

**ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION – GRANDE PRAIRIE DISTRICT - NORTH
2021 INSPECTION**



Site Number	Location	Name	Hwy	km
PH077-1 and 77-2	West of Fairview	Sites E of Hines Creek Bridge	682:02	12.5-12.8
Legal Description		UTM Co-ordinates (NAD 83)		
NE35-81-5-W6		11V N 6215000	E 396650	

	Date	PF	CF	Total
Previous Inspection:	June 17, 2020	11	4	44 (PH077-1)
		13	4	52 (PH077-2)
Current Inspection:	July 13, 2021	13	4	52 (PH077-1)
		9	4	36 (PH077-2)
Road AADT:	160	Year:		2020
Inspected By:	Ed Szmata, AT Roger Skirrow, AT Rocky Wang, AT Max Shannon, AT Ken Szmata, AT		Barry Meays, Thurber Nicole Wilder Thurber	
Report Attachments:	<input checked="" type="checkbox"/> Photographs		<input checked="" type="checkbox"/> Plans	<input checked="" type="checkbox"/> Maintenance Items

Primary Site Issue:	<p>PH077-1: Creek bank slumping caused by creek erosion continues to retrogress and has caused cracks to appear in the highway about 150 m east of the bridge. A shallow sideslope slide also exists at the east end.</p> <p>PH077-2: Settlement and cracking in the highway and an active landslide through the south embankment are causing distress to the BF culvert and pavement. Channel and ditch erosion on the north embankment have created a slide around the culvert inlet which has retrogressed to near the highway.</p>		
Dimensions:	<p>PH077-1: Slide dimensions ~100 m wide along the embankment parallel to the highway x ~30m long.</p> <p>PH077-2: South embankment slide ~40 m wide x 75 m long extending to river. North embankment slope slide ~40 m wide x ~40 m. Erosion ~30 m long in the ditch TRM's, plus ~25 m of upstream channel erosion in front of the culvert inlet.</p>		
Date of any remediation:	PH077-2 was repaired in the fall of 2014 with a new 1.8m dia. SWSP (WSP = Consultant, In-Line = Contractor). In 2020, rip rap was added on one of the north crotch ditches where erosion was noted previously at PH077-2, and it appeared that the trash rack had been cleaned out of debris.		
Maintenance:	Crack sealing.	Worsened?	
Observations:	Description	Yes	No
<input checked="" type="checkbox"/> Pavement Distress	<p>At PH077-1, a 40 m long (30 to 80mm wide) crack and a 15m long crack (near the east end) exist in the highway. A dip exists outside the longer crack extending across the highway. Appeared the same in 2021</p> <p>At PH077-2, cracks and a noticeable dip exist across a 40 m length of the highway overtop the SWSP culvert, with another dip existing further east. Same condition in 2021.</p>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

<input checked="" type="checkbox"/> Slope Movement	<p>At PH077-1: The Creek has eroded the toe of the south embankment, and a slide scarp has developed parallel to the highway and is as close as 8 m from the pavement. Additional fresh sloughing in same areas was observed in 2021. At the east end, the 15 m wide shallow sideslope slide has moved downslope and created a 0.4 m high scarp (at 3.6 m from the guardrail) and a 0.6 m high toe push.</p> <p>At PH077-2: A landslide has developed through the south embankment and has deformed the culvert. There is a 0.4 m high scarp located 4.6 m from the white shoulder line. North of the highway, a 1.5 m wide graben crack with a 0.2 m drop has developed above the erosion near the culvert inlet, and which has developed into a slide that has retrogressed back to near the highway.</p>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> Erosion	<p>At PH077-1, active erosion caused by the creek is occurring at the toe of the slope along the creek's edge. However, the river level was lower than normal at the time of the visit due to much drier weather in 2021.</p> <p>At PH077-2, the TRM south of the highway along the east runoff ditch where previously erosion was observed had been repaired with rip rap lining this ditch as well as placing riprap on the downstream end of the gabions.</p>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Seepage		<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> Bridge/Culvert Distress	<p>The ends of the 1.8 m diameter SWSP (BF75380) at PH077-2 did not appear to be visibly damaged at the time of our inspection, however the 2015 bridge inspection noted that there were distortions and cracks/separations within the culvert (along with low ratings).</p>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/> Other		<input type="checkbox"/>	<input type="checkbox"/>
Instrumentation: None			
Background/Assessment (Refer to Figures PH077-1, -2, -1/2): <p>The existing bridge file management system records indicate that BF75380 at PH077-2 consisted of a SPE having an in-service date of 1961 (the size of the SPE was not identified), with a 15.8 m deck height.</p> <p>PH077-2 was repaired in 2012 with a new culvert pipe, and there was some mention of a slide at the site at that time. The soil conditions identified from 2 test holes drilled through the highway as part of the 2012 design indicated a predominant clay fill embankment, overlying a stratified predominant clay deposit, overlying glacial clay till near Creek level. The submitted As-Built drawings indicates that the new pipe was a 157 m long x 1.8 m dia. SWSP spanning beneath the highway, containing horizontal and vertical elbows, and which also contained a 1.2 m diameter vertical access manhole located 34 m downslope of the highway centerline. A drawing note described the installation methodology as "Installed SWSP by augering and jacking through the existing road fill, backfill of culvert ends and other typical details in accordance with Std Drawing S-1418-03". Another drawing note indicated</p>			

