

**ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION (GRANDE PRAIRIE DISTRICT– NORTH)
2023 INSPECTION**



THURBER ENGINEERING LTD.

| Site Number | Location | Name | Hwy | km |
|-------------------|------------------|---------------------------------|----------|-----------|
| PH067 | West of Fairview | East Hill Ditch Erosion Section | 682:02 | 13.8-14.1 |
| Legal Description | | UTM Co-ordinates (NAD 83) | | |
| Centre 36-81-5-W6 | | 11 N 6214450 | E 398000 | |

| | Date | PF | CF | Total |
|-----------------------------|---|----|--------------|-------------------------|
| Previous Inspection: | May 17, 2022 | 12 | 4 | 48 (Erosion Risk Scale) |
| Current Inspection: | May 30, 2023 | 12 | 4 | 48 (Erosion Risk Scale) |
| Road AADT: | 160 | | Year: | 2022 |
| Inspected By: | Don Proudfoot, Nicole Wilder (Thurber) Max Shannon, Rishi Adhikari, Ken Szmata, (TEC) | | | |
| Report Prepared By: | Nicole Wilder, Don Proudfoot (Review) | | | |
| Report Attachments: | <input checked="" type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input checked="" type="checkbox"/> Maintenance Items | | | |

| | | |
|---|--|-------------------------------------|
| Primary Site Issue: | Highway North Ditch Erosion – from top of East Hill to Grimm's Creek. | |
| Dimensions: | About 700 m long by <10m wide | |
| Date of any remediation: | 2017 (under Contract 18261) - Installation of erosion protective liners along a 600 m length of the north ditch, consisting of a combination of 3 types of riprap and 2 types of Articulated Concrete Block (ACB) mats (which formed part of compound liners). Also, a north highway embankment slump was repaired, and a riprap channel leading to the ACB mat was installed. | |
| Maintenance: | 2007 - Riprap placement in scour bowl near top of hill, a portion of the backslope was flattened, and ditch erosion backfilled. 2013 - After spring runoff as emergency measures, grading and uncompacted pitrun gravel placed for ditch/shoulder erosion. 2014 - Large riprap placement below culvert outlet near top of hill. 2016 (fall) – Ditch erosion was backfilled with some clay obtained from cutting the backslope, then topped with track-packed pitrun gravel. | |
| Observations: | Description | Worse? |
| <input checked="" type="checkbox"/> Pavement Distress | Cracks in 3 areas, no change noted in 2023. | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> Slope Movement | A dip and crack across the highway adjacent to the sag pond (first observed in 2014) had no noticeable change. Some north hwy. embankment slumping caused by the adjacent north ditch erosion was worse in 2023. There was more slumping on the north slope near where the ACB blocks began caving in. | <input checked="" type="checkbox"/> |
| <input checked="" type="checkbox"/> Erosion | There were a few areas showing erosion activity at intermittent locations along the north ditch. The most severe was near the west end at the steep gradient leading to Grimm's Creek where a 75 m length of the ACB mat is now undermined and new erosion gullies and tension cracks have formed. The ditch erosion ~100 m long upslope of the ACB mats installed in 2017 at the top of the east hill has also gotten slightly worse. There is erosion in the north ditch east of where the ACB blocks begin that has significantly worsened and is up to 3.6 m wide and 1 m deep and 2.1 m away from the white pavement line on the highway. | <input checked="" type="checkbox"/> |

