major bank slumping upstream of the culvert and minor bank slumping downstream of the outlet.	☑
☑ Erosion	Slump on the west side of the creek at the inlet has continued to retrogress since 2015; erosion at end of north ditch channel relatively stable. Erosion occurring in east ditch sporadically over 200 m length between km 44.3 to 44.1 south of PH075-1.	☐
☐ Seepage		☐
☑ Bridge/Culvert Distress	No signs of distress in the culvert itself; however, slide movements are obstructing flow at the inlet and sediment is accumulating at the outlet.	☑
☐ Other		☐

PH075-2 Observations:	Description	Worsened?
☑ Pavement Distress	Cracks and dip in gravel road surface are being maintained through routine grading.	☐
☑ Slope Movement	The dip encompasses the entire roadway surface and trees at the toe are leaning	☐
☐ Erosion		☐
☐ Seepage		☐
☐ Bridge/Culvert Distress		☐
☐ Other		☐

Instrumentation:

None.

Assessment:

PH075-1 (Drawing 32121-PH075-1)

Significant landslide movements on both sides of the valley closed the highway in July 2020 until detours where in place in Fall 2020. This site is located on a relatively flatter section of the roadway and was unaffected by these other movements.

The creek bank at the culvert inlet began to regress significantly due to heavy runoff in Spring 2018. The spring of 2020 also had significant runoff and there was an ice jam at this site (reported by MCI). The scarps above the culvert have formed into numerous slump blocks and continue to retrogress and were 2.2 m (slope distance) from the edge of the gravel surfacing (was 2.6 m in 2021, 8.85 m in 2018, and 5 m in 2020). Slumping continues to worsen along the west bank of the creek moving further into the slope since first mapped in 2017. In 2018, the pin installed 2 m upslope of the tension crack was only 0.36 m from the resulting scarp and was shifted 3 m further upslope. The pin was 3.0 m from the scarp in 2019, had to be reset again in 2020, and was lost in 2021. The slumping of the riverbank is undermining the embankment and is causing instability which will impact the highway and has started to impact the culvert obstructing the inlet slightly.

The embankment slope above the riprap was about 2H:1V which is steeper than usual for a slope constructed using clay in this area. This steeper slope will likely result in more rapid retrogression if the channel experiences similar water flows. The ongoing slumping on the west side at the culvert inlet has displaced much of the riprap apron which increases the vulnerability of the slope to future highwater events. Furthermore, the point bar forming on the east side of the channel also concentrates flow into the west bank. This point bar had increased in size noticeably in 2020 and started to vegetate in 2021 and became denser in 2023.

Erosion was previously noted where the north ditch contacts the west bank north of the culvert inlet. The rate of downcutting has slowed with only an additional 0.1 m deeper and wider since 2017. A significant amount of sediment has accumulated at the culvert inlet in 2021 which may be from the progressive downcutting and toe erosion that triggered the slide movements at PH039 and elsewhere in the valley.

The shallow gully that formed at the west side of the top of the outlet riprap has vegetated and did not appear to have increased in size since 2017. This gully has likely formed due to surface runoff short-cutting out of the ditch channel. It was also observed that the displaced riprap from the culvert outlet apron is mounded in the centre of the channel forcing flow around causing the increasing undercut on the east bank. The length of affected bank was slightly longer in 2020 but unchanged in 2021 and 2023.

PH075-2 (Drawing 32121-PH075-2)

The slide at PH075-2 was first noticed during a callout inspection of other sites on Hwy 743 on August 4, 2020, shortly after movements closed the highway. The site is located on a sidehill

alignment ascending the valley slope of a tributary to the Whitemud River. LiDAR provided by TEC shows that the valley slope has been affected by historic landslide movements. Similar to the other sites along this highway that moved during the summer of 2020, it was likely that higher groundwater levels re-activated a large slide block which affected about 55 m of the road surface. The highway is located about 25 m vertically above the creek. The valley slope surface, as shown by the cross-section on Dwg. No.13351-PH075-2, is hummocky, indicating the presence of several retrogressive slide blocks between the creek and the road. The dip encompasses the entire roadway surface at this location and trees at the toe of the embankment are being to tilt. Ongoing grading has obscured the cracks in the highway although the main scarp is still visible on both sides of the highway.

