THURBER ENGINEERING LTD.
GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS

July 2, 2009 File: 15-16-229

Alberta Transportation
Room 301, Provincial Building
9621 - 96 Avenue
Peace River, Alberta T8S 1T4

Attention: Mr. Ed Szmata

PEACE REGION (PEACE RIVER/HIGH LEVEL) GEOHAZARD ASSESSMENT
HWY 744:04 PH62 MARIE-REINE
2009 INSPECTION REPORT

Dear Sir;

This letter documents the 2009 annual site inspection of an embankment instability located along Highway 744:04, about 1.5 km north of the village of Marie-Reine. Thurber Engineering Ltd. (Thurber) undertook this inspection in partial fulfillment of our Geotechnical Services for Geohazard Assessment, Instrumentation Monitoring and Related Work contract (CE105/2008) with Alberta Infrastructure and Transportation (AT).

Mr. R. Saunders, P.Eng. of Thurber undertook the inspection in the company of Mr. Roger Skirrow, P. Eng., Mr. Neil Kjelland, P.Eng. and Mr. Ed Szmata of AT and the local MCI.

1. BACKGROUND

It is understood this site has a history of instability and that the upstream (east) side of the road embankment was repaired with a gabion wall at its toe several years ago. Further, it is understood that a slide affecting the downstream (west) side of the embankment occurred in the fall of 2008. This slide was initially assessed during a Call-Out Inspection in October 2008 by Karl Engineering Consultants Ltd. and the results of that inspection can be found in a letter report to AT dated October 24, 2008.

2. GEOLOGICAL SETTING

The slide area is located on Highway 744 approximately 1.5 km north of the Village of Marie-Reine. At this location the highway crosses an unnamed creek

within a small incised ravine that flows into a larger tributary to the Heart River less than 100 m downstream of the crossing (Figure 1).

The study area is located within the Peace River Lowland physiographic region. According to Hamilton et al. (1999), the area is underlain by grey, fine-grained, feldspathic sandstone with hard calcareous beds; laminated siltstone and grey silty shale of deltaic to marine origin belonging to the Dunvegan Formation. However, bedrock is believed to occur well below the elevation of the current slope instability.

The upland area, through which the unnamed creek is incised, is part of a large hummocky glaciolacustrine plain comprised predominantly of clay, silts and sands. The fill embankment at the creek crossing is believed to be constructed of similar material borrowed from the general vicinity of the crossing.

Recent minor alluvial deposits, consisting predominantly of silts, sands and gravels, occupy the valley bottom.

3. SITE OBSERVATIONS

At the time of the May 2009 inspection, the slope instability on the west side of the road embankment was observed to be perpendicular to the roadway with a 1.8 m high vertical headscarp running along the shoulder of the southbound lane of Highway 744 as shown in Photos 62-01 to 62-04 and Figure 1, attached. The length of the headscarp along the roadway was about 13 m, with the overall width of the slide at its widest point being in the order of 20 m. The downslope length of the slide was estimated to be about 20 m.

Scarps along the flanks of the slide ranged from about 0.5 m (south side) to about 1.0 m high (north side). High plastic clay (fill) was observed within all of the exposed scarp features.

The total height of the fill embankment was estimated to be at about 7 m with an original slope gradient of about 3H:1V.

A 1200 mm diameter Corrugated Steel Plate (CSP) culvert runs in a southeast to northwest direction through the embankment as shown in Figure 1. The toe of the slide was noted to be well-defined near the culvert outlet (Photo 62-05). The outlet of the culvert appeared to be tilted upward slightly and a sinkhole was noted over the culvert part way up the slope (Photo 62-06), suggesting it has likely separated within the embankment.

Comparing photos taken in October 2008 and May 2009, it appears that some minor retrogression of the landslide has occurred. The headscarp appears to have encroached slightly from the edge of the asphalt in 2008 to near the white-line of

the shoulder in 2009. Also, the headscarp was reported to be about 1.5 m high in 2008 compared to about 1.8 m high in 2009.

4. ASSESSMENT

Based on our preliminary geotechnical assessment, the cause of the slumping is likely the result of weathering and a loss of strength within the clay fill (i.e. loss of cohesion) over time. The trigger mechanism for the slide may be a combination of a heavy precipitation event with possible seepage along the base of the ravine/culvert.

5. RISK LEVEL

The risk level for this site has been assessed as follows:

PF(10) * CF(4) = 40

A Probability Factor of 10 is considered appropriate since the slide is active with a steady rate of movement. Even though the embankment is only moderately high (i.e. 7 m), a Consequence Factor of 4 is considered appropriate since any new movement will affect portions of the southbound driving lane, resulting in its closure. The shoulders are very narrow and it would be necessary to reduce traffic to one lane should additional movement occur.

