

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



Site Number	Location	Name	Hwy	km
PH59	East Hill	34+770 to 35+680 Site 2	2:60	35.20
Legal Description		UTM Co-ordinates		
S28-083-21 W5M		11V E 484105	N 6231090	

	Date	PF	CF	Total
Previous Inspection:				
Site 2 Downslope	9-Jun-2020	10	5	50
Shallow slide 34+850	9-Jun-2020	9	4	36
Current Inspection:				
Site 2 Downslope	25-May-2022	10	5	50
Shallow slide 34+850	25-May-2022	9	4	36
Road WAADT:	3990		Year:	2021
Inspected By:	Ed Szmata, TRANS Roger Skirrow, TRANS Max Shannon, TRANS		Don Proudfoot, TEL Tyler Clay, TEL	
Report Attachments:	<input checked="" type="checkbox"/> Photographs		<input checked="" type="checkbox"/> Maintenance Items	
	<input checked="" type="checkbox"/> Plans			

Primary Site Issue:	Large landslide referred to as Site 2 (35+250) previously encompassed highway in the 1980s. The upslope area was mitigated by major crest unloading. The area below the road was mitigated by the construction of large berms. Area is still potentially unstable and has ongoing shallow and deep-seated movements. Shallow slide up to guardrail occurred in 2007 at 34+850.	
Dimensions:	Site 2 is 750 m wide; extends 300 m upslope of roadway to crest of valley and 350 m downslope of roadway to North Heart and Heart Rivers. Shallow slide at 34+850 is approximately 40 m wide and extends 25 m downslope.	
Maintenance:	No maintenance activity since 2011.	
Observations:	Description	Worsened?
<input type="checkbox"/> Pavement Distress		<input type="checkbox"/>
<input checked="" type="checkbox"/> Slope Movement	Shallow slump at 34+850 appears to have minor downslope movement within the displaced slide mass but no major retrogression of the main scarp or lateral expansion (Photo 59-01) with a minimum offset of approximately 0.8 m from the guardrail. Slide is grass covered. Sliding downslope of embankment at 35+250 immediately downslope of roadway appears in	<input type="checkbox"/>

	<p>fair to good condition. Flank of scarp near 35+300 has no change from 2019 condition.</p> <p>New active landslide area occurring at the base of the valley below the erosion gully at KM 35+500 (Photo - 59-06) as well as ongoing movements in the slide area further up the valley slope along this erosion feature (Photo 59-03).</p>	
<input checked="" type="checkbox"/> Erosion	<p>Erosion gully is active near 35+450, approximately 125 m downslope from highway (Photo 59-05). Erosion gully downstream of gabion culvert outlet near 35+500 has minor ongoing erosion/expansion at the flanks but no major retrogression since previous inspection (Photo 59-03).</p> <p>North ditch erosion damage between approximately KM 35+350 to 35+575 has been repaired and armored with riprap by the maintenance contractor. Minor erosion damage is occurring outside of the repaired extents.</p> <p>Silt buildup and minor erosion was noted within ditch on the north side of the highway near 35+650 (Photo 59-02).</p>	<input checked="" type="checkbox"/>
<input type="checkbox"/> Seepage		<input type="checkbox"/>
<input checked="" type="checkbox"/> Bridge/Culvert Distress	Culvert at 35+100 and 35+480 under the highway corroded and the inlet is blocked.	<input type="checkbox"/>
<input checked="" type="checkbox"/> Other	<p>Outlet drain pipe blocked in gabion discharge structure at 35+480. Slumping downslope of discharge structure is ongoing. Structure is in similar condition to previous inspection. (Photo 59-03).</p> <p>The slope above the road between 35+200 and 35+400 the was being used as a borrow source area has been graded back and reclaimed. Minor rill erosion was noted as the soil was not yet vegetated (Photo 59-04).</p>	<input type="checkbox"/>
<p>Instrumentation:</p> <p>SI67 – No discernible movement SI69 – No discernible movement SI75 – 0.9 mm/yr over 0.0 m to 5.4 m depth since the fall of 2021 readings. SI81 – 0.9 mm/yr over 1.9 m to 6.1 m depth and a rate of movement of 2.8 mm/yr over 6.1 m to 9.2 m depth since the fall of 2021 readings. SI82 – Sheared at 11.7 m below ground surface since Fall 2012 reading.</p>		

Standpipe piezometers SP-003 and SP-004 showed increases in groundwater level of 0.59 m and 0.17 m, respectively, since the fall of 2021 readings. No change in previously measured trends.