Recommendations:

Short Term:

- The maintenance contractor and/or MCI should review these sites frequently, particularly after significant rainfall events, to ensure that the highway is not impacted by further slumping.
- At Site 2, the cracks and dip are limited in extent and can be managed with routine grading so the road can still be used. Slide warning and speed reduction signs should be considered at this site.

Medium-Term:

- Site 1: A localized realignment to the southwest by about one lane width which allow for slope flattening to the northeast.
- Site 2: A localized realignment to the west of the roadway around the slide could be carried out if the slide accelerates and the road condition becomes unsafe.
- Site 2: A driven steel pile wall might also be considered to provide temporary support to the road but might become distorted over time if the larger slide blocks move again.

Long-Term:

- Site 1: The steep embankment slope above the culvert inlet needs to be stabilized. As the slope is now failing, it should be rebuilt with geogrid-reinforced granular material. The stream channel should be realigned through the point bar to reduce erosion pressure of the highway embankment. A stability analyses should be undertaken to assess the potential effectiveness of these measures.
  - Alternatively, the extent of slope reconstruction would be reduced by lowering the roadway over the culvert to flatten the slopes.
- Site 1: The mound of riprap downstream of the outlet should be redistributed to create a flow path down the centre of the channel rather than the unprotected sides.

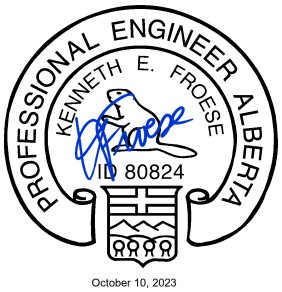
Ongoing Investigation:

- It is recommended that the annual Geohazard inspection should continue as scheduled every two years.

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.

Tarek Abdelaziz, Ph.D., P.Eng.
Partner | Senior Geotechnical Engineer



PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE: _____
RM APEGA ID #: 91085
DATE: October 10, 2023
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

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

THURBER

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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.

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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.

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FLOW

BOTTOM OF BANKS

EXPOSED RAVELLING SLOPE

EROSION SCOUR
RETROGRESSED (2014)
NO CHANGE (2015)
SLIGHT CHANGE (2016)

EROSION CONTROL SOIL COVERING
TYPE C AS PER DETAIL BELOW

BARE SLAKING BANK;
MORE EROSION (2019)

NOTE: LARGE ICE JAM IN SPRING 2020

NE 2-88-21W5M

N
W E
S

0.5m DEEP SCOUR AT NICK POINT (2016);
1m DEEP (2017); 1.1m (2018, 2019);
0.3m AS VERTICAL PART ERODING (2020);
0.7m (2023)

1m HIGH

RETROGRESSED IN 2019

WILLOWS

SILT DEPOSIT
(SPRING 2020 FLOOD)

POINT BAR DEFLECTING FLOW TOWARDS OPPOSITE BANK
MORE DEPOSITION ~1m HIGH, 2-3m WIDE (2020), BECOMING VEGETATED (2021)

0.9m HIGH (2021, 2023)

REFERENCE PIN
(SEE TABLE)

RIPRAP SLUMPED INTO CREEK CHANNEL

SILT DEPOSIT

FURTHER SLUMPING (2017)

POSSIBLE TOE OF ANCIENT LANDSLIDE

TH06-2A

1.1m SLUMP

TOE OF SLIDE PARTIALLY BLOCKING CULVERT (2019);
ERODED BY SPRING 2020 FLOOD

0.9m VERTICAL DROP (2018); 1.6m VERTICAL DROP (2019)
0.8m VERTICAL DROP AS ERODED (2020); 1.2m SCARP (2021,2023)

0.7m HIGH

8.85m (2018); 5.0m (2019)
5.0m, 1.2m HIGH (2020)
2.6m TO TENSION CRACK, 1.0m HIGH (2021)
2.2m TO TENSION CRACK (2023)

SLUMP CRACKS STARTING
TO FORM (2013)
(SAME IN 2014, 2015)

HWY 743

TH06-1A

0.4m HIGH (2012, 2023)

R.O.W.

