**ALBERTA TRANSPORTATION**
**GEOHAZARD ASSESSMENT PROGRAM**
**PEACE REGION (PEACE RIVER DISTRICT)**
**2021 INSPECTION**

THURBER ENGINEERING LTD.

| Site Number | Location | Name | Hwy | km |
|---|---|---|---|---|
| SH010-1 | Little Smoky River | Little Smoky River Valley, South Hill – Site #1 | 744:02 | 14.4-14.7 |
| **Legal Description** | | **UTM Co-ordinates** | | |
| NE-13-76-23-W5 | | 11U E 473,759 | N 6,160,016 | |

| | Date | PF | CF | Total |
|---|---|---|---|---|
| **Previous Inspection:** | 2-June-2020 | 11 | 3 | 33 |
| **Current Inspection:** | 29-June-2021 | 13 | 3 | 39 |
| **Road AADT:** | 240 | | **Year:** | 2020 |
| **Inspected By:** | Rocky Wang, TRANS<br>Ed Szmata, TRANS<br>Max Shannon, TRANS | | Barry Meays, Thurber<br>Mark Gallego, Thurber | |
| **Report Attachments:** | ☑ Photographs<br>☑ Plans | | ☐ Maintenance Items | |

| | | |
|---|---|---|
| **Primary Site Issue:** | Highway traverses deep-seated, retrogressive landslide with ongoing creep movement due partly to erosion at toe by the Little Smoky River resulting in cracking and sagging of the pavement surface at several locations. Site #1 is 110 m above and 1.1 km from the Little Smoky River. | |
| **Dimensions:** | Two erosion gullies on backslope from overland drainage.<br>200 m of reactivated scarp located 15 m downslope of the highway (north of culvert) and slumping located 30 m from highway (south of culvert). | |
| **Date of Remediation:** | 1974: Realigned of highway upslope due to movement.<br>2004: 600 m realignment of Hwy 744 through SH10 and SH28 approx. 10 m into backslope with toe berm and surface drains | |
| **Maintenance:** | 2020: Line painting | |
| **Observations:** | **Description** | **Worsened?** |
| ☑ Pavement Distress | Crack across highway at km 14.5 with dip forming to the north | ☑ |
| ☑ Slope Movement | Two older slump blocks downslope of the highway have become active. Recent movement on a third block burying the lower portion of the gabion mattress swale. Scarp cracks are also present between the north slump and the highway. | ☑ |
| ☑ Erosion | Two gullies on backslope: north is 3.1 m wide and 1.9 m deep and the south is >4 m wide and 1.0 m deep at the crest.<br>Short gully on sideslope at km 14.4 is stable | ☑ |
| ☐ Seepage | | ☐ |
| ☐ Bridge/Culvert Distress | Two 800 mm centreline CSP culverts are in good condition. | ☐ |

| | | |
|---|---|---|
| ☑ Other | Sediment from gullies accumulating over ditch gabion check baskets | ☑ |

**Instrumentation:**

None.

**Assessment:**

The overall valley slope is moving as several separate slide blocks in response to the toe erosion and downcutting by the Little Smoky River resulting in numerous scarps, sag ponds, and differential movement zones. South of the bridge, the highway intersects the scarps of these blocks at several locations over 2.7 km with the potential for an uneven highway surface and cracking although the south side of the river valley appears more stable than the north.

The highway at this location has been realigned twice: once in 1974 and again in 2004 after major landslide movements resumed in 1996. Prior to the second realignment, five inclinometers and four piezometers were installed in August 2002; however, these were destroyed or removed during construction. The LiDAR surface inset on the Drawing shows the presence of two toe rolls west of the highway (dashed line) below km 14.45. The plateau below the highway where the toe rolls end appears to be an abandoned river terrace. Section A-A' highlights the relative topography through the area and indicates the proximity to the highway of the recently-activated scarps between km 14.48 and km 14.55.

In 2021, the movement zone of the slide located north of the culvert expanded an additional 20 m south towards the gabion basket swale, with observed vertical displacements of up to 0.8m. The tension cracks observed in 2020 between the highway and the main slide have developed into longer and continuous scarps and have the potential for retrogression to compromise the highway. Cracks have appeared through the asphalt patch in the highway indicating that the north slide might be retrogressing into the highway.

The backscarp of the slide located south of the gabion basket swale (km 14.45) had signs of slight ravelling (freshness) since 2020.

