

**ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION (PEACE RIVER DISTRICT)
2022 INSPECTION**



| Site Number | Location | Name | Hwy | km |
|---|------------------|------------------------|--------|------|
| PH065 | 44+700 to 45+200 | Trib. to Heart River | 744:04 | 45.0 |
| Legal Description | | UTM Co-ordinates | | |
| NE12-82-22 W5M SE13-82-22 W5M NW7-82-21 W5M SW18-82-21 W5M | | 11V E 481975 N 6217485 | | |

| | Date | PF | CF | Total |
|-----------------------------|---|----|--|-------|
| Previous Inspection: | 06-Jul-2021 | 13 | 5 | 65 |
| Current Inspection: | 25-May-2022 | 13 | 5 | 65 |
| Road WAADT: | 620 | | Year: | 2021 |
| Inspected By: | Tyler Clay, TEL Ed Szmata, TRANS Max Shannon, TRANS | | Don Proudfoot, TEL Roger Skirrow, TRANS | |
| Report Attachments: | <input checked="" type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input checked="" type="checkbox"/> Maintenance Items | | | |

| | | | |
|---|---|-------------------------------------|--|
| Primary Site Issue: | <p>Widespread, mostly shallow, slumping extending close to roadway on both sides of embankment and cutslope.</p> <p>WEST EMBANKMENT (44+810):</p> <ul style="list-style-type: none"> shallow slide above culvert active shallow slide on upper portion of slope extending to pavement with defined toe roll deeper sliding at toe of slope due to creek erosion <p>EAST EMBANKMENT (45+020):</p> <ul style="list-style-type: none"> multiple shallow slides coalescing above culvert to within 10 m of roadway. Culvert outlet flow compromised due to jammed secondary culvert and wood debris (44+990) active landslide within pavement shoulder above culvert outlet (45+000) <p>EAST EMBANKMENT (45+200):</p> <ul style="list-style-type: none"> sliding downstream of northernmost culvert due to erosion <p>WEST CUTSLOPE (45+100):</p> <ul style="list-style-type: none"> area regraded in 2016 to fix two slumps (2012) | | |
| Dimensions: | <p>West Embankment Slides at 44+810: 75 m wide; 65 m from roadway to creek (intermittently active), active slide at 44+840: 11 m wide and 27 m from roadway</p> <p>East Embankment Slides: at 45+200 gully erosion at culvert 10 m wide and 15 m from road, slide at 45+030: 13 m wide; 11 m from roadway, multiple slides at 45+020 around culvert: 50 m wide; 65 m from roadway to creek, recently active 2016 slide at km 45+000: 32 m wide, 0.8 m into road pavement.</p> | | |
| Maintenance: | No maintenance activity since 2011. | | |
| Observations: | Description | Worsened? | |
| <input checked="" type="checkbox"/> Pavement Distress | Roadway settlement and rutting up to 100 mm; has been patched and cracks filled several times in | <input checked="" type="checkbox"/> | |