“Organic, and soft/yielding materials removed from existing slope failures prior to backfilling”.

The 2015 Bridge Inspection Report indicated culvert distortions, along with a 10 mm wide crack at 26 m from the upstream end, a 23 mm crack with clay at 67 m from the upstream end, and a 100 mm wide crack exposing clay at 93 m from the upstream end.

The cracks and subsidence in the south embankment slope are evidence that a landslide has formed in the slope at this location. This is supported by 2015 reports from AT that the culvert barrel had become distorted and separated, which indicate that the landslide is deep seated.

Similarly, cracks in the north embankment slope which have retrogressed to near the highway also suggest a landslide has developed. This is also supported by a documented crack in the culvert. This landslide might have been triggered by loss of toe support due to erosion caused by the tributary creek. Highway ditch runoff erosion (at the TRM/gabion intersections) may have also been contributing factors.

There is currently significant settlement observed overtop of the culvert at Site 2, in the form of dips and cracks in the highway. The subsidence and cracking could be the result of embankment fill settlement but might also be an indication that the slide movement will eventually retrogress towards the highway or has already.

At PH077-1, the slide roughly paralleling the creek and highway is a direct result of erosion by Hines Creek and resulting soil loss along the toe of the embankment. The slope will tend to flatten with time due to loss of cohesion in the clay fill embankment material. Therefore, the slide could also gradually enlarge into the driving lanes of the highway surface, and there are already indications of this presumably starting to occur based on the existing cracks and dips in the highway. The smaller 15 m wide slide near the east end of this site may have been triggered by east ditch runoff erosion, and/or having a slope that is too steep for the composition material of the embankment. Ditch or surface erosion of the slope could also contribute to more rapid slope movements.

Recommendations:

\$ Ballpark Cost

In the short term, regular monitoring of these sites should be undertaken for enlargement. If any of the slides encroach into the shoulders of the highway, barricades should be erected and enhanced with warning signage until highway repairs are undertaken. A temporary detour upslope (to the north of the highway) may also be required depending on the extent of the highway affected.

PH077-1:

Medium Term: The recommended repair for only the small, shallower slide near the east end of the site is to subexcavate the failed slide mass down to intact clay and rebuild the slope with imported pitrun gravel. The new fill material should be placed and compacted in thin horizontal lifts, benched into the intact slope surface, possibly utilizing a gravel shear key to stabilize the slide area. Some of the more suitable excavated clay could be used to provide a covering layer overtop the gravel as the finished slope surface to shed runoff. A subdrain should be installed along the base of the slide excavation surface, to drain any surface/subsurface water that may enter the rehabilitated slide mass. The east ditch along the toe of this slide should be re-contoured and lined with either TRM or gabions. All existing topsoil should also be stripped and salvaged for replacement and seeded at completion of the repairs.

