

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



Site Number	Location	Name	Hwy	km
PH033-1	Judah Hill	CNR Slide	744:04	59.451
Legal Description		UTM Co-ordinates		
NE¼ 29-083-21 W5M		11V E 482645	N 6231308	

	Date	PF	CF	Total
Previous Inspection:	6-July-2021	16	4	64
Current Inspection:	24-May-2022	17	4	68
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:	Two rotational slides, one above the other, with the toe being eroded at the Heart River. Slide movement apparently occurring over an eroded bedrock surface, above river level. Crest of slide(s) has previously affected the highway and rail line near the level crossing. Pile walls and a large gravel toe berm were previously installed to protect the highway and rail line. The Heart River has shifted and is cutting into the slope behind the rip rap installed to protect the toe of the toe berm slope.	
Dimensions:	80 m wide, 110 m long (plan view). Slide plane is probably 15 m to 20 m deep, with backscarp now about 6 m from S110-17.	
Maintenance:	Highway was closed from May 2013 to January 2014 due to Sunshine Landslide. The inlet to the CNR Trunk downpipe was partially cleaned in 2016. The first void behind the pile wall at the road was filled with concrete in 2020.	
Observations:	Description	Worsened?
<input checked="" type="checkbox"/> Pavement Distress	Pavement distress with scouring and rills on the west (downslope) shoulder of the roadway embankment near km 59.53.	<input type="checkbox"/>
<input checked="" type="checkbox"/> Slope Movement	No obvious retrogression of upper main backscarp since 2008 (Photo 6 and 10). No obvious slope movement directly downslope from the wall, upslope of S10-17. Continued slope movement along lower portion of the north flank due to river erosion of the lower landslide toe (Photo 7).	<input type="checkbox"/>
<input checked="" type="checkbox"/> Erosion	Erosion along the roadway west shoulder to the south of the pile wall. Ongoing ditch erosion and debris transportation near the CNR Trunk inlet along the highway upslope ditch. Ongoing sideslope erosion rills and gulying at km 59.55 and km 59.48. Erosion is occurring below the severed section of the CNR Trunk downslope drainpipe. There has	<input checked="" type="checkbox"/>

	<p>been retrogression and lateral expansion since 2021. (Photos 4 and 5)</p> <p>A new erosion void has opened up behind the pile walls adjacent to the previously repaired void area. The void is a result of soil loss between the piles and extends to the base of the exposed piles (over 5 m in depth). The void bridges to previously repaired void area to the west. The void at the surface was 3 m x 2 m in size and was beginning to undermine the road shoulder (Photos 1, 2 and 9).</p>	
<input type="checkbox"/> Seepage		<input type="checkbox"/>
<input checked="" type="checkbox"/> Bridge/Culvert Distress	Inlet to the CNR Trunk is partially buried with debris. The pipe conduit has completely failed immediately below the crest of the upper valley slope. As a result, a scour is rapidly forming in the slope below the breakage and sediment is accumulating in the intermediate plateau below (Photos 4 and 5).	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Other	Increased concrete spalling and sloughing between the piles on the CNR retaining (noted in previous years) (Photo 3).	<input checked="" type="checkbox"/>
Instrumentation:		
SI10-16	Installed about 15 m downslope of the CNR pile wall. Showed a rate of movement of 1.1 mm/yr over 11.7 m to 13.5 m depth since fall of 2021 readings. Movement rate is consistent with historic trends (1 to 3 mm/yr) since 2010 and the total cumulative movement has been below 25 mm.	
SI10-17	Installed about 6 m from the crest of the main backscarp. Showed a rate of movement of 1.0 mm/yr over 9.5 m to 11.3 m depth since fall of 2021 readings. Movement rate is consistent with historic trends (1 to 3 mm/yr) since 2010 and the total cumulative movement has been below 15 mm.	
PN10-16	Near pile wall. PN10-16 showed a decrease in groundwater level of 0.28 m since the fall of 2021 readings. Ground level has shown a consistent trend since 2010 installation with groundwater depth between 10 m to 12 m.	
Assessment:		
<p>Movement at the toe of the CNR slide is continuing, worsened by river erosion of failed material at the toe of the slide. Erosion at the toe of the slope, which started in 2007, is expected to continue, with consequent further slide movement and retrogression of the backscarp towards the rail line and highway. The pile wall along Hwy 744 was drilled to 20 m depth, and terminated above the expected rupture surface, so would be vulnerable to loss of toe support. Now that the river erosion has reached a hard bedrock face, the rate of lateral river erosion directly downslope of the pile wall has slowed.</p> <p>The CNR drainage trunk pipe is broken immediately below the crest of the valley slope and both water and sediment are pouring directly onto the slope below. A large scour gully has formed immediately beneath the break in the pipe. We recommended that this be addressed as a matter of urgency, preferably by replacing the existing segmented CPP with a welded anchored pipe along a flatter alternate alignment in addition to re-profiling and armoring the inlet.</p> <p>The new erosion void behind the pile wall should also be repaired as a matter of urgency before further undermining of the road continues. A structural (e.g., wire mesh facing) facing tied into the concrete and/or anchors on the downslope side of the piles to contain fill/grout and prevent future soil loss is recommended. Surface drainage should be directed away from the area behind the pile wall to reduce erosion rates and future void formation.</p>		

