ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION – HIGH LEVEL
2023 INSPECTION REPORT

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy	km
PH080	North of St. Isidore	McKinney Creek	688:02	15.42
Legal Description		**UTM Co-ordinates**		
NW15/NE16/SE21/SW22-084-20-W5M		11U E 461,782	N 6,308,097	

	Date	PF	CF	Total
Previous Inspection:	11-Sept-2017	N/A	N/A	N/A
Current Inspection:	15-May-2023	8	2	16 (Erosion)
Road AADT:	1107		**Year:**	2023
Inspected By:	Max Shannon, TEC Rocky Wang, TEC Pramaya Kannel, TEC		Don Proudfoot, Thurber Ken Froese, Thurber	
Report Attachments:	☑ Photographs	☐ Plans	☐ Maintenance Items	

Primary Site Issue:	Landslide on west slope of high embankment during installation of extensions for bridge file culvert in 2017. 2023: Erosion at the edges of the fill	
Dimensions:	Embankment fill is 300 m measured along the road and 220 m perpendicular	
Date of Remediation:	2018: New culvert installed and embankment sideslopes flattened	
Maintenance:		
Observations:	**Description**	**Worsened?**
☑ Pavement Distress	Some differential settlement was observed at the ends of the embankment fill	☑
☐ Slope Movement	Significant slump occurred on the west side of the embankment during culvert extension excavation in 2017. The existing culvert and extension were abandoned and a new culvert installed instead. Slump had also occurred near shoulder on east side in 2013.	☐
☑ Erosion	Erosion gullies are forming at the fill/native slope contacts in all four quadrants. Some erosion in ditches beyond the embankment fill.	☐
☐ Seepage		☐
☐ Bridge/Culvert Distress	New culvert installed in 2018 – no apparent distress or evidence of slope movement	☐
☐ Other		☐

Instrumentation:

Three vibrating wire piezometers (VW18-1 to 18-3) were installed by hand auger during construction from the base of the culvert excavation. These piezometers were trenched to the side of the excavation and used to monitor pore pressures during fill placement. Significant increases in the water level were observed during fill placement.

VW18-1 (near west end of culvert): The water level spiked up about 6 m from the baseline readings during construction and appears to have stabilized about 2 m above the pre-construction level.

VW18-2 (at west 1/3 of culvert): The water level spiked up almost 15 m from the baseline readings during construction and has dropped steadily since though at a decreasing rate. The current water level is about 3.5 m above the pre-construction level.
VW18-3 (at east 1/3 of culvert): The water level spiked up about 5.5 m form the baseline readings during construction and has dropped steadily since though at a decreasing rate and is about 3 m above the pre-construction level.

Assessment:

It was understood from WSP that movement at this location had been documented by TEC as far back as 1998. In 2013, Thurber conducted a call-out inspection for this site. At that time, the main area of movement was on the west side where a toe roll was identified in the lower third of the slope with scarp cracking partway into the SBL. Other zones of concern were identified during the visit including a shallow slump on the east embankment just north of the culvert centerline and slumping along the creek banks particularly in the NW quadrant.

Another call-out was done in 2017 due to a slide that occurred in this embankment during grade widening construction. Culvert extensions were being installed to accommodate an increased pavement width and flattening of the sideslopes to 4H:1V including two 3 m-wide intermediate benches. The existing culvert had previously been lined for approximately 60 m in the center of the pipe. As part of the 2017 construction, the lining had been extended to the ends of the existing culvert and the annulus between the original culvert and the liner was to be grouted. The extensions to the west and east would be the diameter of the original culvert.

At the time of the 2017 call-out, the east culvert extension had been excavated and installed but not yet backfilled. Excavation for the west culvert extension had begun approximately two weeks before the call-out. As the west culvert extension was on a 48° bend to accommodate the alignment of the creek, the excavation was closer to parallel to the highway than perpendicular. Thus, the vertical face of the extension excavation cut approximately 2 m deep likely destabilized the west side of the embankment. Further exacerbating the instability, it is understood that stockpiling of the excavated material was placed further up on the west slope above the excavation. The Contractor had also cut a bench across the slope at about mid-height to provide access for construction equipment. Approximately 2 days after the excavation was cut open, a 75 mm drop at the pavement was noticed along with heaving of the base of the excavation. Shortly after the slope started moving, there was about 50 mm of rainfall. Approximately 2 days later, the drop at the pavement surface had increased to 0.5 m and the Contractor began to excavate material from the upper portion of the west slope to slow the movement.