Assessment:

Small deep-seated movements are occurring within fill embankment downslope of roadway (35+250) indicating low Factors of Safety. However, movements appear to have steadied and the acceleration observed approximately eight years ago (rates up to 30 mm/yr) has subsided. Measured rates of movement within two of the instruments below the road have averaged around approximately 2 mm/yr to 6 mm/yr the last several years. No movement has been measured within the SI upslope of the road at 35+200. Shallow slump at 34+850 appears to be only intermittently active and is not expanding significantly. Shallow slumping upslope of roadway is active but has limited potential to affect roadway at this time.

Erosion is very active and deep in the north ditch and within two major gullies south of the highway. Ditch should be regraded and armored. Culvert drainage should be restored. Current gullies do not present an immediate risk to the highway but adding a trunk drain to this section should be considered to reduce rate of retrogression.

The unloading of the upslope area above the highway between 35+150 to 35+400 is expected to help reduce the potential reactivation of the old landslide plane from the 1980s; however, revegetation of the disturbed soils and managing erosion will be required.

Recommendations:

Cost

Drain pipe outlet needs to be cleared in gabion discharge structure at 35+480. Culvert at 35+480 under the highway needs to be repaired. Regrading of the slope or fill placement at 34+850 may be required in the future if the guardrail becomes undermined due to erosion or movement at the slide scarp. It is understood that this work might already be underway as part of the 2022 pavement overlay project.	\$40,000
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Continue to monitor instruments twice yearly and undertake annual inspections.	-
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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

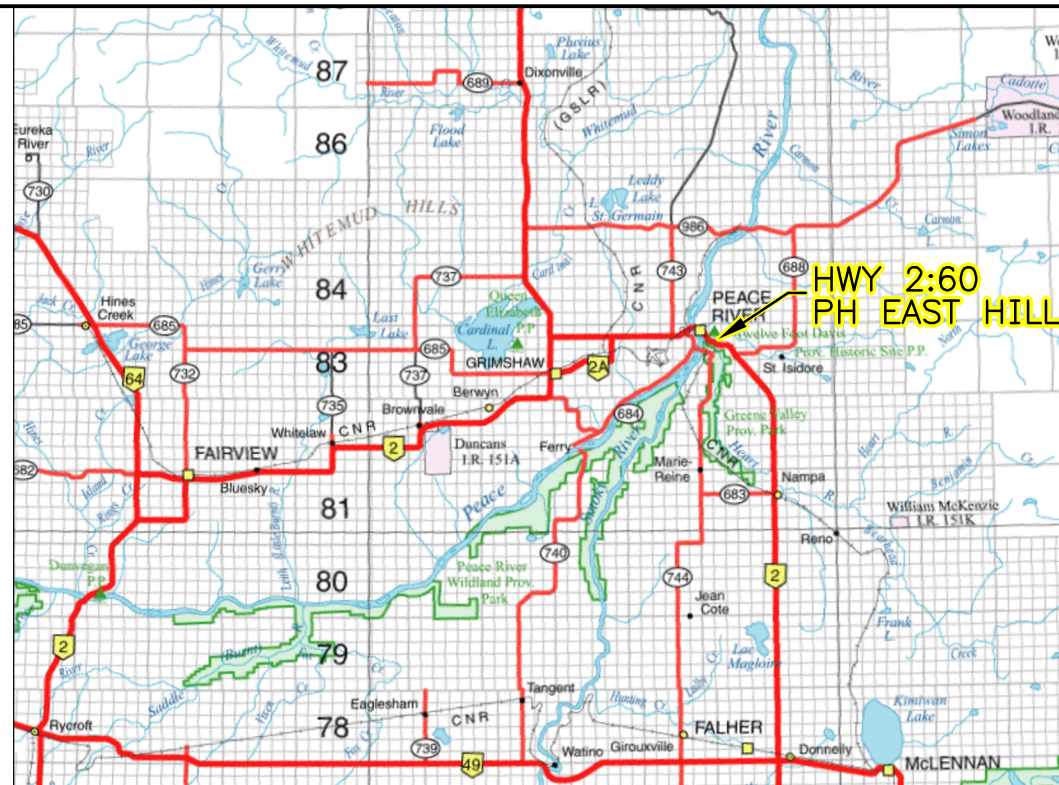
- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification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



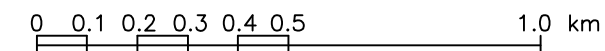
KEY MAP
SCALE 1:1 000 000

LEGEND:
PH059 EXTENT



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 TARIN RESOURCE SERVICES LTD. 0.4 m/PIXEL (2012).
- 3 CHAINAGE SHOWN ARE APPROXIMATE ONLY.