\$350,000

Medium to Long Term: A short highway re-alignment around the affected highway may be feasible. In order to meet the existing bridge (~100 m to the west), it would not be able to be a significant detour but could work if only a small portion of the highway was affected by a slide. The eroded slope should be cut back to a flatter inclination. Riprap should also be installed along the toe of the existing south embankment to mitigate future creek erosion. Rock vanes could be considered in conjunction with riprap to reduce the quantity of riprap required. Environmental approvals (DFO, AEP) for working within the confines of Hines Creek would first need to be authorized for any rock or riprap placement.

\$2 to \$3 Million

Long Term: Alternatively, due to the anticipated slide depth extending down to creek level and the embankment height (~13 m), a pile wall is feasible at this site. It would need to be a tied back pile wall (multiple anchors/pile), and a detour would be required to the north of the highway during construction. Perhaps other measures may be required in addition to the tied back pile wall, such as offloading a portion of the downstream embankment, and/or lightweight fill replacement of soil. A minimum length of 100 m of pile wall would be required to span the slide length at this site. Riprap should also be installed to mitigate creek erosion for this option.

\$4 Million

PH077-2:

Short Term: The breaks in the joints of the culvert should be sealed by installing a thin sleeve at each joint that is welded on the upstream side and shingles in the downstream direction over the gap, or by sealing the gap with ethafoam on an annual basis until more permanent repairs can be completed. In 2020, it was understood that the bridge group were pursuing doing some minor remedial work at this site and perhaps some sleeves were already included in that work.

Long Term: A potential long-term solution is a highway re-alignment to the north, done in conjunction with the re-alignment for Site 1, before meeting the existing bridge over Hines Creek. A re-alignment could allow some flattening of the south slope leading down to the creek. For this option, the top section of the culvert might need to be re-profiled to remain within the embankment fill and the inlet end of the pipe would need to be extended to allow a shift and flattening of the north embankment slope. The damaged pieces of the pipe will need to be repaired. Some shear piles might also be needed in the south slope.

\$6 Million

Investigation: As a minimum recommendation, at least 2 or 3 test holes drilled at each site complete with piezometer and slope inclinometer installations to establish the soil and groundwater conditions, is required. At PH077-1, 2 holes should be located along the south edge of the highway. At PH077-2, 1 hole should be along the north side of the highway, 1 along the south edge of the highway, and 1 further downslope on the south embankment.

\$175,000

Additional test hole drilling would be required if a highway realignment or a pile wall is considered. The culvert pipe should also be re-inspected for further signs of distress, and the locations of any distress should be surveyed. A topographic survey, detailed design and tender package will also be required prior to carrying out the remedial measures.

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

Nicole Wilder, P.Eng.
Geotechnical 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.

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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.