On September 6, 2017, the scarp located 1 m into the highway was between 5.5 m to 6 m high, inclined at 55° (from horizontal), and about 38 m wide along the highway surface (measured north-south). The exposed soils appeared to consist of medium to high plastic clay and were obviously slickensided. Groundwater seepage was not observed. Intermediate cracking was visible in the slide mass slope and there was a large perpendicular crack over top of the culvert where the slumping soil had fallen to either side. Heave was evident in the base of the west culvert extension excavation which the Contractor estimated at about 1 m higher overall from the original cut surface. Tension cracks were visible in the surface of the north access road and potentially continued into the topsoil stripping stockpiles on the north side of the slope. MPA conducted a rise/run survey of the culvert lining on September 5, 2017, and identified that there was a deflection in the roof of the culvert about 30 m from the existing inlet which was roughly coincident with the projected slide plane.

As the existing culvert and liner had been damaged by slide movement, it was decided to replace it with a new culvert which could be installed on a better alignment eliminating the need for horizontal elbows. The new culvert was installed after the slide mass was excavated. The fill was placed in stages with traffic shifted back and forth as the east and west sides were brought up in stages. The final design grade was about 2 m lower than designed to limit as the culvert thickness was insufficient for the designed vertical profile (a thicker culvert could not be obtained on short notice).

In 2023, there were no signs of slope movement on the embankment or highway surface. Some erosion and slumping of the creek banks were noted at the east side. There were significant erosion

gullies forming at all of the fill interfaces in all quadrants of the embankment. At some locations, clusters of riprap had been placed in the ditch. However, the domed shape of these clusters has served to push flow to both sides resulting in downcutting beside these clusters and the formation of gullies immediately downslope. Significant gullies have formed at the inlet (east end) on both sides of the bank just upstream of the riprap treatment.

Recommendations:

Short-Term:

- Routine inspection should be undertaken to ensure that the ongoing ditch erosion is not encroaching on the highway or nearby approaches.

Medium-Term:

- The ditches in all four quadrants should be reconstructed: remove the existing riprap clusters, regrade the ditches, line flat sections of the ditches with TRM and steep sections of the ditch with riprap. If the gradient requires it, riprap or gabion basket check dams should be installed.
- Extend the bridge culvert inlet riprap apron further upstream and reshape the ditch such that flow discharges in a controlled manner on to this apron.
- Use compacted fill or grout, along with ditch reshaping and erosion protection, to repair the hanging outlet at the southwest approach.

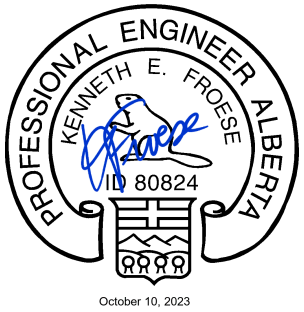
Ongoing Investigation:

- It is recommended that the once-per-contract Geohazard inspection frequency be increased to every second year.

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.

Tarek Abdelaziz, Ph.D., P.Eng.
Partner | Senior Geotechnical Engineer



PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE:
RM APEGA ID #: 91085
DATE: October 10, 2023
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

Ken Froese, P.Eng.
Associate | Senior 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.

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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.