Recommendations:	Cost
The inlet of the downpipe is being cleaned out and upstream ditch erosion and sideslope rilling addressed in a construction project currently being completed through the maintenance contract	
Install mesh (welded wire or similar), anchored to the piles (and into the soil if possible) using Hilti anchors, for example, at areas of spalled parging. Place new parging to cover the mesh and fill the voids between piles. Install drainpipes through the parging to avoid blocking seepage. Fill void behind the wall with grout or granular fill with geotextile filter	\$300,000
<p>Replace CPP drainpipe with a realigned anchored welded pipe.</p> <p>Consider a curb and gutter along the edge of asphalt, or a depressed swale, to channel water away from edge of pavement and to divert runoff away from the back of the piles. Fill the rills and around the guardrail posts with gravel covered with seeded topsoil.</p>	\$300,000 Maintenance
Establish survey network around the pile wall, including benchmarks on 'stable' ground, and control points on the top and bottom of the wall. Conduct regular surveys every 1 – 2 years to detect movement / deflection of the wall, check for the length of exposed wall and movement of the ground around the wall.	Investigation
Assess the stability of the wall and ability to resist overturning based on the length of exposed wall and current ground anchorages. Assess the need for a toe support wall.	Investigation
Options to limit erosion by the Heart River at the toe of the slope should be assessed – this will require a review of river hydraulics. Drone survey of the toe area would also be beneficial for detailed assessment and ongoing monitoring.	Investigation
Mid-term to long-term repair options might include installation of a secant pile wall near the base of the slope. A shorter wall could be constructed nearer the toe of the existing pile wall at reduced cost.	\$ 3 million to \$ 5 million
River training works such as rock vanes may be required in support of other repair options, or to limit further slope movement.	\$ 500,000
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.

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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

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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.