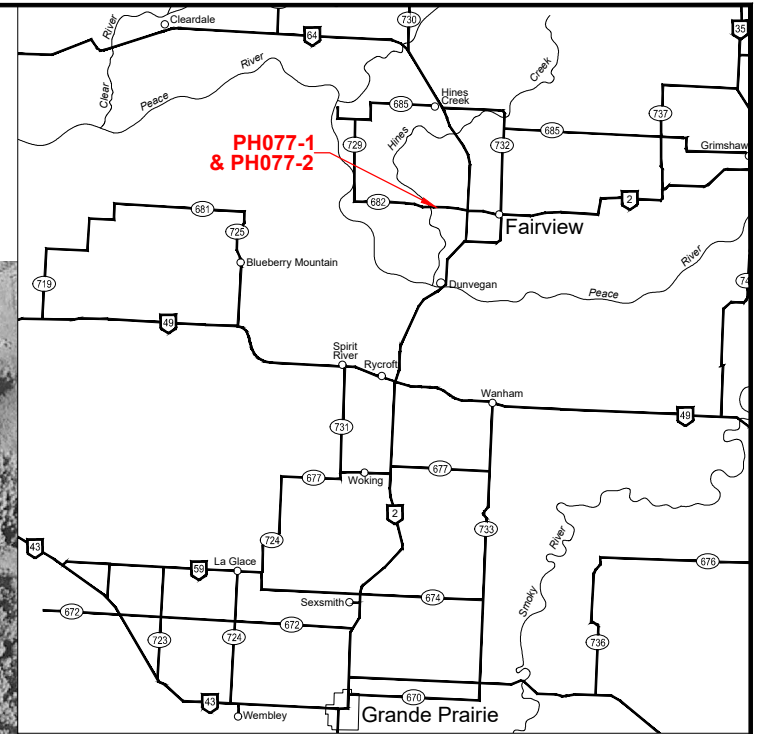
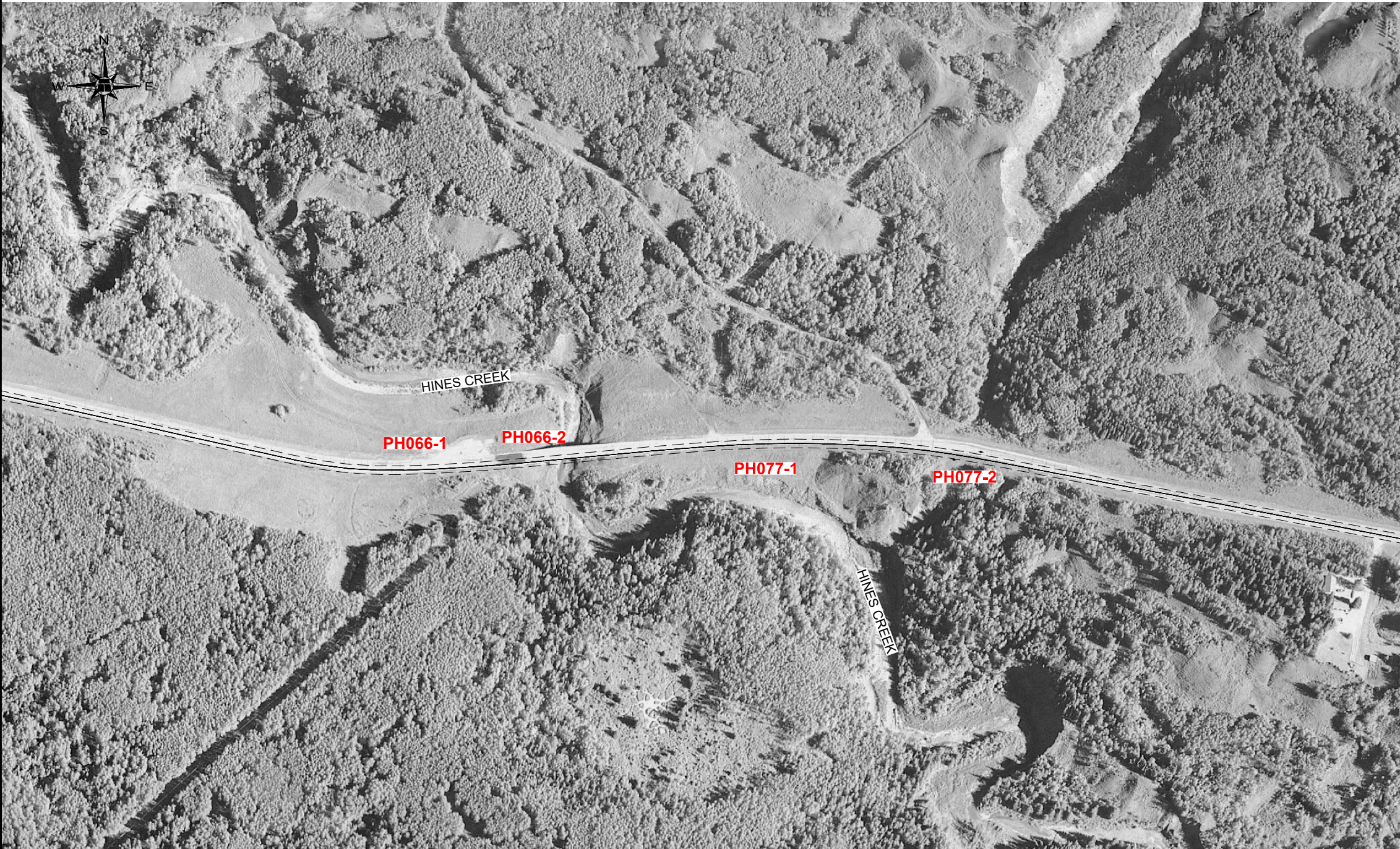
6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