Erosion of the two gullies in the backslope has deepened and regressed further upslope somewhat and will continue to worsen until repaired. Sediment from these gullies is accumulating in the ditch and overtopping the gabion check baskets reducing their effectiveness.

**Recommendations:**

**Short-Term:**
The backslope erosion gullies should be repaired by installing engineered riprap-lined swales extending down to the highway ditch. This work should be undertaken as soon as possible to reduce further erosion.

**Medium-Term:**
Due to the reactivation of the larger slide mass between km 14.48 and km 14.62, it is recommended that a geotechnical investigation be undertaken to understand the stratigraphy and install slope inclinometers to determine the depth and rate of movement. Continued development of this large scarp commensurate with new tension crack formation indicates that the movement is active and regressing toward the highway. It is recommended that two inclinometers be installed within this slide mass and a third placed upslope of the km 14.45 slump.

**Long-Term:**
Overall, the south hill portion of the highway is relatively stable and low maintenance compared to the north hill. However, the new slide is progressing toward the highway, and it is recommended that preliminary engineering be initiated as repair may be required within 5 years. A potential longer term solution might be to construct a large toe berm on the terrace to buttress the moving slope

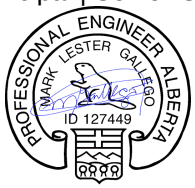
**Ongoing Investigations:**

- Due to the ongoing movements observed at this site, it is recommended that the GeoHazard inspection be undertaken annually.

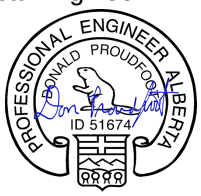
**Closure**

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




October 13, 2021




October 13, 2021

**PERMIT TO PRACTICE**
**THURBER ENGINEERING LTD.**
RM SIGNATURE: Don Proudfoot
RM APEGA ID #: 51674
DATE: October 13, 2021
**PERMIT NUMBER: P005186**
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Mark Gallego, P.Eng.
Geotechnical Engineer

THURBER

# STATEMENT OF LIMITATIONS AND CONDITIONS

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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.

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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.

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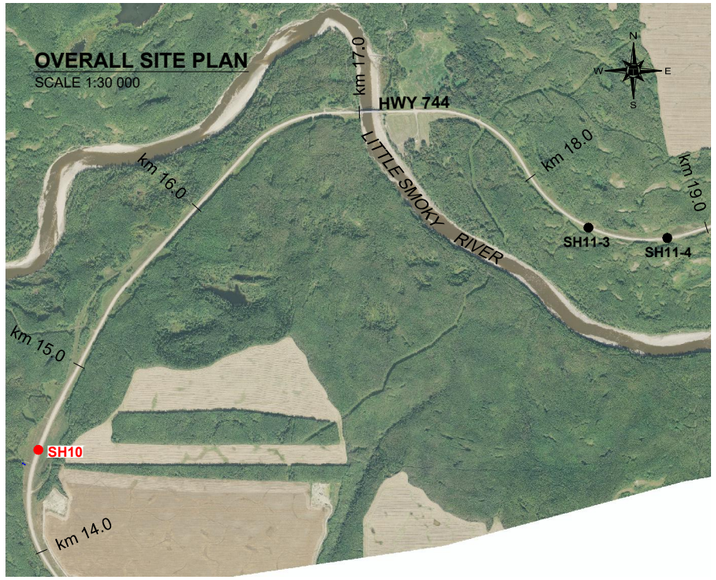
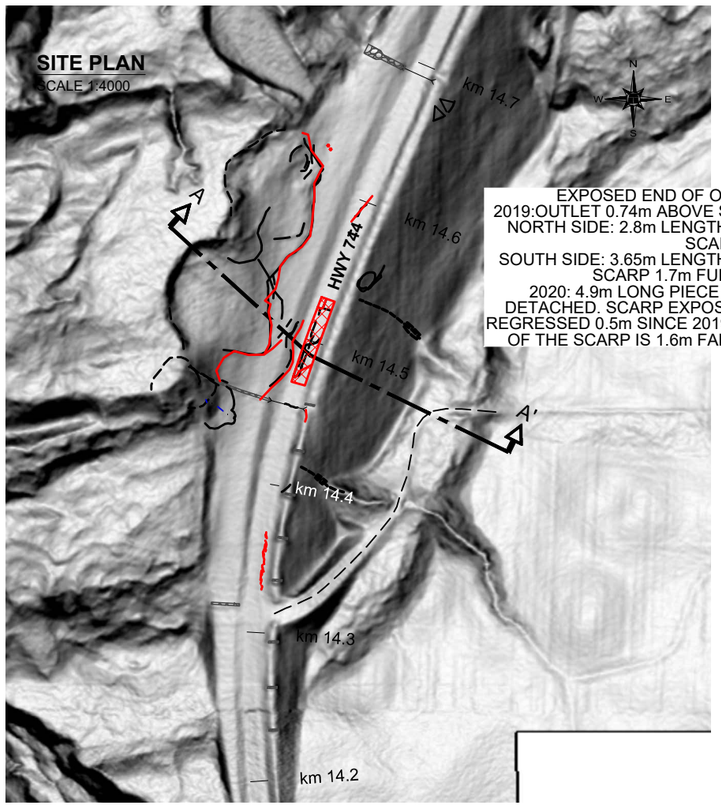