BF77272-2 (2009)
3.67m Ø, 84.25m LONG

EROSION CONTROL
SOIL COVERING TYPE C
AS PER DETAIL BELOW

TH06-3A

SHALLOW GULLY
2018-2020: BECOMING GRASSED

UNDERCUT 0.7m VERTICAL FACE (2018)
1.0m VERTICAL AND 4.7m LONG (2019)
0.8-1.0m VERTICAL AND 6.2m LONG (2020); SAME (2021, 2023)
-LIKELY CAUSED BY DISPLACED ROCK FROM APRON

CLASS 2 ROCK RIPRAP

BOTTOM OF BANKS

TOP OF BANK

TOP OF BANK

SHALLOW GULLY (0.6m WIDE, 0.4m DEEP) - 2014
(1.2m WIDE, 0.4m DEEP) - 2015
(1.2m WIDE, 0.6m DEEP) - 2016
(1.3m WIDE, 0.6m DEEP) - 2017
(1.4m WIDE, 0.7m DEEP) - 2018-2020
0.9m WIDE, 0.3m DEEP (2023)

RIPRAP DISPLACED FROM APRON
BUNCHED IN CENTER OF CHANNEL

C. CREEK

C. CREEK

R.O.W.

HWY
20°
CRACKS
28°
RIP RAP

SECTION A-A'
N.T.S.

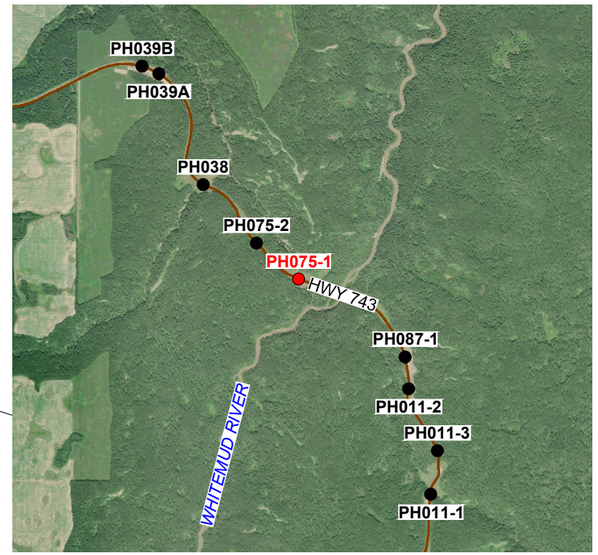
TYPICAL SILT FENCING AS NOTED
EROSION CONTROL SOIL
COVERING (TYPE C)
0.6m (MIN.)
2.1m
1.2m
2.1m

DETAIL
N.T.S.

PLAN
SCALE 1:1000 (APPROX.)

YEAR	REFERENCE PIN DISTANCE TO CRACK (m)	TO SLUMP SCARP (m)	SCARP HEIGHT (m)
2017	2.0	3.1	-
2018	-	0.36/3.36*	0.7
2019	-	3.0	DOWN TO CREEK LEVEL
2020	-	3.0*	0.6

*PIN MOVED BACK 3m



KEY PLAN
SCALE 1:40 000

LEGEND :

- ① → PHOTO AND DIRECTION
- DITCH
- SILT FENCE
- APPROXIMATE TEST HOLE LOCATION

NOTES :