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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H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\CAD\2021\NPW\32123 PH077-1-18-2.dwg - OVERALL - Oct. 10, 2021



KEY PLAN
SCALE 1:1 500 000

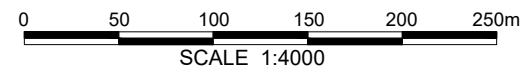
BASE AIRPHOTO TAKEN IN JULY 2, 2006 TO AUGUST 10, 2006



**PEACE REGION (GRANDE PRAIRIE DISTRICT - NORTH)
PH077-1 & PH077-2 EAST SIDE OF HINES CREEK BRIDGE
HWY 682:02, km 12.6-12.7**

SITE LOCATION PLAN

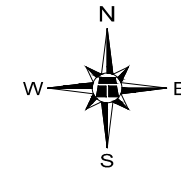
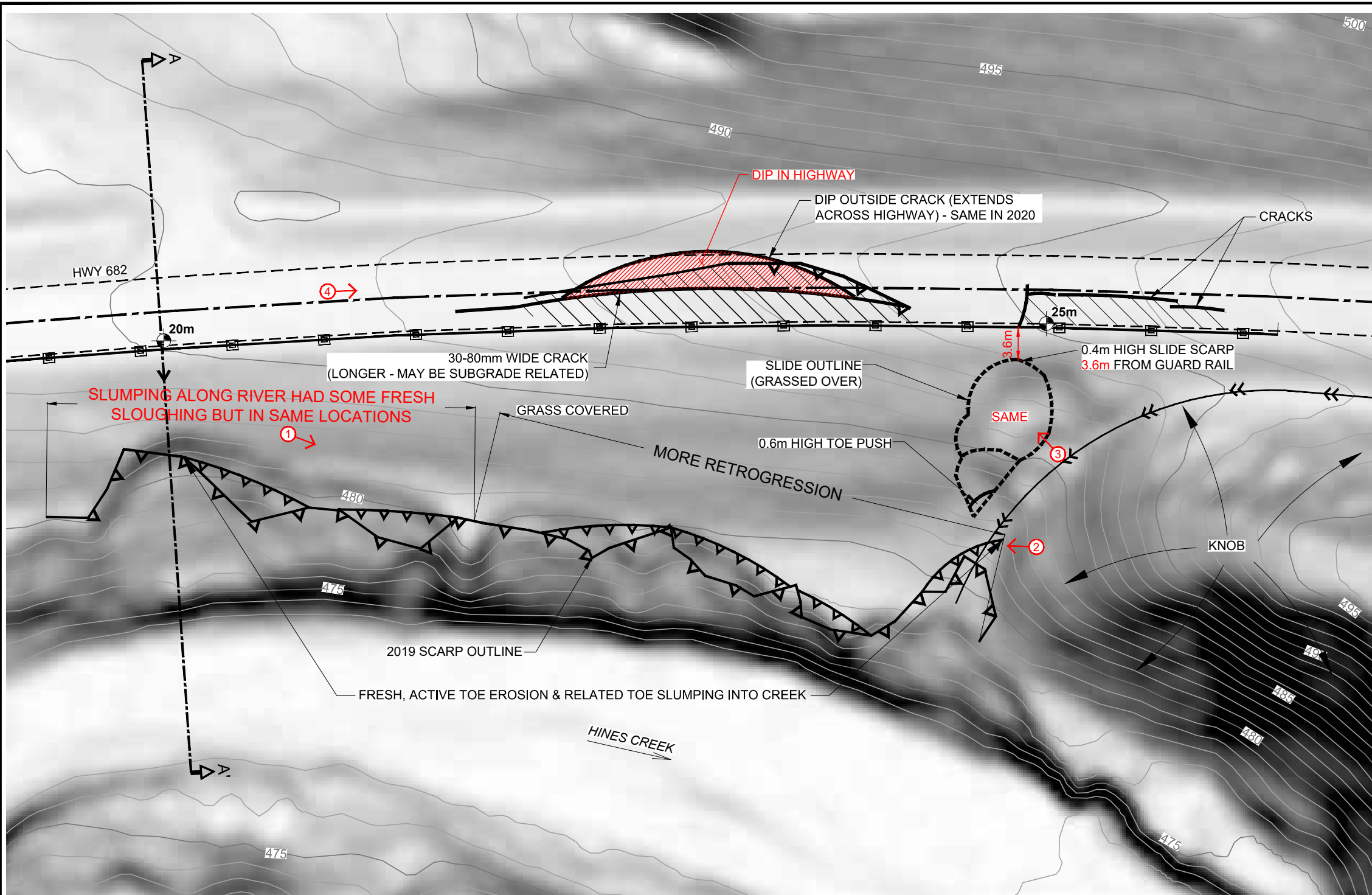
DWG No. 32123-PH077



