ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
NORTH CENTRAL REGION – ATHABASCA & FORT MCMURRAY DISTRICTS
2021 SITE INSPECTION

THURBER ENGINEERING LTD.

Site Number	Location	Name	Hwy	km
NC097	Fort McMurray	Parsons Road Overpass/Hwy 63	686:20	
Legal Description		**UTM Co-ordinates (NAD 83)**		
SW7-90-9-W4		12V N 6,293,600 E 473,700		

	Date	PF	CF	Total
Previous Inspection:	June 25, 2020	7	3	21 (Landslide basis)
Current Inspection:	June 25, 2021	7	3	21 (Landslide basis)
Road AADT:	3,500		**Year:**	2020
Inspected By:	José Pineda, Tarek Abdelaziz (Thurber) Kristen Tappenden, Bernard Ching (Alberta Transportation)			
Report Attachments:	☑ Photographs ☑ Plans ☐ Maintenance Items			

Primary Site Issue:	A crack formed across both traffic directions along the top of the Parsons Road overpass (BF85178), ~6 m west of the west abutment (along the western edge of the approach slab); settlement of west approach slab causing a dip behind the west abutment.
Dimensions:	The cracks is across eastbound and westbound lanes (26 m long), dip is within the boundaries of the approach slab (26 m wide x 6 m long).
Site History:	Based on information provided by Alberta Transportation and an examination of the as-built drawings, weak soil overlying limestone bedrock existed at this overpass location. An instrumented test fill was built at the east headslope, supported on a wick drain perforated foundation soil. Based on the performance of that test fill it was determined that in order to meet the construction schedule demands the weak soils had to be completely excavated from the west headslope area (up to 7 m in depth), and the portion of the east headslope not covered by the instrumented test fill (up to 5 m in depth). Engineered fill, mainly consisting of clay shale, was placed to restore the grades, and then the headslope fills were constructed overtop original grade level (up to 13 m in height). The west headslope fill was built with geogrid reinforcement clay shale. An extensive instrumentation program consisting of slope inclinometers, piezometers and settlement cells were installed to monitor construction activities, control fill placement rates, and provide post construction information. Thurber is currently monitoring these instruments as part of the GRMP geohazards contract.
Maintenance:	ACP Patch was placed in 2020 on eastbound and westbound lanes extending about 11 m west of the finger plate joint

Observations:	Description	Worse?
☑ Pavement Distress	After the ACP Patch was placed in 2020, a 5 to 20 mm wide x ≤ 0.2 m deep x 26 m long crack reflected through the patch along the western edge of the west approach slab, about 6 m west of the west abutment; 15 to 20 mm	☐

	dip on the west bound lanes west of the Finger Plate Joint; 10 mm dip on the eastbound lanes west of the Finger Plate Joint.	
☐ Slope Movement		☐
☑ Erosion	Erosion along south face of the fill slope adjacent to the west wingwall and headwall slope, caused by runoff from the end of the southwest drain trough.	☐
☐ Seepage		☐
☑ Bridge/Culvert Distress	Cracks observed at the interfaces of both the north and south drain troughs and wingwalls (35 to 40 mm wide); about 50 mm of vertical separation of the abutment seat and the top of headslope (causing separation of the sheet metal parging on the west abutment); 70 to 150 mm of headslope settlement along the faces of the wingwalls; no visible cracks on abutment walls, wing walls, and abutment slope concrete facing	☐
☑ Other	Based on available records, AT provided the following information: 1) The Finger Plate Joint does not appear to be as constructed with a gap of about 110 mm at a temperature of 13 degrees. There appears to be no gap at the time of the visit. 2) The Plate Bearing offset observed during the site visit matches the original design	☐

Instrumentation: (10 SIs, 32 VWs, 4SCs)

Readings from selected Instrumentation in the vicinity of existing Crack (between fall of 2020 and spring of 2021):

SI14-05 is moving at 3.9 mm/yr over 1.5 and 4.6 m depth, and at 4.3mm/yr over 5 and 9 m depth; The total lateral movement recorded in SI14-05 since 2014 is 100 mm; the increases in settlement values in operational settlement cells are: SC14-09=53mm, SC15-04=14mm, SC14-12=72mm.

Assessment (Refer to attached Figure):

The site observations and instrumentation monitoring results indicate progressive settlement and creep movement of the west approach headslope fill. The crack along the west edge of approach slab and the dip within the boundaries of the slab are reflections of the vertical and lateral movements of the approach fill.

The ACP patch placed in 2020 improved the situation, but the ongoing movement of the west approach fill resulted in the reappearance of the crack and formation of 10 to 20 mm dip behind the abutment on the eastbound and westbound lanes. This dip created a rough driving condition behind the west abutment.

The movement will likely continue to occur for a few years and the situation may get worse with time. If a void exists below the approach slab, which is the most likely scenario, it may get bigger in size with time and additional differential settlement may impact the integrity of the slab. Furthermore, surface water infiltration into the open crack will likely saturate and soften the high plastic approach fill, resulting in further softening of subgrade below the slab and may eventually impact the stability the slope.