| | | |
|--|--|-------------------------------------|
| <input checked="" type="checkbox"/> Seepage | Several areas along the ACB mats had water flowing and the erosion that formed upslope (east) of the mats had water ponding and flowing slightly. Water was ponding within the riprap as well. | <input checked="" type="checkbox"/> |
| <input type="checkbox"/> Bridge/Culvert Distress | | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> Other | Some willows were observed growing through the ACB mats where they were in good condition. | <input checked="" type="checkbox"/> |
| Instrumentation: None | | |
| <p>Assessment:</p> <p>The ditch erosion at this site was remediated in 2017 under Contract 18261 (in conjunction with other erosion repairs at neighbouring sites PH029 and PH066), utilizing various types of surface linings, consisting of: Class 1M riprap for the 3 to 4 percent gradients, Class 2 riprap for the dissipation bowls, Class 40T articulated concrete block (ACB) mats for the 5 to 8 percent gradients, and Class 60T ACB mats for the steepest gradients.</p> <p>The 2018 spring snowmelt flows over the new ditch linings were extreme, as evidenced by videos taken/shared by a member of TEC ~ April 25, 2018, however everything appeared to be functional at that time. Information from the maintenance contract inspector suggested that some erosion problems had been observed a few days after this in some areas of the surface liners. Our May 16, 2018, annual site inspection showed that some areas contained erosion damage, most of it relatively minor or that which occurred on unprotected areas not included under Contract 18261 work. However, the lower 45 m of the Class 60T mats on the steepest slope (Sta 3+525 to Grimms Creek), sustained major damage consisting of undermining and formation of new gullies under/alongside the mats. Each year since 2018, this major erosion damaged area has steadily regressed further upslope, currently affecting the mats to about Sta 3+597 (75 m above the downslope end). Also, the associated erosion head scarp elongation in this area has similarly retrogressed closer to the highway. A design to repair the eroded areas was prepared but has not been implemented due to lack of available funding. If left unattended, the erosion will continue to lead to further degradation and enlargement and could soon start affecting the highway. A slide related tension crack was 0.3 m from the edge of highway at the time of the recent inspection.</p> <p>Since installation of the ACB mats in 2017, it has been observed that there is increasing abrasion and spalling of many blocks with some broken blocks located along the very bottom (center) portion of the ACB mats in the channel, with the thicker 60T mat blocks (~Sta 3+340 to 3+265) in noticeably worse condition than the thinner 40T mat blocks further east. It is anticipated that highway salt and/or freeze-thaw conditions may be contributing to the degradation of these ACB mat blocks.</p> <p>In conjunction with associated warranty work for Contract 18261, in the fall of 2018 the channel leading from the dugout runoff exit to the ACB mats near the top of the east hill was modified to remedy the erosion and undermining that occurred in the spring of 2018. The 1 m dia. half culvert was removed, and a combination of Class 2 (bottom) and Class 1 (flanks) riprap was placed over non-woven geotextile over a re-compacted clay base shaped in a 1 m wide flat-bottomed channel with 3H:1V side slopes.</p> <p>The dip across the highway near the sag pond (first noticed in 2014 ~Sta 3+200), has not gotten any worse this year, however new cracks appeared in 2020 and suggests that a landslide might be developing at this location, moving southward.</p> | | |
| <p>Recommendations:</p> <p>It is understood that engineering is scheduled for 2024 and that repair work could be combined with PH029 Grimms Creek</p> <p>Maintenance:</p> <p>Repair the damaged guardrail end at ~Sta 3+437.</p> <p>Consider installing culverts (900 or 1200 mm diameter) in the slumping channel areas upstream of the existing 1524 mm diameter culvert inlet, to allow flow to the existing culvert while minimizing debris and potential blockage.</p> | | |

Spray the willows that are growing in the lined channel with broadleaf pesticide to eliminate the trees from growing larger as their presence, if left unchecked, could impede drainage and cause high flows to erode outside the lined channel

Short Term:

Continue monitoring the slide that appears to be developing across the highway near the sag pond.

Remedial repairs of the eroded areas should be carried out, which could consist of:

- 1) Sta 3+500 to Grimms Creek: Completely remove the damaged ACB block mats then fill/compact the eroded bottom with clay then repair with a stepped structure consisting of sheet piles and class 3 or grouted Class 2 riprap.
- 2) Extending the length of the CI 2 riprap dissipation bowl by at least 15 m (Sta 3+360 to 3+375), where flow scoured the existing CI 1M riprap and exposed the underlying non-woven geotextile and deepening the channel to accommodate the larger riprap. Then re-arranging the moved CI 1M riprap over the 40 m length of channel downstream of this.
- 3) Repairing the short erosion gully that outlets from the sag pond onto the ACB mats (Sta 3+195) and installing a CI 1 riprap channel with a compacted clay cut-off leading onto the top of the mats.

Ballpark Cost ~\$500,000

Long Term:

The newly eroded 120 m section of north ditch at the east end of the site that extends from the beginning of the 40T ACB mats at Sta 2+975 to the 500 mm dia. approach ditch culvert further east will eventually need to be repaired, using either Class 2 riprap, or gabion mattress.