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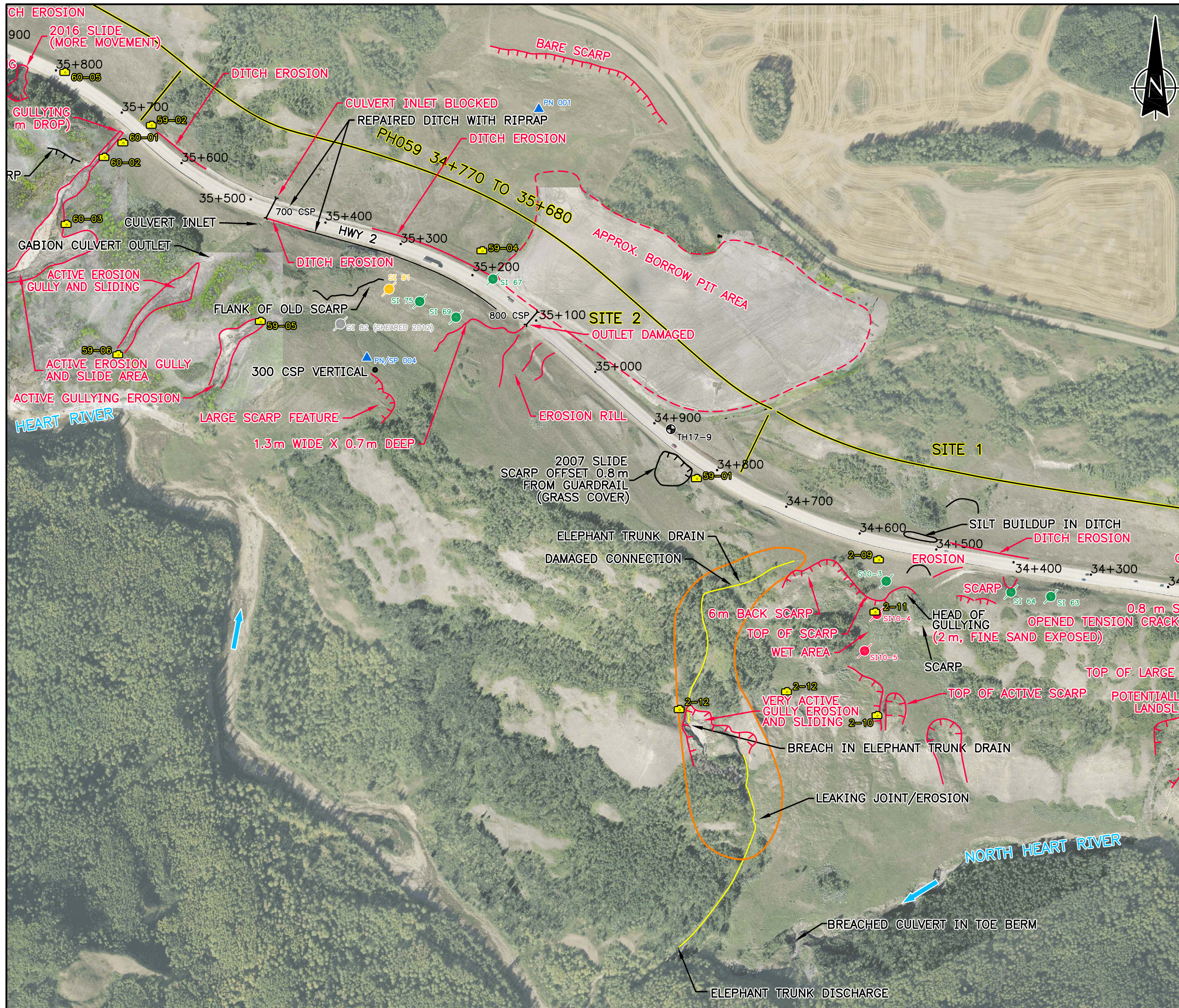
PEACE REGION (PEACE RIVER DISTRICT)

PEACE RIVER EAST HILL
HWY 2:60 (PH059)
KEY MAP

FIGURE PH059-1

DRAWN BY	ICB
DESIGNED BY	TTC
APPROVED BY	DWP
SCALE	1:15 000
DATE	OCTOBER 13, 2022
FILE No.	32121-A6C



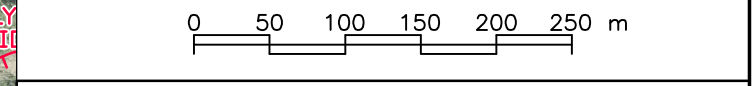


LEGEND:

- HORIZONTAL CHAINAGE (37+130 GROUARD BRIDGE) ● 34+900
- PHOTOGRAPH LOCATION ■ 41-01
- TEST HOLE LOCATION ⊕
- SLOPE INCLINOMETER ● SI 64
- NO MOVEMENT ● SI 82
- CREEP ● SI 82
- MEASURABLE MOVEMENT (OR RECENTLY SHEARED) ● SI 82
- PIEZOMETER ▲ PN 004
- PH059 EXTENT —
- SLIDE —
- DRAIN BOUNDARY —

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 PHOTO BASE IMAGE COMBINED FROM 2012 AIR PHOTO (TARIN RESOURCES SERVICES LTD.), THURBER DRONE IMAGERY (2022), MACINTOSH PERRY DRONE SURVEY (2022).
- 3 SLIDE FEATURES, PHOTOGRAPHS AND CHAINANGE ARE SHOWN APPROXIMATE ONLY.



Alberta Transportation
 PEACE REGION (PEACE RIVER DISTRICT)
PEACE RIVER EAST HILL
HWY 2:60 (PH059) STA. 34+770 TO 35+680
LOCATION PLAN
 FIGURE PH059-2

DRAWN BY	ICB
DESIGNED BY	TTC
APPROVED BY	DWP
SCALE	1:5000
DATE	OCTOBER 13, 2022
FILE No.	32121-A7C

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Photo 59-01.
Looking east at headscarp area of shallow landslide on downslope side of roadway. Some downslope movement within displaced slide mass but no major expansion at the main scarp since 2009 (34+850).



Photo 59-02.
Look east at ditch erosion near the west end of the new ditch armoring before the culvert inlet (35+650).



Photo 59-03.
Overhead drone image of erosion and slide damage downslope from the gabion culvert outlet structure (35+500).



Photo 59-04.
Oblique drone view towards the east of the graded borrow area above the highway (35+200). Minor rill erosion was noted.

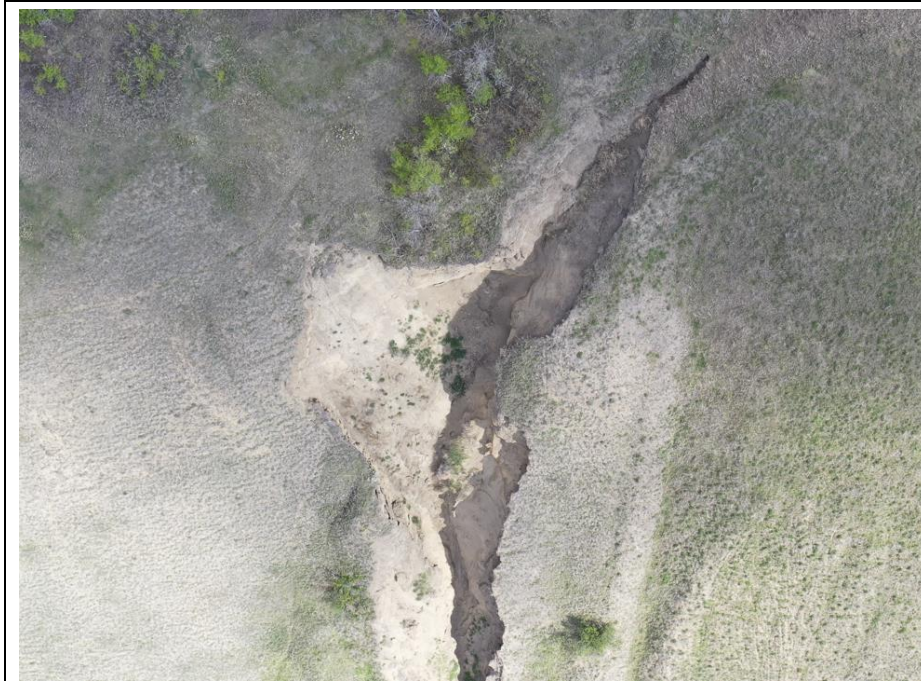


Photo 59-05.
Overhead drone image of an erosion gully approximately 125 m downslope (south) from the highway (35+450). Ongoing erosion and minor expansion relative to the 2020 condition.



Photo 59-06.
Overhead drone image of a recent landslide in the lower valley below the erosion gully at KM 35+500. Offset over 250 m from the highway.