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BANK EROSION AND SLUMPING
GULLY: 2.1m WIDE x 1.2m DEEP
COFFERDAM DURING CONSTRUCTION (2017)
EXTENSION INSTALLED BUT NOT BACKFILLED (2017); REMOVED LATER WHEN NEW CULVERT INSTALLED
GULLY: 1.0m WIDE x 0.9m DEEP, GEOTEXTILE HANGING
2017 EXTENSION EXCAVATION
EROSION RUNS OUTSIDE OF DITCH CHANNEL INTO BUSHLINE
GULLY: 0.2m WIDE x 0.25m DEEP
GULLY: 0.6m WIDE x 0.9m DEEP
STRIPPING WINDROW (2017)
GULLY: 0.7m WIDE x 0.3m DEEP
GULLY: 0.2m WIDE x 0.25m DEEP
GULLY: 0.5m WIDE x 0.6m DEEP
STOCKPILE (2017)
400mm Ø PRIVATE CULVERT
VW18-3
GULLY: 0.2-0.3m WIDE x 0.3m DEEP
STRIPPING STOCKPILE (2017)
GULLY: 0.4m WIDE x 0.3m DEEP
A'
APPROXIMATE LOCATION OF SLUMP SEEN IN 2013
GULLY: 0.2m WIDE x 0.2m DEEP
MAIN SCARP AT 2017 CALL-OUT
APPROXIMATE CULVERT ALIGNMENT BF72477-2 (2018), 3.99m Ø, 165.8m LONG
SOME NOTICEABLE DIFFERENTIAL SETTLEMENT AT CUT/FILL TRANSITIONS
600mm Ø APPROACH CULVERT
GULLY: 0.8m WIDE x 0.5m DEEP
SOME NOTICEABLE DIFFERENTIAL SETTLEMENT AT CUT/FILL TRANSITIONS
POSSIBLE CRACK (2017)
TENSION CRACKS (2017)
VW18-2
MINOR EROSION: 0.2m DEEP
600mm Ø CSP OUTLET HANGING
GULLY: 0.5m WIDE x 0.4m DEEP
TOPSOIL STOCKPILE (2017)
GULLY: 0.3-0.5m WIDE x 0.1m DEEP
GULLY: 0.4m WIDE x 0.4m DEEP
EROSION GULLY
VW18-1
TOPSOIL WINDROW (2017)
GULLY: 0.3m WIDE x 0.2m DEEP
CULVERT LINER EXTENSION DAMAGED (2017)
RIPRAP PILE IN DITCH (TYP); POSSIBLE DITCH CHECKS
TOE ROLL CRACK (2017)
ESTIMATED EXTENTS OF SLIDE REMOVAL
DAMP
GULLY: 0.8m WIDE
A
BASE HEAVING (2017)
EXTENSION EXCAVATION (2017)
DITCH CHECK: 1.7m WIDE x 0.8m HIGH x 3m LONG, SETTLING INTO ERODED DITCH
CULVERT BARREL SHOWS NO DISTRESS (2023)

N E S W

LEGEND

- LANDSLIDE SCARP (SURVEYED SEPTEMBER 1, 2017)
- APPROXIMATE VIBRATING WIRE PIEZOMETER (VW) LOCATION
- PHOTOGRAPH NUMBER AND DIRECTION

NOTE:

1. MAY 2023 OBSERVATIONS SHOWN IN RED

0 10 20 30 40 50 60m
SCALE 1:1000

Alberta

PEACE REGION (PEACE RIVER DISTRICT)

PH080: McKINNEY CREEK CULVERT SLIDE
HWY 688:02 km 15.42 BF72477
2023 SITE INSPECTION PLAN

DWG No. 32121-PH080-1

DRAWN BY	KLW
DESIGNED BY	KEF
APPROVED BY	TSA
SCALE	1:1000
DATE	SEPTEMBER 2023
FILE No.	32121

THURBER ENGINEERING LTD.

Photo 1 – Looking east at erosion around the riprap clusters in NW quadrant ditch.

Photo 2 – Looking west at a riprap cluster and erosion gully in lower half of NW quadrant ditch.

Photo 3 – Looking west at erosion gully forming in SW quadrant ditch.

Photo 4 – Looking south at eroding west ditch.

Photo 5 – Looking north at erosion gully forming below the outlet of an approach culvert in the west ditch south of the bridge culvert.

Photo 6 – Looking north at erosion gully on the north side of the culvert inlet.

Photo 7 – Looking south at the north erosion gully (far side of Photo 6) and south erosion gully (far side of this photo) at the culvert inlet.

Photo 8 – Looking east at slumping forming upstream of the culvert inlet.

Photo 9 – Looking east at erosion gully forming below private landowner culvert on the east side of the ditch north of bridge culvert.

Photo 10 – Looking northeast at a gully starting to form below an approach culvert near Photo 9.