DRAWN BY	ML
DESIGNED BY	BDM
APPROVED BY	DWP
SCALE	1:4000
DATE	JULY 13, 2021
FILE No.	32123



H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\CAD\2021\NPW\32123 PH077-1-1-1-1-1 - Oct. 10, 2021

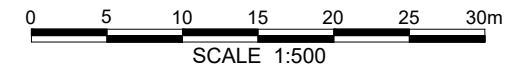


LEGEND

- APPROXIMATE GUARD RAIL LOCATION
- DITCH
- DIRECTION AND NUMBER OF PHOTO
- SLIDE SCARP
- PROPOSED SI / PIEZOMETER LOCATION
- 25m DEPTH OF THE TEST HOLE IN METRES

NOTES

1. JULY 13, 2021 OBSERVATIONS SHOWN IN RED.
2. LOCATIONS ESTIMATED WITH HANDHELD GPS.



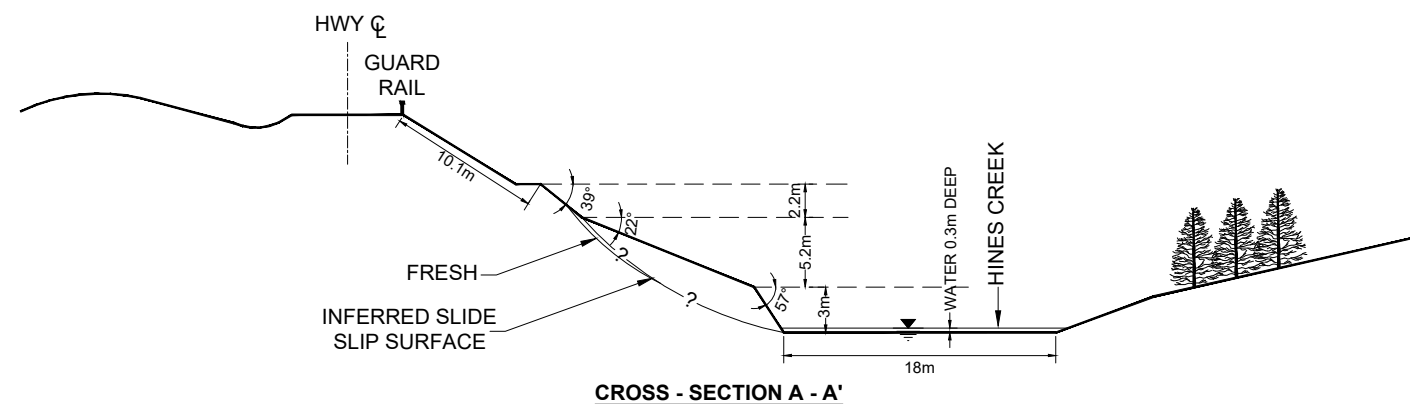
BASE LIDAR FLOWN IN 2015



PEACE REGION (GRANDE PRAIRIE DISTRICT - NORTH)
PH077-1: EAST SIDE OF HINES CREEK BRIDGE
HWY 682:02, km 12.6-12.7

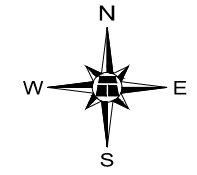
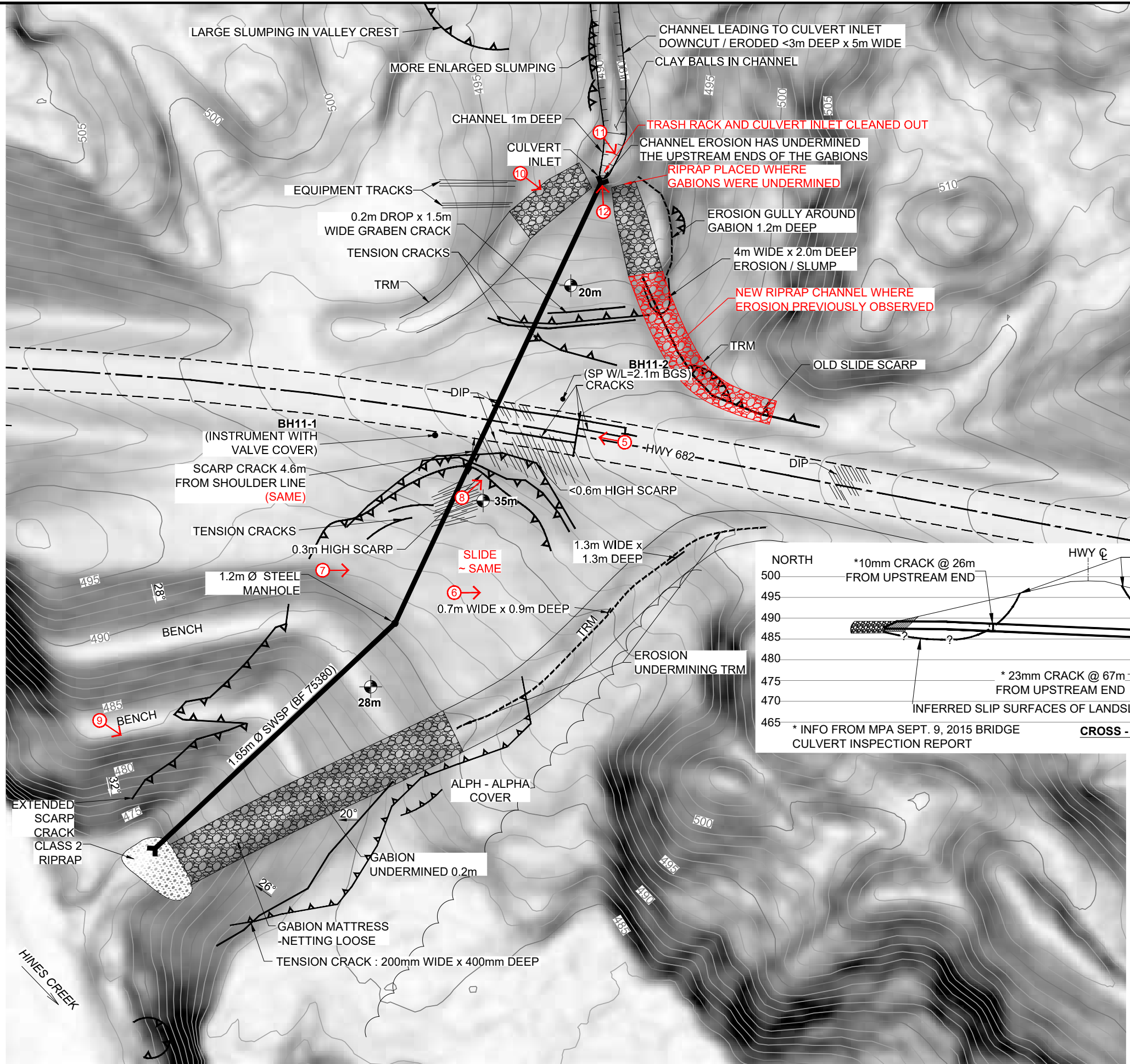
INSPECTION PLAN - SITE 1