| | | |
|---|---|-------------------------------------|
| | vicinity of 44+850. Longitudinal cracks (about 15 mm to 50 mm wide in average) near the centre lines and shoulders of both northbound and southbound lanes. Arc-shaped cracking near active slide area (Photo 65-1 and 65-2) has not significantly worsened but there was additional damage to the shoulder near the active slide. Wheel rutting and longitudinal cracking at south end of site within southbound lane between 44+750 to 44+840. | |
| <input checked="" type="checkbox"/> Slope Movement | West cutslope repair is performing well, no change from 2021 (45+100). Active slide at 45+000 (Photos 65-1 to 65-3) appears to have similar extents with minor retrogression into the road shoulder with a 1.7 m (± 0.0 m) high scarp located 0.8 m (+0.1 m) from the guardrail. Very active sliding around and above culvert outlet at 45+020 (Photos 65-4 to 65-6). West side of the embankment between 44+775 to 44+830 appears similar to 2021 condition (Photo 65-7) within the upper embankment (main scarp had 2.6 m minimum offset from guardrail). Toe roll is visible along the lower slope and has encroached into the armored drainage swale at the south end of the site (Photo 65-8 and 65-9). Active slope movement with some minor retrogression above culvert inlet (44+830) offset approximately 27 m from highway and at culvert inlet headwall (Photo 65-8 and Photo 65-9). Inactive slide scarp at the west embankment was offset 2.6 m from guardrail Photo 65-8). | <input checked="" type="checkbox"/> |
| <input checked="" type="checkbox"/> Erosion | Erosion at northernmost culvert outlet 45+200 is ongoing along the gully flanks. At Bridge File culvert outlet (45+000) ongoing decrease of toe support on both sides of the embankment due to highly active erosion and localized slumping (Photos 65-5 and 65-6). Scour near the culvert inlet has not significantly worsened since previous inspection condition (Photo 65-9). | <input checked="" type="checkbox"/> |
| <input type="checkbox"/> Seepage | | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> Bridge/Culvert Distress | A section of an abandoned culvert (buried upstream of the inlet) has been washed through the main culvert beneath the road in a 2017/2018 high-flow event. The old culvert is still jammed against the displaced rip-rap creating a blockage of woody debris near the outlet opening, increasing erosion, scour and reducing flow capacity (Photo 65-6). | <input checked="" type="checkbox"/> |
| <input checked="" type="checkbox"/> Other | Slumping on east side of roadway is affecting power transmission pole anchor wires (Photo 65-6) but flanks have not significantly expanded from 2021 condition. Damaged guardrail posts along the northbound side of highway near 44+800 and three unsupported posts near active slide scarp at 45+000 (Photo 65-2). | <input type="checkbox"/> |

Instrumentation:

No instrumentation installed at this site.

Assessment:

The area experienced a high-flow event between the 2017/2018 inspections that caused scour and debris buildup at the main functioning culvert beneath the road embankment. The partially blocked culvert outlet has likely resulted in an increased rate of scour and bank loss around the culvert that reduces toe support for the embankment slope.

Widespread shallow slumping is attributed to the loss of soil strength in high plastic soils, particularly on fill/embankment slopes. Deeper instability upstream and downstream of culverts is attributed to erosion of toe of slope by creek. The slide scarp at 45+000 has continued to retrogress into the pavement of the road shoulder. Thurber completed a landslide mitigation design and tender package (AT Contract 22583) for the west embankment in December 2021 that includes slide excavation, building a granular shear key, slope regrading, pavement repairs and culvert maintenance. The tender has been awarded and the mitigation work is planned to be completed in summer/fall of 2022. The risk level for this site should reduce once these repairs have been completed.

Other slide areas identified at this site are expected to retrogress closer to the road in the next 5-10 years and are expected to continue unless mitigation at the culvert outlets is implemented. The rate of movement is difficult to assess without instrumentation installed at this site.

The longitudinal cracking on the pavement appear to be caused mainly by fatigue failure caused by repeated traffic loading and has not become significantly worse since 2016.

Repaired of the cutslope at 45+100 appears to be in stable condition and has revegetated well.

Recommendations:**Cost**

Continue to undertake annual inspections.

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Additional geotechnical investigation with piezometers and a series of test pits may be required to support long-term site stabilization design.

\$ 30,000

Long-term stabilization measures would likely consist of extensive erosion control measures and bank armouring of the creek, coupled with shallow stabilization measures such as granular blankets, soil nails or granular trenches. Alternatively, extension of the culvert on both sides with slope flattening could be considered.