1. FEATURE LOCATIONS ARE APPROXIMATE
2. PREVIOUS OBSERVATIONS SHOWN IN BLACK
3. MAY 2023 OBSERVATIONS SHOWN IN RED

UAV ORTHOIMAGE FLOWN BY THURBER 2020

Alberta

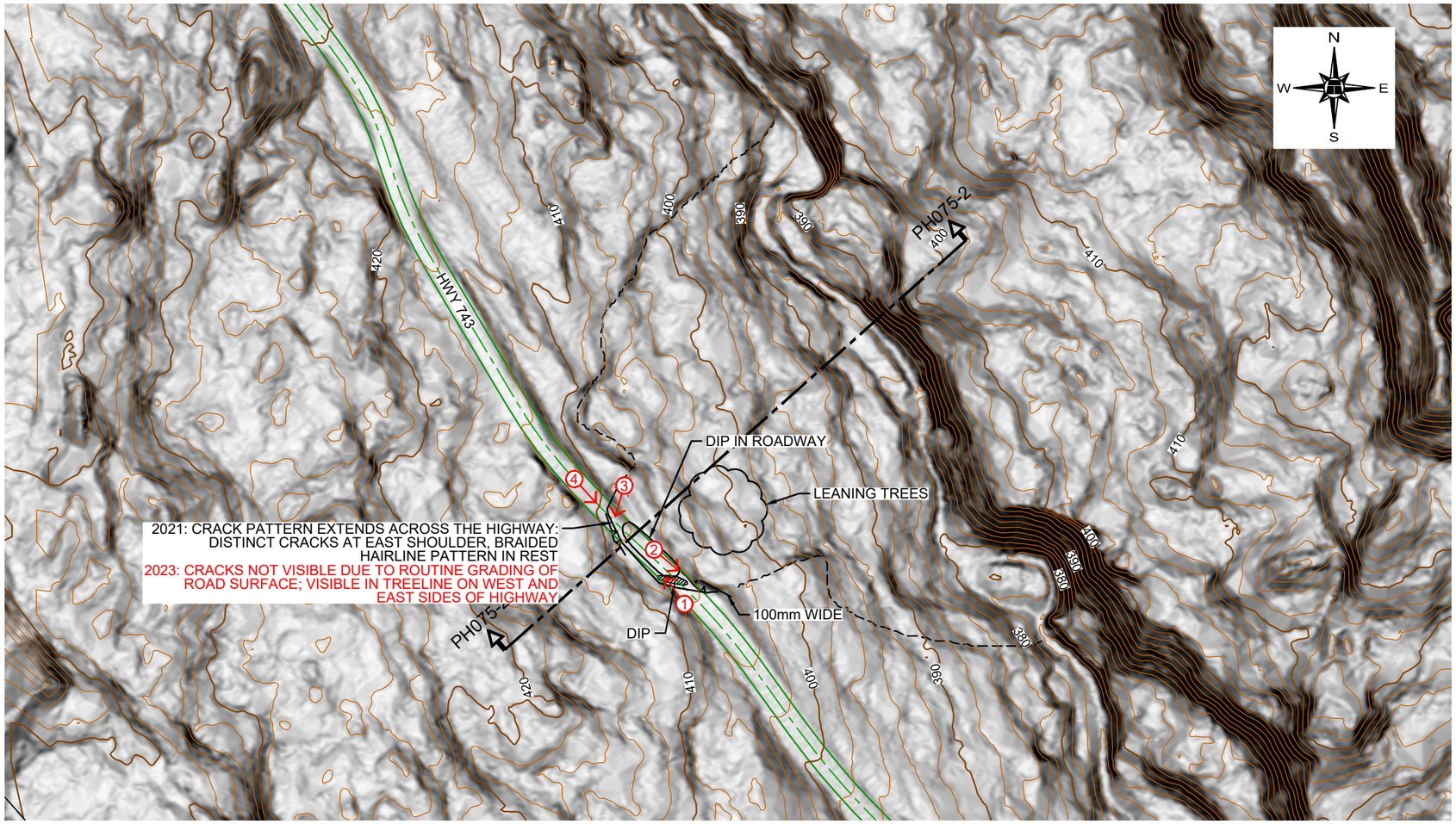
PEACE REGION (PEACE RIVER DISTRICT)

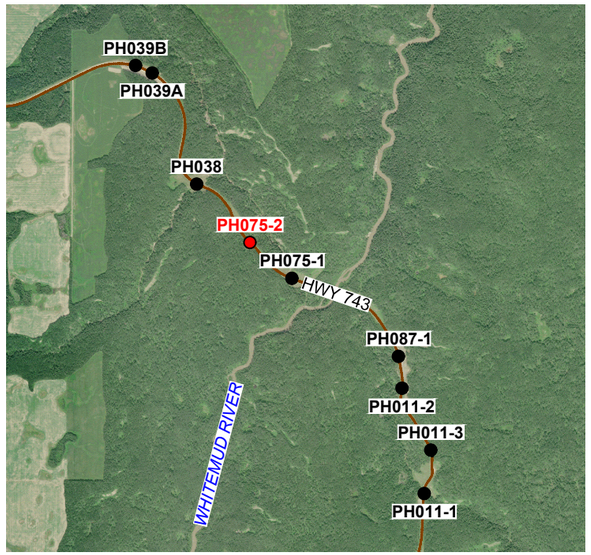
PH075-1: HWY 743:02 AT km 44.4
2023 SITE INSPECTION PLAN