DWG No. 32123-PH077-1-1



DRAWN BY	ML
DESIGNED BY	BDM
APPROVED BY	DWP
SCALE	1:500
DATE	JULY 13, 2021
FILE No.	32123



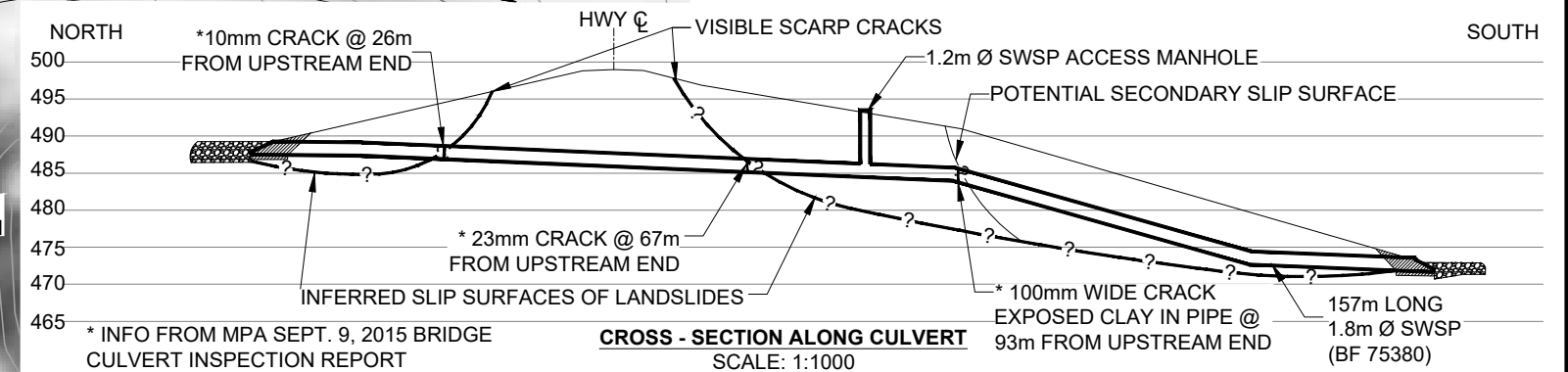


LEGEND

- SLIDE SCARP
- APPROXIMATE TREE LINE
- APPROXIMATE GUARD RAIL LOCATIONS
- PHOTOGRAPH NUMBER, AND APPROXIMATE DIRECTION AND LOCATION
- GABION MATTRESS
- SETTLEMENT AREAS
- PROPOSED SI / PIEZOMETER LOCATION
- 25m** DEPTH OF THE TEST HOLE IN METRES

NOTES

1. SITE RELATIVELY UNCHANGED.
2. GABIONS LACKING INTERMEDIATE BAFFLES AND LIDS NOT ADEQUATELY TIED.
3. JULY 13, 2021 OBSERVATIONS SHOWN IN RED.



BASE LIDAR FLOWN IN 2015



PEACE REGION (GRANDE PRAIRIE DISTRICT - NORTH)
PH077-2: EAST SIDE OF HINES CREEK BRIDGE
HWY 682:02, km 12.6-12.7

INSPECTION PLAN - SITE 2

DWG No. 32123-PH077-2-1

DRAWN BY	ML
DESIGNED BY	BDM
APPROVED BY	DWP
SCALE	1:750
DATE	JULY 13, 2021
FILE No.	32123





Photo 1 – Looking east at Slide PH077-1 at the erosion along the north side of the Creek.



Photo 2 – Looking west at the fresh toe slumping above the creek at PH077-1 in the south highway embankment.



Photo 3 – Looking north upslope at the slide scarp adjacent to the highway at PH077-1.



Photo 4 - Looking east along the highway at the crack/dip in the highway above the Slide at PH077-1.



Photo 5 - Looking east along the highway across PH077-2. Note the settlement and cracking in the highway.



Photo 6 – Looking north along the TRM ditch channel of PH077-2.



Photo 7 - Looking east along the south hwy embankment and southeast ditch drainage channel of PH077-2, Hines Creek.



Photo 8 – Looking north towards the hwy from the south embankment of PH077-2, at the slide scarp in proximity to the highway.



Photo 9 - Looking southeast at the culvert outlet area of PH077-2. Note the riverbank slumping east of the culvert outlet.



Photo 10 – Looking south at the erosion along the northeast ditch crotch leading to the culvert inlet area of the north embankment of PH077-2. The riprap protection has been extended further upslope on the east side since the 2020 inspection



Photo 11 – Looking south at the culvert inlet area of the north embankment of PH077-2. The trash rack and culvert inlet were cleaned of debris since the 2020 inspection.



Photo 12 - Looking north along the infilled channel leading into the culvert inlet north of the highway at PH077-2.