\$ 3,000,000

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

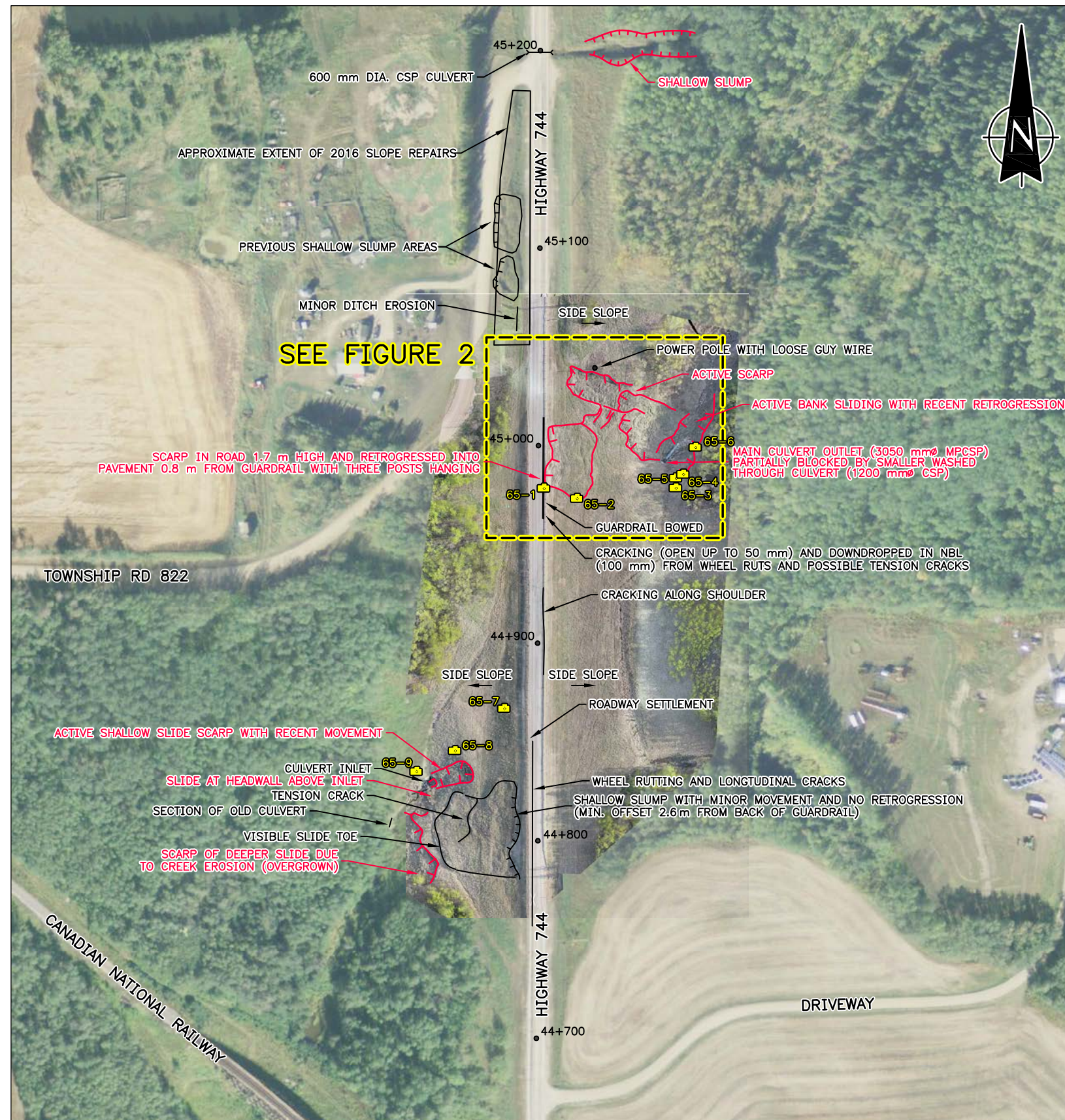
- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification 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