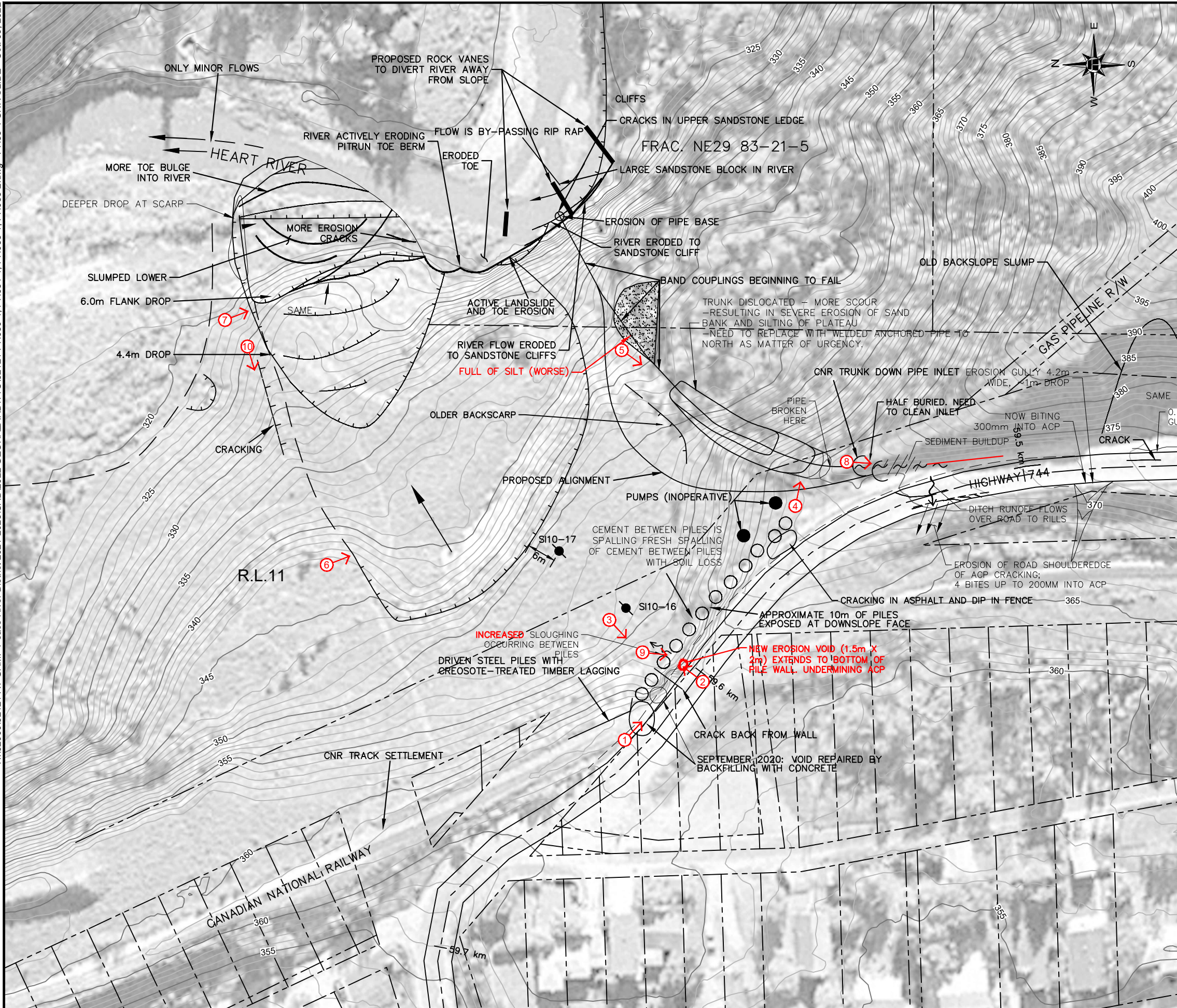
6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

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.

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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.

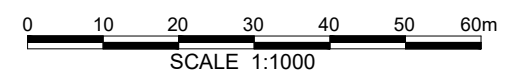
H:\32000\32121 AT GRMP Peace River District 2021-2025\CAD\2022 GEOHAZARD\TTC\32121-PH030-1, PH031-1, PH032-1, PH033-1, PH033-2.dwg - Oct. 09, 2022



LEGEND:
 SLOPE INDICATOR
 DIRECTION AND NUMBER OF PHOTO



NOTES:
 1 LOCATION DATA RECORDED USING HANDHELD GPS RECEIVER. ALL LOCATIONS ARE APPROXIMATE AND ARE FOR ILLUSTRATIVE PURPOSES ONLY.
 2 MAY 24, 2022 OBSERVATIONS SHOWN IN RED.



PEACE REGION (PEACE RIVER DISTRICT)

PH033-1 JUDAH HILL - CNR SLIDE
 2022 SITE INSPECTION PLAN

DWG No. 32121-PH033-1-1

DRAWN BY	ML
DESIGNED BY	TTC
APPROVED BY	DWP
SCALE	1:1000
DATE	OCTOBER 2022
FILE No.	32121





Photo 1.
Looking southeast from the north end of the CNR pile wall. A new erosion void has opened up behind the wall adjacent to the previously repaired void area.



Photo 2.
View into the new erosion void behind the pile wall. Void has been created as a result of soil loss between the piles. Void was 3 x 2 m wide in size and over 5 m deep. The void 'bridged' to the other void repair area to the west.



Photo 3. Looking south at the soil loss between the northernmost piles of the CNR pile wall north of Hwy 744:04 at km 59.61. Increased buildup of soil and concrete spalling between the piles since 2021 that has resulted in an open void at the surface between the wall and the road.



Photo 4.
Looking northeast at break in CNR CPP Trunk pipe and erosion gully at crest of the Heart River valley slope.



Photo 5.
Looking southwest from below the scour caused by the breakage in the CNR CPP Trunk pipe. There has been some retrogression and lateral expansion at the gully headwall since 2021.