Ballpark Cost (Including Short Term Measures) ~\$200,000

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

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.

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.

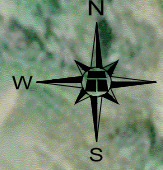
6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

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.

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PH29 GRIMMS CREEK

HWY 682

2m HIGH BACKSLOPE SCARP ALONG BUSH LINE

SAG POND

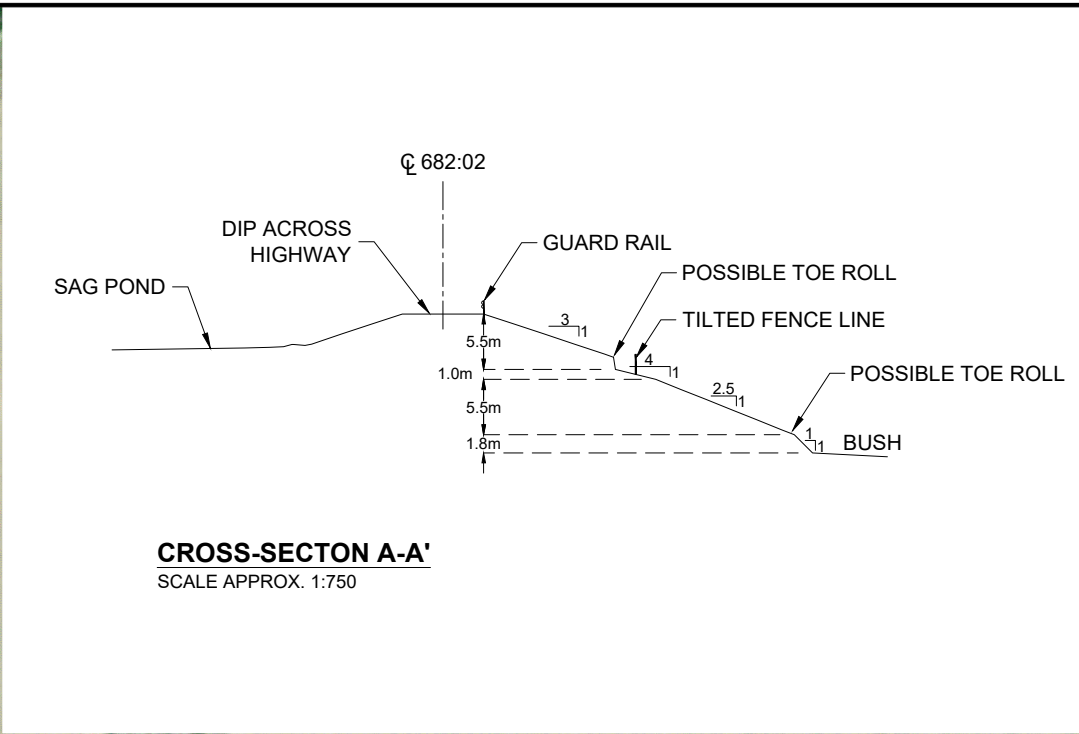
DUGOUT

HILL

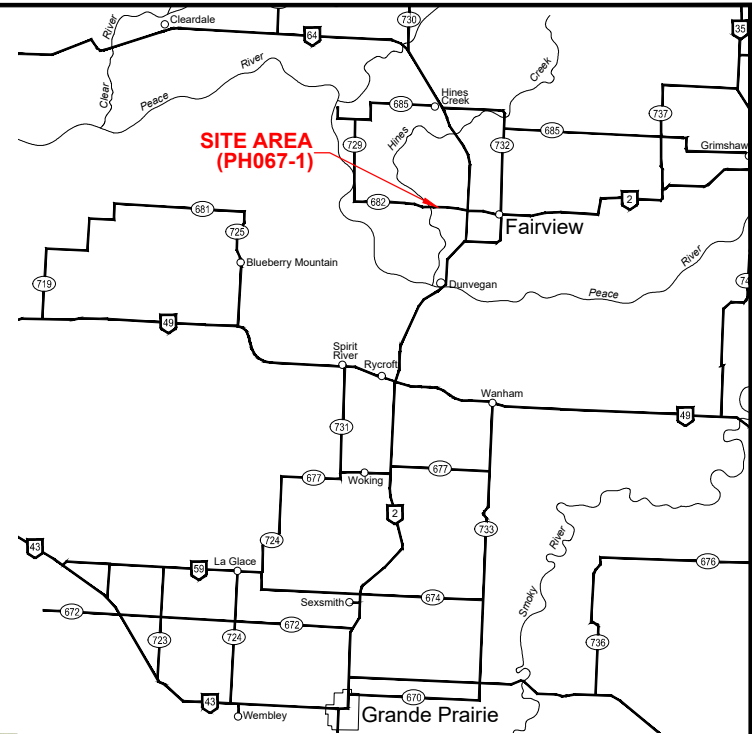
46m

HILL

SLIDE STARTING DIP AND CRACK NOTED ACROSS HIGHWAY APPEARED THE SAME IN 2023

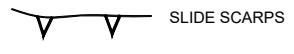


CROSS-SECTION A-A'
SCALE APPROX. 1:750



KEY PLAN
SCALE 1:1 500 000

LEGEND



BASE AIR PHOTO FROM ESRI WORLD IMAGERY EXPORTED ON SEPTEMBER 29, 2022



PEACE REGION (GRANDE PRAIRIE DISTRICT - NORTH)

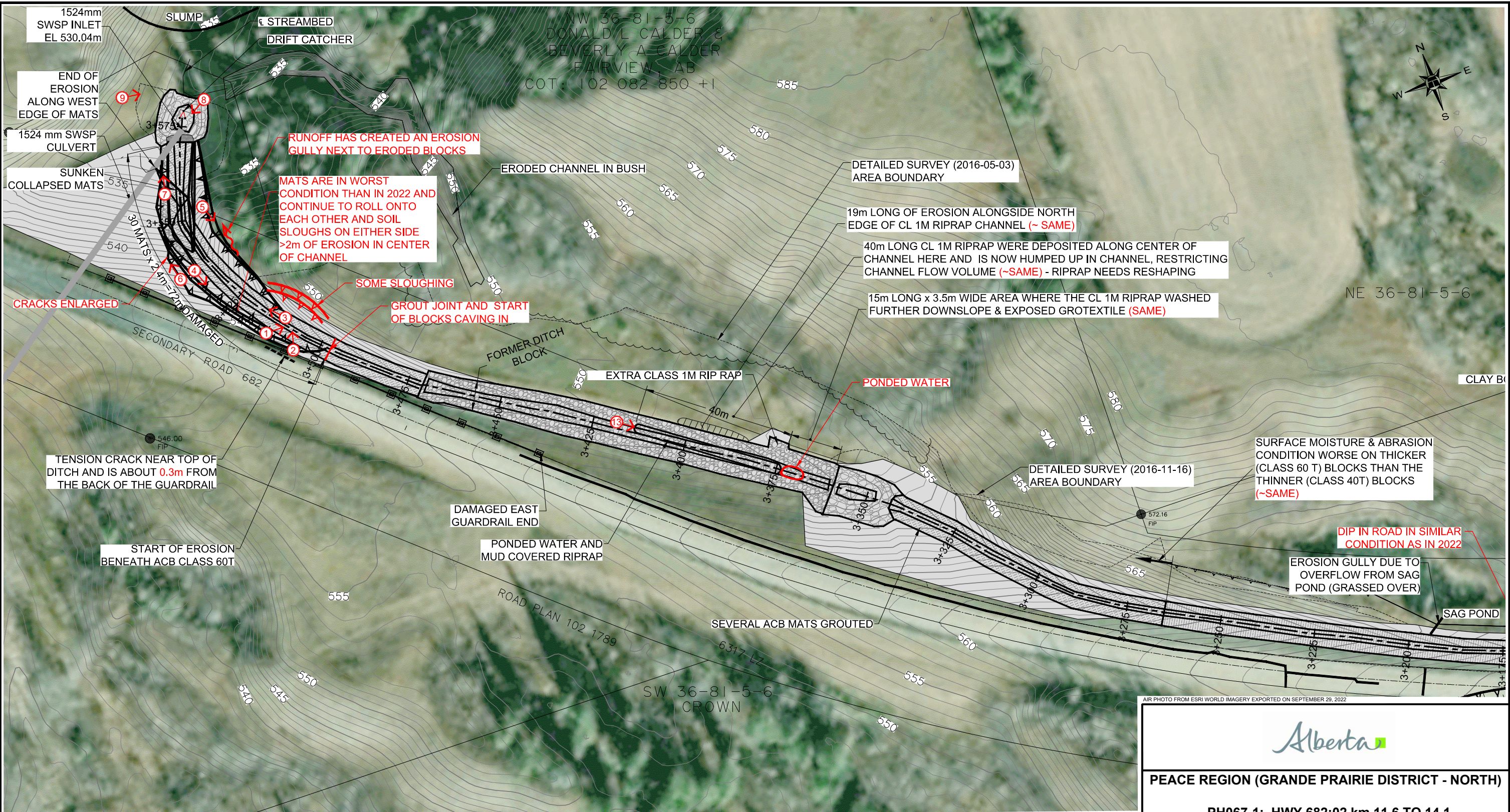
PH067-1: HWY 682:02 - HINES CREEK
2023 INSPECTION PLAN