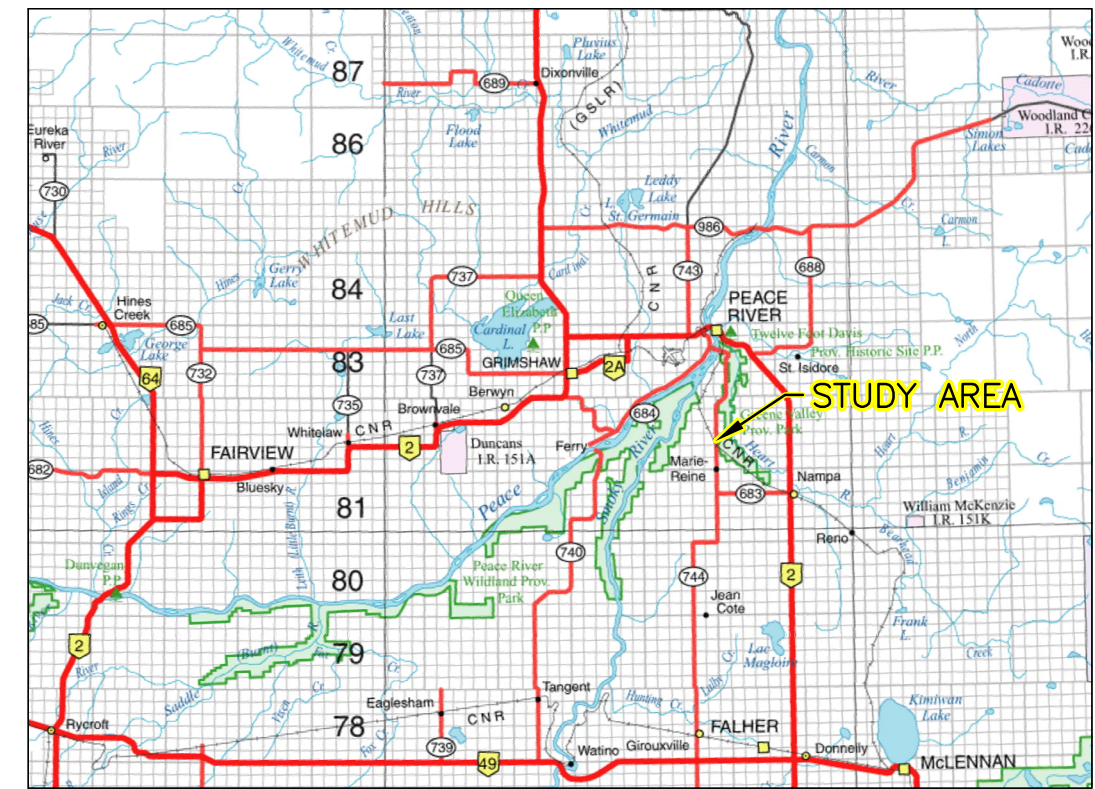
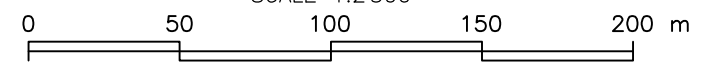
The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or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



SEE FIGURE 2

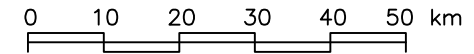
DETAIL MAP

SCALE 1:2 500



KEY MAP

SCALE 1:1 000 000



LEGEND:

PHOTOGRAPH LOCATION



NOTES:

- DRAWING MUST BE USED IN CONJUNCTION WITH THE ATTACHED REPORT REFERENCE 32121 DATED OCTOBER 2022 AND IS SUBJECT TO THE STATEMENT OF LIMITATIONS AND CONDITIONS INCLUDED IN THE REPORT.
- AIR PHOTO BASE FROM TARIN RESOURCE SERVICES LTD. 0.4 m/PIXEL (2012).
- AIR PHOTO BASE FROM THURBER DRONE 0.01 m/PIXEL (2022).
- SLIDE FEATURES, PHOTOGRAPHS AND CHAINAGE ARE SHOWN APPROXIMATE ONLY.
- SITE FEATURES SHOWN IN RED ARE FROM MAY 25, 2022 SITE VISIT.