Photo 6.
Looking southeast from the north side of the lower slide. No major changes observed in the slope area directly below the pile wall since 2021.



Photo 7.
Looking east along the toe of the lower landslide. Some minor lower slide activity and toe erosion at the river bank is active. No major visible differences from 2021.



Photo 8.
Looking south
towards the
erosion in the east
ditch upslope from
the draining pipe
inlet.

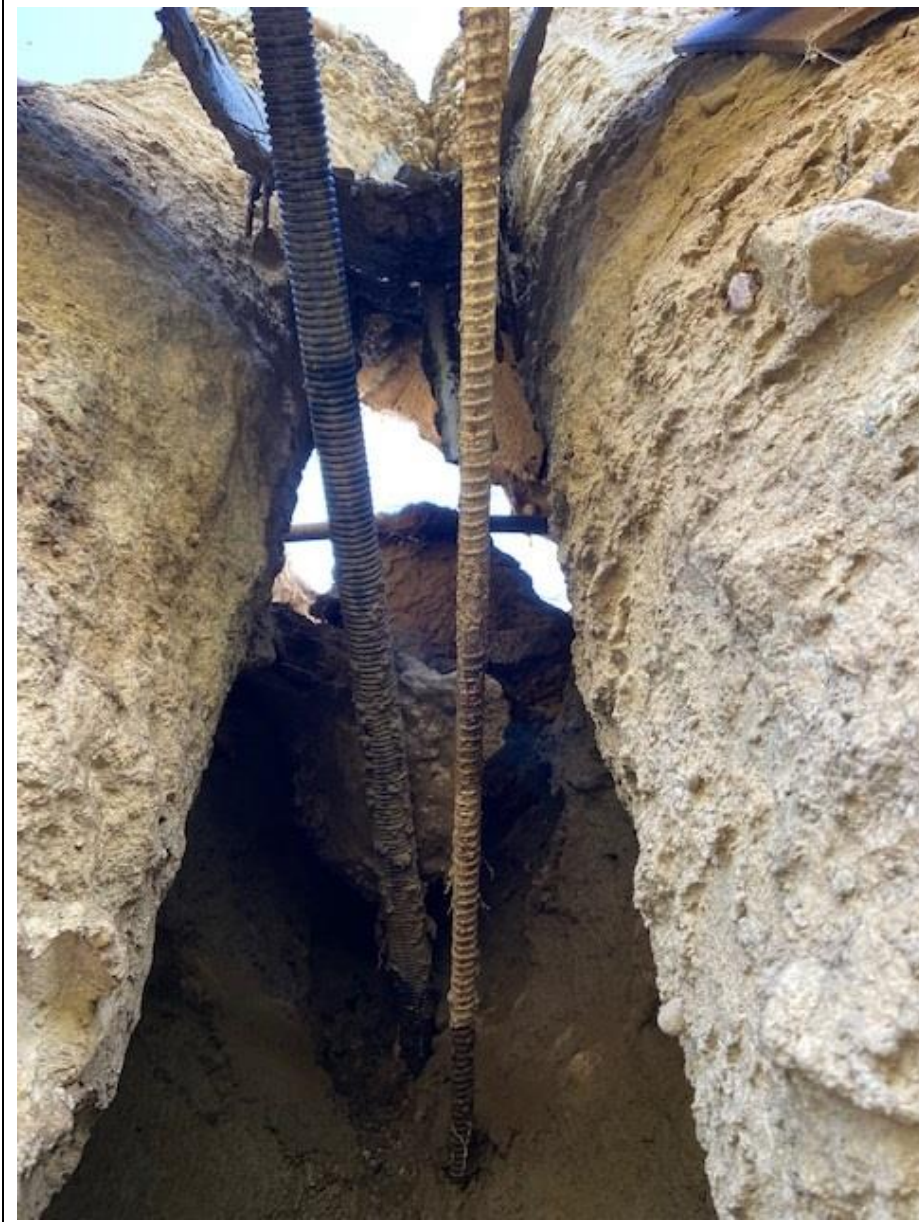


Photo 9.
Looking up into the erosion void between the piles. Void expanded in size to 3 x 3 m below the ground surface and extended to the base of the exposed piles at the lower bench.



Photo 10.
Looking south towards the northwest flank of the lower slide. No major change from the 2021 condition.