DWG No. 32123-PH067-1-1

| | |
|-------------|----------------|
| DRAWN BY | ML |
| DESIGNED BY | BDM |
| APPROVED BY | DWP |
| SCALE | APPROX. 1:2500 |
| DATE | SEPTEMBER 2023 |
| FILE No. | 32123 |



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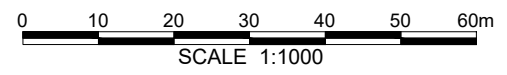


LEGEND

- CRACK IN PAVEMENT
- EDGE OF BUSH
- HWY 682 SURFACE (8.2m WIDE)
- FIP / PROPERTY LINE
- EMBANKMENT SLUMP OUTLINE
- GUARD RAIL LOCATIONS
- BOUNDARY OF DETAILED SURVEY
- RIPRAP
- ACB - CLASS 60T
- ACB - CLASS 40T
- GRADING LIMITS
- PHOTOGRAPH NUMBER, AND APPROXIMATE DIRECTION AND LOCATION
- SLIDE SCARPS

NOTES :

1. FEATURE LOCATIONS ARE APPROXIMATE
2. PREVIOUS OBSERVATIONS SHOWN IN BLACK
3. **MAY 30, 2023 FEATURES SHOWN IN RED**
4. ADVANCED ABRASION & SPALLING OF ACB MAT BLOCKS AND MANY BROKEN BLOCKS ALONG CENTER BASE OF CHANNEL; SOME MATS WORSE THAN OTHERS.
5. HIGHWAY SAND / SALT STAINING ALONG BASE & HIGHWAY SIDE OF ACB MATS IN CHANNEL.