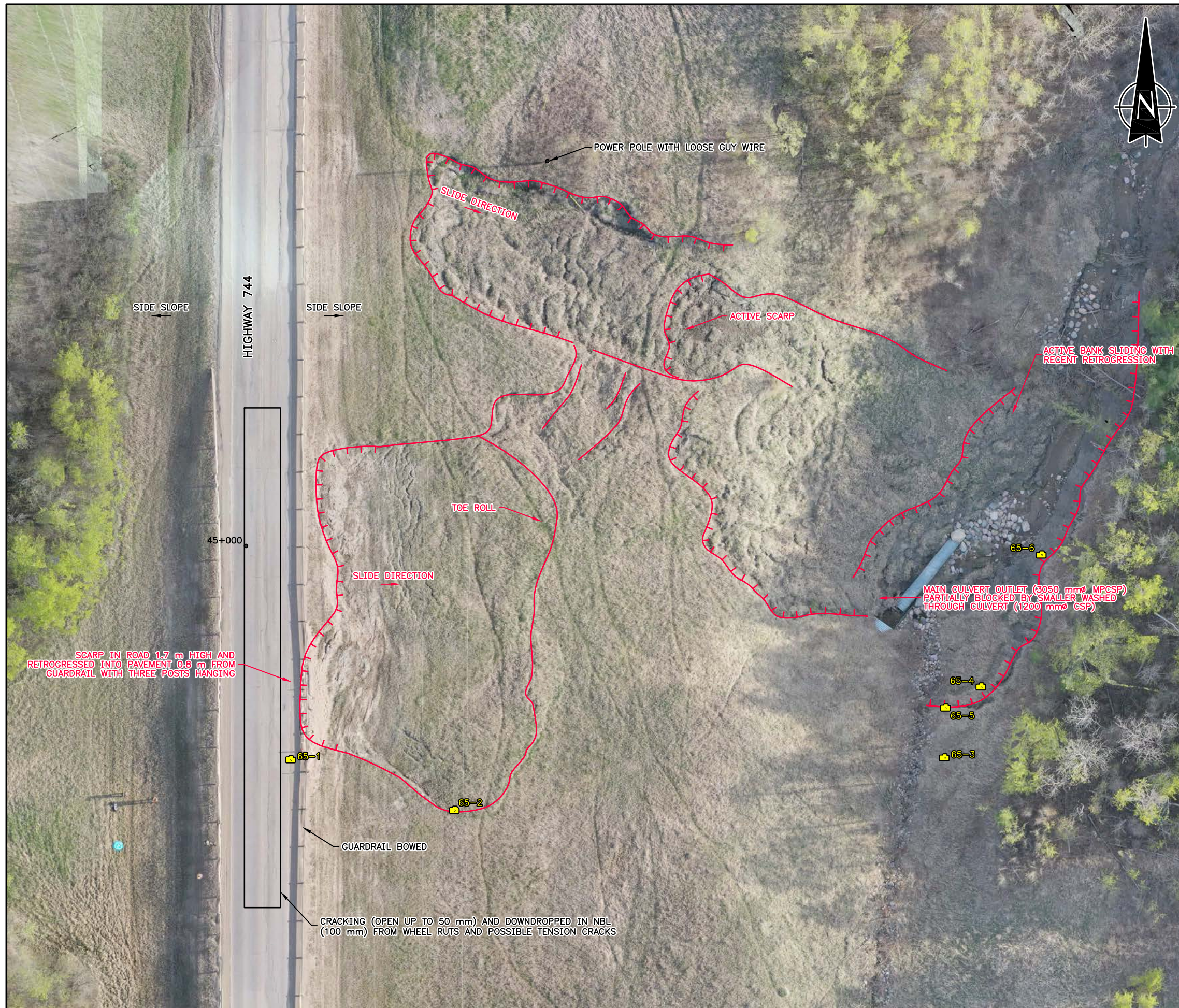
PEACE REGION (PEACE RIVER DISTRICT)


TRIB TO HEART RIVER
HWY 744:04 (PH065)
LOCATION PLAN

FIGURE PH065-1

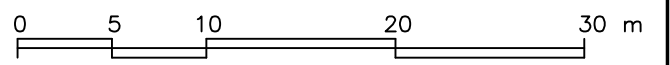
| | |
|-------------|--------------|
| DRAWN BY | ICB |
| DESIGNED BY | TTC |
| APPROVED BY | DWP |
| SCALE | AS SHOWN |
| DATE | JULY 6, 2022 |
| FILE No. | 32121-A4B |