Minor erosion, noted during previous inspections, is still visible within the south side slope to the west of the south drain trough. Runoff from the end of the drain trough has also created minor erosion along the south headslope by the south wingwall. It appears that runoff does not flow through along the gravel filled geocell channel due to insufficient channel cross-sectional depth (it is almost flat). The eroded surfaces are not currently severe and are in the order of 0.2 m wide and 0.1 m deep. However, severe erosion may occur within the side slope and headslope if erosion issues are not dealt with in the near future.

Recommendations:

This site should be visited again in 2023.

If the cracking becomes more severe or continues to get worse, a structural engineer should be called to examine the location and severity of the cracking, so that the structural integrity of the constructed overpass works is not threatened.

The west abutment bearings and the expansion joint of the bridge should be inspected by a representative from AT's bridge group during the winter and spring seasons to confirm whether they are performing as designed.

Short Term:

The local MCI should periodically monitor the crack and measure the crack widths/depths at the five locations shown on Figure 1, attached. The bridge abutment/headslope/approach fill should also be monitored for any signs of new or additional movements or settlements. A history of the future crack development and any sort of maintenance (including future re-sealing of open cracks and placement of ACP patch) should be recorded.

Consideration should be given for coring through the concrete slab (at least one hole along each of the traffic directions) to confirm whether a void exists beneath the slab at the crack location. Any voids identified within the slab should be filled with flowable grout. The highway surface can then be patched to provide a smooth ride to motorists. Frequent patching of the impacted area will not solve the issue if voids are still present below the slab.

The gaps between drain troughs and wingwalls and below the abutment seat under the bridge should also be filled with grout. The sheet metal parging on the west abutment should also be reinstated to the original condition.

A few sandbags should be placed along the east edge of the southwest concrete drain trough and runoff channel to divert surface runoff from going eastwards down the slope. The sandbags should extend at least 5 m southwards along the channel, or until the point where the existing channel has sufficient cross-sectional depth to carry the flow. The eroded section of the slope immediately to the west of the gully should be repaired though excavating all loose material (no deeper than the underside of the trough) and re-building this area using clay to match adjacent grade. This could be considered as a temporary measure to re-establish flow along the channel and reduce future erosion issues.

Medium to Long Term:

If the sandbags are not effective at re-directing the flow southwards along the gravel filled geocell channel, the medium-term recommendation is to remove the upper approximate 5 m reach of the existing gravel/geocell extending from the end of the drain trough. This portion of the channel area should then be properly graded to re-establish a sufficient cross-sectional geometry size to carry surface runoff, and then relined with new geocell and gravel infilling.

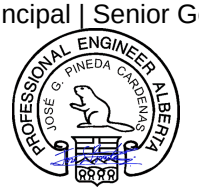
If the cracking/settlement continues and becomes a structural or safety concern, reconstruction of the west approach apron/fill area in proximity to the crack may be required.

Ball Park Cost VARIABLE, depending on methodology.

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.
Principal | Senior Geotechnical Engineer



September 8, 2021

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
RM SIGNATURE:
RM APEGA ID #: 91085
DATE: September 9, 2021
PERMIT NUMBER: P005186
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)

José Pineda, M.Eng., P.Eng.
Senior Geotechnical Engineer

THURBER

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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.