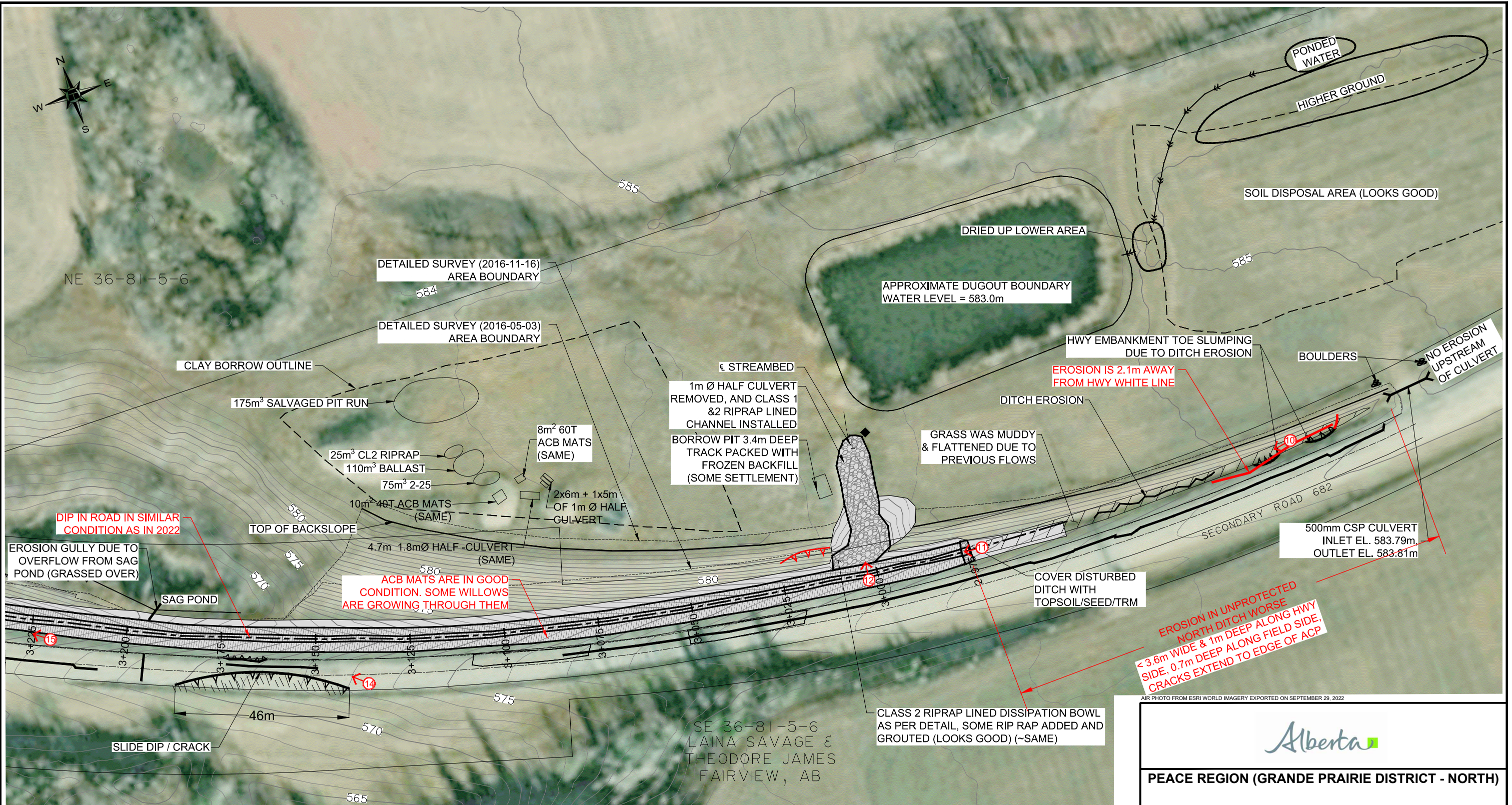


PEACE REGION (GRANDE PRAIRIE DISTRICT - NORTH)
PH067-1: HWY 682:02 km 11.6 TO 14.1
DITCH EROSION REPAIRS
SITE 3
DWG No. 32123-PH067-1-2

| | |
|-------------|----------------|
| DRAWN BY | ML |
| DESIGNED BY | NPW |
| APPROVED BY | DWP |
| SCALE | 1:400 |
| DATE | SEPTEMBER 2023 |
| FILE No. | 32123 |

THURBER ENGINEERING LTD.

H:\32000\32123 AT GRMP Grande Prairie District North 2021-2025\CAD\2023\NPW\32123 PH067-1-2-3.dwg - 2 - Aug. 31, 2023



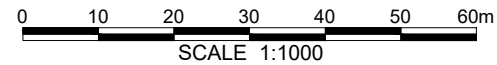
AIR PHOTO FROM ESRI WORLD IMAGERY EXPORTED ON SEPTEMBER 29, 2022

LEGEND

- CRACK IN PAVEMENT
- HWY 682 SURFACE (8.2m WIDE)
- FIP / PROPERTY LINE
- BOUNDARY OF DETAILED SURVEY
- RIPRAP
- ACB - CLASS 40T
- GRADING LIMITS
- "DANGER - OPEN CULVERT" SIGN
- SLIDE SCARPS
- PHOTOGRAPH NUMBER, AND APPROXIMATE DIRECTION AND LOCATION

NOTES :

1. FEATURE LOCATIONS ARE APPROXIMATE
2. PREVIOUS OBSERVATIONS SHOWN IN BLACK
3. MAY 30, 2023 FEATURES SHOWN IN RED



PEACE REGION (GRANDE PRAIRIE DISTRICT - NORTH)

PH067-2: HWY 682:02 km 11.6 TO 14.1
DITCH EROSION REPAIRS
SITE 3

DWG No. 32123-PH067-1-3

| | |
|-------------|----------------|
| DRAWN BY | ML |
| DESIGNED BY | NPW |
| APPROVED BY | DWP |
| SCALE | 1:1000 |
| DATE | SEPTEMBER 2023 |
| FILE No. | 32123 |





Photo 1. Looking east along the beginning of the eroded ACB mat area north of the highway. Photo credit: Nicole Wilder.