LEGEND:
 PHOTOGRAPH LOCATION  65-10

- NOTES:
- 1 DRAWING MUST BE USED IN CONJUNCTION WITH THE ATTACHED REPORT REFERENCE 32121 DATED OCTOBER 2022 AND IS SUBJECT TO THE STATEMENT OF LIMITATIONS AND CONDITIONS INCLUDED IN THE REPORT.
 - 2 AIR PHOTO BASE FROM THURBER DRONE 0.01 m/PIXEL (2022).
 - 3 SLIDE FEATURES, PHOTOGRAPHS AND CHAINAGE ARE SHOWN APPROXIMATE ONLY.
 - 4 SITE FEATURES SHOWN IN RED ARE FROM MAY 25, 2022 SITE VISIT.



Alberta Transportation

PEACE REGION (PEACE RIVER DISTRICT)

**TRIB TO HEART RIVER
 HWY 744:04 (PH065)
 DETAILED PLAN**

FIGURE PH065-2

| | |
|-------------|--------------|
| DRAWN BY | ICB |
| DESIGNED BY | TTC |
| APPROVED BY | DWP |
| SCALE | 1:400 |
| DATE | JULY 6, 2022 |
| FILE No. | 32121-A4B |



SCARP IN ROAD 1.7 m HIGH AND RETROGRESED INTO PAVEMENT 0.8 m FROM GUARDRAIL WITH THREE POSTS HANGING

SIDE SLOPE

HIGHWAY 744

SIDE SLOPE

45+000

POWER POLE WITH LOOSE GUY WIRE

SLIDE DIRECTION

ACTIVE SCARP

ACTIVE BANK SLIDING WITH RECENT RETROGRESSION

TOE ROLL

SLIDE DIRECTION

MAIN CULVERT OUTLET (3050 mm ϕ MPCSP) PARTIALLY BLOCKED BY SMALLER WASHED THROUGH CULVERT (1200 mm ϕ CSP)

GUARDRAIL BOWED

CRACKING (OPEN UP TO 50 mm) AND DOWNDROPPED IN NBL (100 mm) FROM WHEEL RUTS AND POSSIBLE TENSION CRACKS

65-1

65-2

65-4

65-5

65-3

65-6



Photo 65-1.
Looking north towards the scarp retrogressing into the road pavement (45+00). Slide scarp was first noted in 2016 and is now approximately 1.7 m high at the pavement and retrogressed 0.8 m from the guardrail into the pavement with three posts hanging freely.



Photo 65-2.
Looking north along the east side of the highway embankment towards an active main slide scarp (45+015) first identified in 2016. Slightly increased retrogression since 2021, minor change to the scarp height.



Photo 65-3.
View towards recently active slide area above culvert outlet that has retrogressed to the pavement on the east embankment (44+975). Note visible toe roll.



Photo 65-4.
Active bank sliding and erosion area around the culvert outlet (44+975). Worse since 2021.



Photo 65-5.
Looking northwest towards multiple active, shallow slides coalescing above the culvert outlet. Area has ongoing movement, especially near the toe where there is active bank erosion (44+975) but no significant retrogression of the headscarp towards the highway.



Photo 65-6.
Active sliding and erosion area around the headwall of the culvert outlet (45+000). Movement has pinched the outlet area of an armoured swale to the south of the outlet. Note old washed through culvert section causing debris jam. There was increased erosion around the outlet and creek banks.



Photo 65-7.
Looking south along the upper slope of the west side of the road embankment. No major changes noted at the head of the slides near the highway.



Photo 65-8.
Looking southeast towards a recently active shallow earth slide above the culvert inlet (44+830). Slide is offset approximately 27 m west of the highway edge. Minor retrogression has occurred at the main scarp (lower right of photo).



Photo 65-9. Looking east towards the west road embankment with active shallow slide activity immediately above the culvert inlet (near inspectors) and near the headwall. Note visible toe roll of slide which has begun to encroach into the armored drainage swale on the right side of the photo.