EXPOSED END OF OLD CULVERT. 2019:OUTLET 0.74m ABOVE SCARP BOWL NORTH SIDE: 2.8m LENGTH EXPOSED & SCARP 1.5m HIGH SOUTH SIDE: 3.65m LENGTH EXPOSED & SCARP 1.7m FURTHER BACK; 2020: 4.9m LONG PIECE OF CULVERT DETACHED. SCARP EXPOSING 0.9m SO REGRESSED 0.5m SINCE 2019. A PORTION OF THE SCARP IS 1.6m FARTHER BACK.

## DETAILED SITE PLAN
SCALE 1:1500

GABION BASKET SWALE
800 mm Ø CSP
km 14.7
OLD SCARP (STILL STABLE IN 2019)
BACKWARDS TILT
TWO OLD INSTRUMENTS
TOE ROLL
1.2m HIGH
0.7m HIGH
CRACK 25m LONG
0.8m HIGH
0.4m HIGH
km 14.6
1.6m HIGH
HWY 744
SHALLOW SLUMP
0.6m HIGH (2019)
1.2m HIGH (2020)
0.5m HIGH
3m WIDE, 1.1m DEEP (2018)
2.9m WIDE, 1.3m DEEP (2019-2020)
1.4m HIGH
1.6m HIGH (2020)
FRESH MOVEMENT (2018)
NORTH GULLY
1m WIDE, 1m DEEP (2014-2015)
2m WIDE, 1.2m DEEP (2017)
3m WIDE, 0.9m DEEP (2018)
3.1m WIDE, 1.3m DEEP (2019)
3.1m WIDE,1.9m DEEP (2020)
0.8m HIGH SCARP
DEBRIS
8.7m
CRACK THROUGH PATCH
1m WIDE, 0.6m DEEP (2017)
1.1m WIDE, 0.4m DEEP (2018)
1.4m WIDE, 0.3m DEEP (2019)
1.8m WIDE, 1.2m DEEP (2020)
GABION MATTRESS UNDERMINED
TOE ROLL
DIP
km 14.5
1m HIGH
TENSION CRACKS
GABION BASKET SWALE
4.6m
CRACK THROUGH PATCH
65m LONG PATCH
DIP
GRASS & SEDIMENT & OVERTOPPING BASKET
0.6m HIGH
8m LONG GULLY LEADING TO CULVERT
MORE SCARP FRESHNESS
CULVERT PIECE
800 mm Ø CSP
1.3m HIGH
CRACK OVER CULVERT 10-20mm WIDE (SAME 2021)
SOUTH GULLY
2.1m WIDE, 1.2m DEEP (2017)
2.6m WIDE, 1.6m DEEP (2018)
2.6m WIDE, 0.6m DEEP, REGRESSED 0.6m (2019)
>4m WIDE, 1m DEEP AT NICK POINT (2020)
SCARP HIGH PLASTIC CLAY EXPOSED (2018
km 14.4
EROSION GULLY 0.5m WIDE, 0.3m DEEP (UNCHANGED)
FIELD ACCESS ROAD
CRACKS
3m WIDE, 2m DEEP (2014-2015)
6m WIDE, 3m DEEP (2017)
5.3m WIDE, 3m DEEP (2018), TENSION CRACKS ON BOTH SIDES; 7m WIDE, BOTH SIDES SLUMPED IN; 2.6m DEEP, >7m WIDE (2020)
GABION (TYP)
720mm CULVERT INLET HANGING
1m WIDE (2014-2015)
1.7m WIDE (2017)
2.9m WIDE, 1.6m DEEP (2018)
GABION CHECK BASKET

LEGEND
- SCARP
- TENSION CRACK / TOE ROLL
- ① DIRECTION AND NUMBER OF PHOTO

NOTES
1. FEATURE LOCATIONS ARE APPROXIMATE.
2. TO CONVERT FROM PREVIOUS STATIONING TO CURRENT KILOMETERS, SUBTRACT 7m.
3. 2013-2015 FROM AMEC FIGURE 1, PROJECT EG10030, PROVIDED BY ALBERTA TRANSPORTATION.
4. JUNE 2021 OBSERVATIONS SHOWN IN RED.