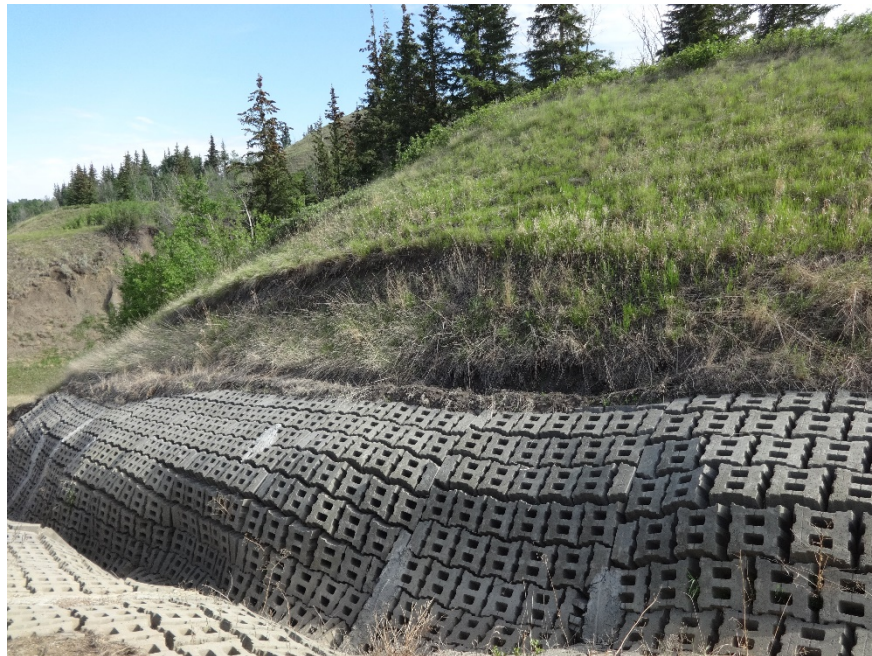


Photo 2. Looking north along the edge of the eroded ACB mat area. Note the recent scarp extension along the north edge of the mats. Photo credit: Nicole Wilder.



**Photo 3. Looking northwest along the severely damaged ACB mat area and enlarged slide scarp area.
Photo credit: Don Proudfoot.**



Photo 4. Looking southeast at the severe erosion through the ACB mats. Note the enlarged erosion and slide developing south of the mats. Photo credit: Nicole Wilder.



Photo 5. Looking southeast along the north edge of the eroded ACB mats. Here the mats have slid down into the deeply eroded channel, exposing the underlying gravel. Photo Credit: Nicole Wilder.



Photo 6. Looking north along the southwest side of the damaged and eroded ACB mats. Photo Credit: Nicole Wilder.



Photo 7. Looking northwest across the eroded mat area near the bottom of the slope. Photo Credit: Don Proudfoot.



Photo 8. Looking southwest at the culvert inlet, trash rack and eroded ACB mat area leading to it. Photo Credit: Nicole Wilder.



Photo 9. Looking north at the slumping and infill occurring into the channel upstream of the 1524 SWSP culvert entrance. Photo Credit: Nicole Wilder.



Photo 10. Looking northwest from the EBL of Hwy 49:06 at the east end of the site. Photo Credit: Nicole Wilder.



Photo 11. Looking west at blocks and where grass had previously been flattened by mud. Photo Credit: Nicole Wilder.



Photo 12. Looking north at where riprap was previously placed, appears to be in good condition. Photo Credit: Don Proudfoot.



Photo 13. Looking east at area within riprap that now has mud covering some of the riprap likely from high runoff flow events and ponding afterwards. Photo Credit: Nicole Wilder.



Photo 14. Looking northwest at cracks in asphalt and dip in highway. Photo Credit: Nicole Wilder.



Photo 15. Looking northwest at the ACB Matting performing well but had some willows growing out of them. Photo Credit: Nicole Wilder.



Photo 16. Looking northeast down at eroded ACB blocks and channel along them. Photo Credit: Drone-Nicole Wilder.