DWG No. 32121-PH075-1-1

DRAWN BY	KLP
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	APPROX. 1:1000
DATE	SEPTEMBER 2023
FILE No.	32121

THURBER ENGINEERING LTD.



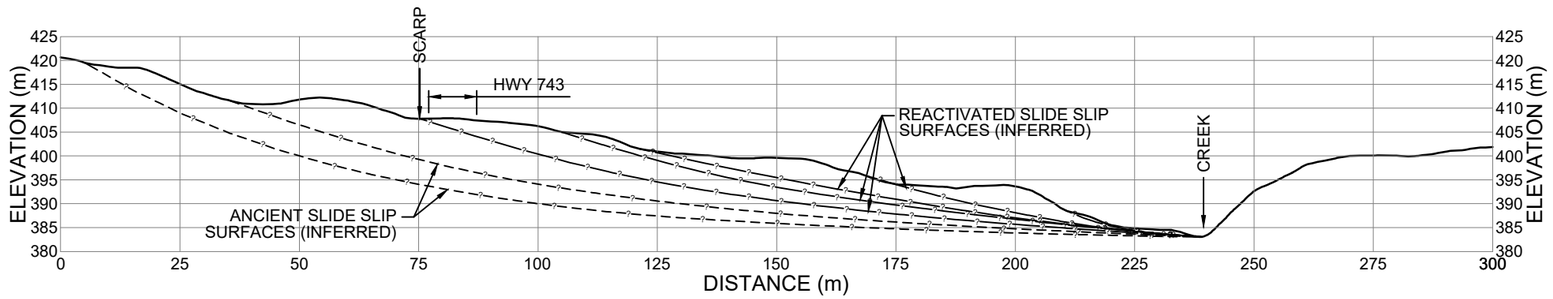


KEY PLAN
SCALE 1:40 000

LEGEND
- ACTIVE LANDSLIDE SCARP
- ANCIENT LANDSLIDE SCARP
- ① PHOTOGRAPH NUMBER AND DIRECTION

NOTES
1. FEATURE LOCATIONS ARE APPROXIMATE.
2. MAY 2023 OBSERVATIONS SHOWN IN RED.

0 25 50 75 100 125 150m
SCALE 1:2500



SECTION
SCALE 1:1250

LIDAR PROVIDED BY ALBERTA TRANSPORTATION

Alberta

PEACE REGION (PEACE RIVER DISTRICT)

PH075-2: HWY 743:02
2023 SITE INSPECTION PLAN

DWG No. 32121-PH075-2

DRAWN BY	KLP
DESIGNED BY	KEF
APPROVED BY	TSA
SCALE	1:2500
DATE	SEPTEMBER 2023
FILE No.	32121

THURBER ENGINEERING LTD.

Site 1, Photo 1 – Looking west at north sideslope.

Site 1, Photo 2 – Looking southeast at creek bank slumping upstream of the culvert inlet.

Site 1, Photo 3 – Looking north at creek bank slumping upstream of the culvert inlet.

Site 1, Photo 4 – Looking south at culvert inlet.

Site 1, Photo 5 – Looking north at culvert outlet. There is significant sediment accumulation.

2020 UAV Image of slumping around Site 1 culvert inlet.

Site 2, Photo 1 – Looking northeast along highway where scarp cracks had previously been visible (since graded over).

Site 2, Photo 2 – Looking southeast where scarp crack is visible on the east side of the highway.

Site 2, Photo 3 – Looking south where scarp continues on the west side of the highway.

Site 2, Photo 4 (composite) – Looking southeast from north end of the site at the sag in the highway where it crosses the slide mass. The clearly visible scarps are shown with red lines.