0 20 40 60 80 100 120m
SCALE 1:2000

LIDAR FROM ALBERTA TRANSPORTATION (DATED 2006-2008)
SATELLITE IMAGE FROM VALTUS IMAGERY (DATED 2014)
UAV IMAGE ACQUIRED BY THURBER (JUNE 2020)

Alberta

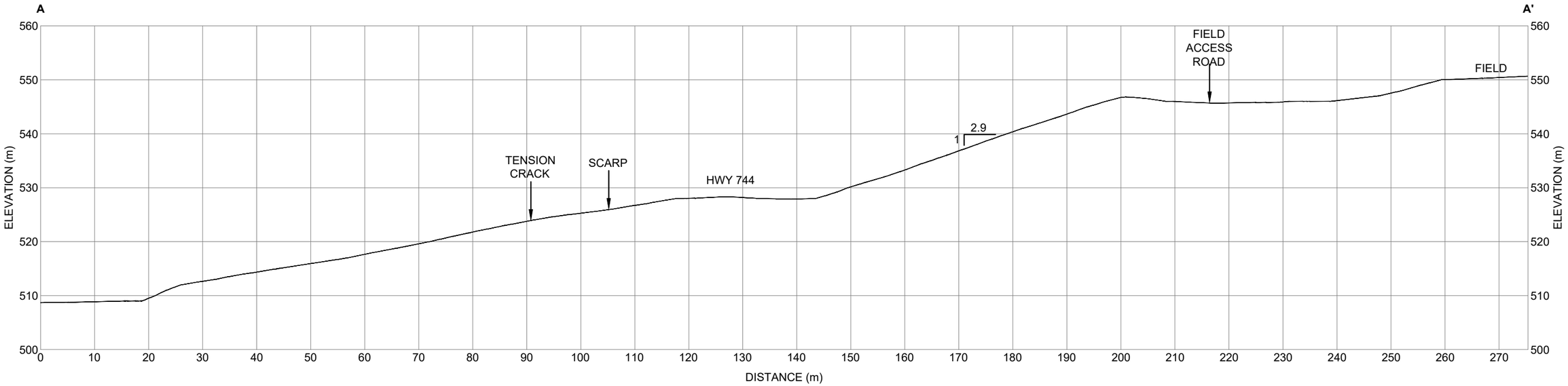
**PEACE REGION (PEACE RIVER DISTRICT)**

**SH010: HWY 744:02 LITTLE SMOKY RIVER VALLEY (SITE #1)**
**2021 SITE INSPECTION PLAN**

**DWG No. 32121-SH010-1-1**

| | |
|---|---|
| DRAWN BY | KLW |
| DESIGNED BY | MG |
| APPROVED BY | DWP |
| SCALE | AS SHOWN |
| DATE | OCTOBER 2021 |
| FILE No. | 32121 |

THURBER ENGINEERING LTD.




NOTE
1. GROUND PROFILE FROM 2006-2008 LIDAR DATA PROVIDED BY ALBERTA TRANSPORTATION

Alberta

**PEACE REGION (PEACE RIVER DISTRICT)**

**SH010: HWY 744:02 LITTLE SMOKY RIVER VALLEY (SITE #1)**
**CROSS-SECTION A-A'**

**DWG No. 32121-SH010-1-2**

| | |
|---|---|
| DRAWN BY | KLW |
| DESIGNED BY | KEF |
| APPROVED BY | DWP |
| SCALE | 1:750 |
| DATE | OCTOBER 2021 |
| FILE No. | 32121 |

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Photo 1 – North gully; note slump to left of gully on lower part of slope.

Photo 2 – South gully; note fan of material at toe.

Photo 3 – Looking south at patched pavement area.

Photo 4 – Looking west at slide at km 14.45 located adjacent to south gabion basket swale.

Photo 5 – Looking southeast at scarps forming close to the highway at about km 14.48

Photo 6 – Looking north over the lower scarp, just north of the gabion basket swale. The vegetation was quite high during the site inspection.