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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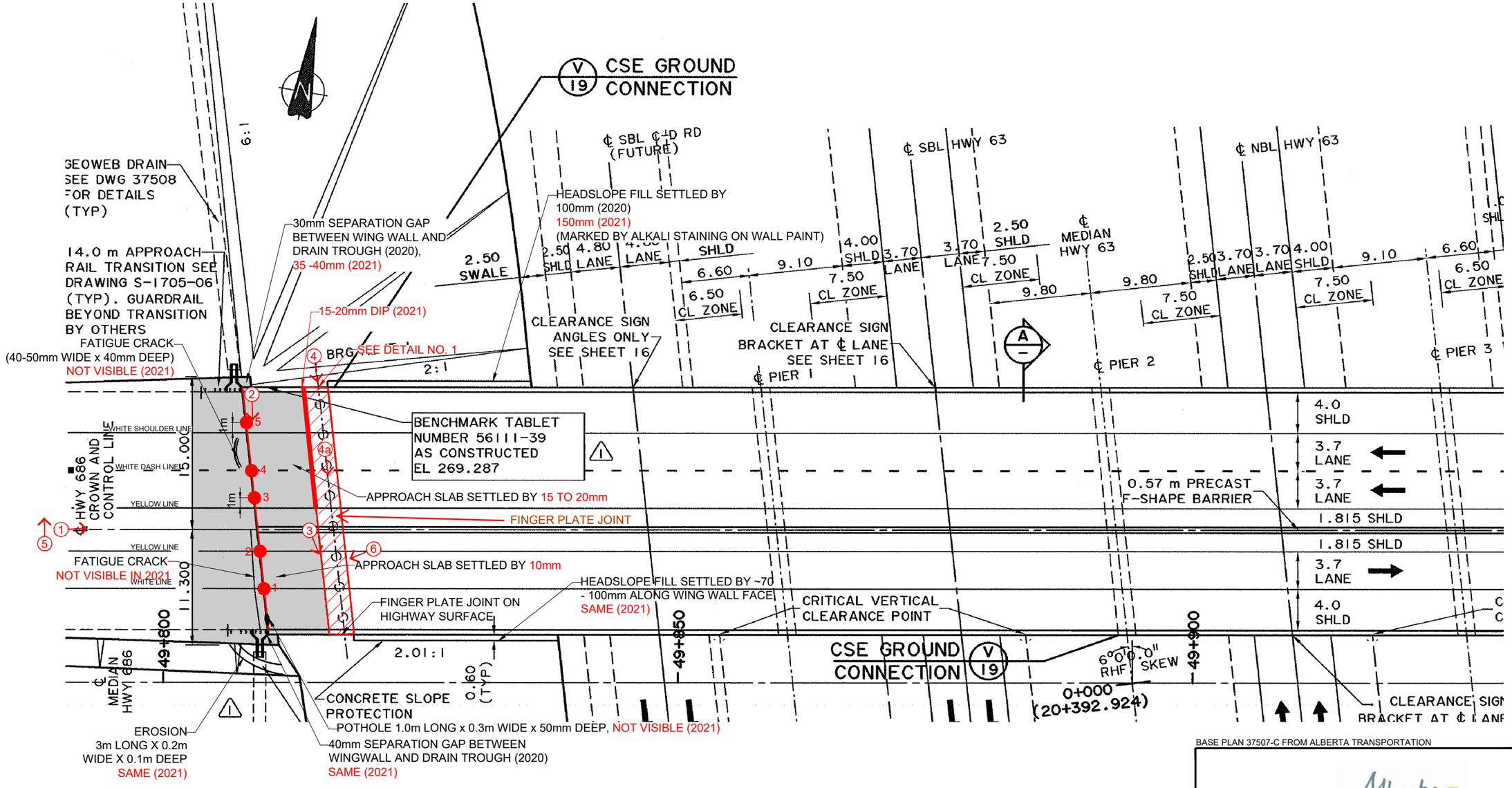


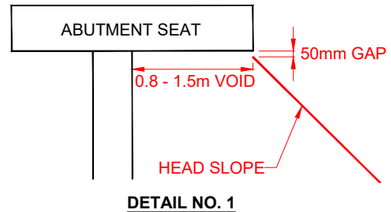
LEGEND

- CRACK MEASUREMENT LOCATION
- CRACK LOCATION
- ① PHOTOGRAPH NUMBER, AND APPROXIMATE DIRECTION AND LOCATION
- ACP PATCH PLACED IN 2020 EXTENDS 12m TO THE WEST OF THE CONSTRUCTION JOINTS

NOTE:
JUNE 24, 2021 SITE OBSERVATIONS ARE SHOWN IN RED.

CRACK LOCATION	JUNE 25, 2020 WIDTH (mm)	DEPTH * (mm)	DROP (mm)	JUNE 24, 2021 WIDTH (mm)	DEPTH * (mm)	DROP (mm)
1	30	240	10	20	30	0
2	50	340	30	20	15	16
3	90	230	30	20	15	15
4	60	260	40	5	5	5
5	50	400	10	5	-	5

* SAND AND SALT WERE NOTED WITHIN BOTTOM OF CRACK.



DETAIL NO. 1

0 5 10 15 20 25m
SCALE 1:400

BASE PLAN 37507-C FROM ALBERTA TRANSPORTATION

Alberta

NORTH CENTRAL REGION (ATHABASCA AND FORT MCMURRAY DISTRICTS) 2021 GEOHAZARD ASSESSMENT

NC097: HWY 686 (PARSONS ROAD OVERPASS) / HWY 63 SITE INSPECTION PLAN

FIGURE 1

DRAWN BY	ML
DESIGNED BY	JGP
APPROVED BY	TSA
SCALE	1:400
DATE	AUGUST 2021
FILE No.	32122

THURBER ENGINEERING LTD.

Photo No. 1 – Looking east at the bridge eastbound and westbound lanes. The cracks are across both traffic lane directions and has formed between the approach slab and the pavement, about 6 m west of the west abutment fingerplate; note ACP patch placed in 2020 and the dip to the west of the expansion joint

Photo No. 2 – Looking south at the crack across the westbound lanes towards the median. The crack is 5 to 20 mm wide x 5 to 15 mmm deep

Photo No. 3 – Looking south across the eastbound lanes; there is almost no gap at the joint to accommodate any further movement

Photo No. 4 – Looking south at a void (50 mm below abutment seat x 1.5 m into the wall) under abutment seat within the northeast corner of the bridge abutment

Photo No. 4a – Looking south at the separation of the sheet metal parging on the west abutment

Photo 5 – Looking at the north drain trough. Note the cracking between the drain trough and wingwall.

Photo 6 – Bridge bearing position appears be in conformance with design drawings