6. RECOMMENDATIONS

6.1 Short Term

6.1.1 Monitoring

Until a site investigation and remediation measures can be undertaken, the site should be regularly inspected by the MCI to ensure the southbound travel lane does not become undermined and fail further into the roadway.

6.1.2 Site Investigation

To properly assess the cause of the landslide and to provide parameters for the design of appropriate remediation measures, it is recommended to drill one test hole near the edge of the shoulder of the southbound lane, as close as possible to the middle of the landslide, offset from the culvert alignment. Test pitting within the slide mass and toe is also recommended to define the bottom of the failure plane and foundation conditions for a toe berm.

A survey of the landslide and adjacent ground should also be undertaken at the time of the investigation so engineering drawings and volume estimates of the remediation measures can be prepared.

6.2 Remediation

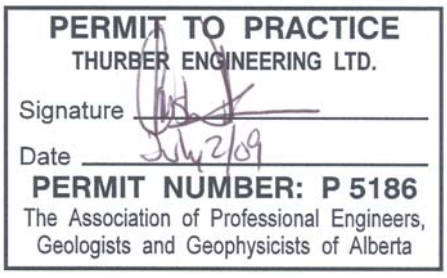
Subject to confirmation of ground conditions with a geotechnical investigation as described above, remediation of this slide is anticipated to incorporate the following:

- Removal of all weak saturated high plastic clay fill material from the toe and slide area.
- Repair/replacement of all broken sections of the CSP culvert and extension to account for proposed flatter fill slopes.
- Placement of a granular berm and/or blanket at the toe and lower portion of the slope prior to placement of new fill.
- Reconstruction of the embankment fill to a flatter slope angle (anticipated to be in the range of 4H:1V to 5H:1V).

7. CLOSURE

We trust this assessment and recommendations meet with your needs at this time. Please contact the undersigned should questions arise or if the slide condition worsens.

Yours truly,
Thurber Engineering Ltd.
Chris Workman, P.Eng., M.Eng.
Review Principal



Robert Saunders, P.Eng., M.Eng.
Senior Geotechnical Engineer
Attachments

THURBER ENGINEERING LTD.

STATEMENT OF GENERAL CONDITIONS

1. STANDARD OF CARE

This study and Report have been prepared in accordance with generally accepted engineering or environmental consulting practices in this area. No other warranty, expressed or implied, is 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 us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which 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. WE CANNOT BE 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 us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document, subject to the limitations provided herein, are only valid to the extent that this Report expressly addresses proposed development, design objectives and purposes, and then only to the extent there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation or to consider such representations, information and instructions.

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 OUR WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS WE MAY EXPRESSLY APPROVE. The contents of the Report remain our copyright property. The Client may not give, lend or, sell the Report, or otherwise make the Report, or any portion thereof, available to any person without our prior written permission. Any use which a third party makes of the Report, are the sole responsibility of such third parties. Unless expressly permitted by us, no person other than the Client is entitled to rely on this Report. We accept no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without our 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 this report is delivered on 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. Where 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 us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot 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 us. We are entitled to rely on such representations, information and instructions and are not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

(see over . . . .)

INTERPRETATION OF THE REPORT *(continued . . . .)*

c) Design Services: The Report may form part of the design and construction documents for information purposes even though it may have been issued prior to the final design being completed. We should be retained to review the final design, project plans and documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the report recommendations and the final design detailed in the contract documents should be reported to us immediately so that we can address potential conflicts.

d) Construction Services: During construction we must be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions 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. RISK LIMITATION

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause an accidental release of those substances. In consideration of the provision of the services by us, which are for the Client's benefit, the Client agrees to hold harmless and to indemnify and defend us and our directors, officers, servants, agents, employees, workmen and contractors (hereinafter referred to as the "Company") from and against any and all claims, losses, damages, demands, disputes, liability and legal investigative costs of defence, whether for personal injury including death, or any other loss whatsoever, regardless of any action or omission on the part of the Company, that result from an accidental release of pollutants or hazardous substances occurring as a result of carrying out this Project. This indemnification shall extend to all Claims brought or threatened against the Company under any federal or provincial statute as a result of conducting work on this Project. In addition to the above indemnification, the Client further agrees not to bring any claims against the Company in connection with any of the aforementioned causes.

7. SERVICES OF SUBCONSULTANTS AND CONTRACTORS

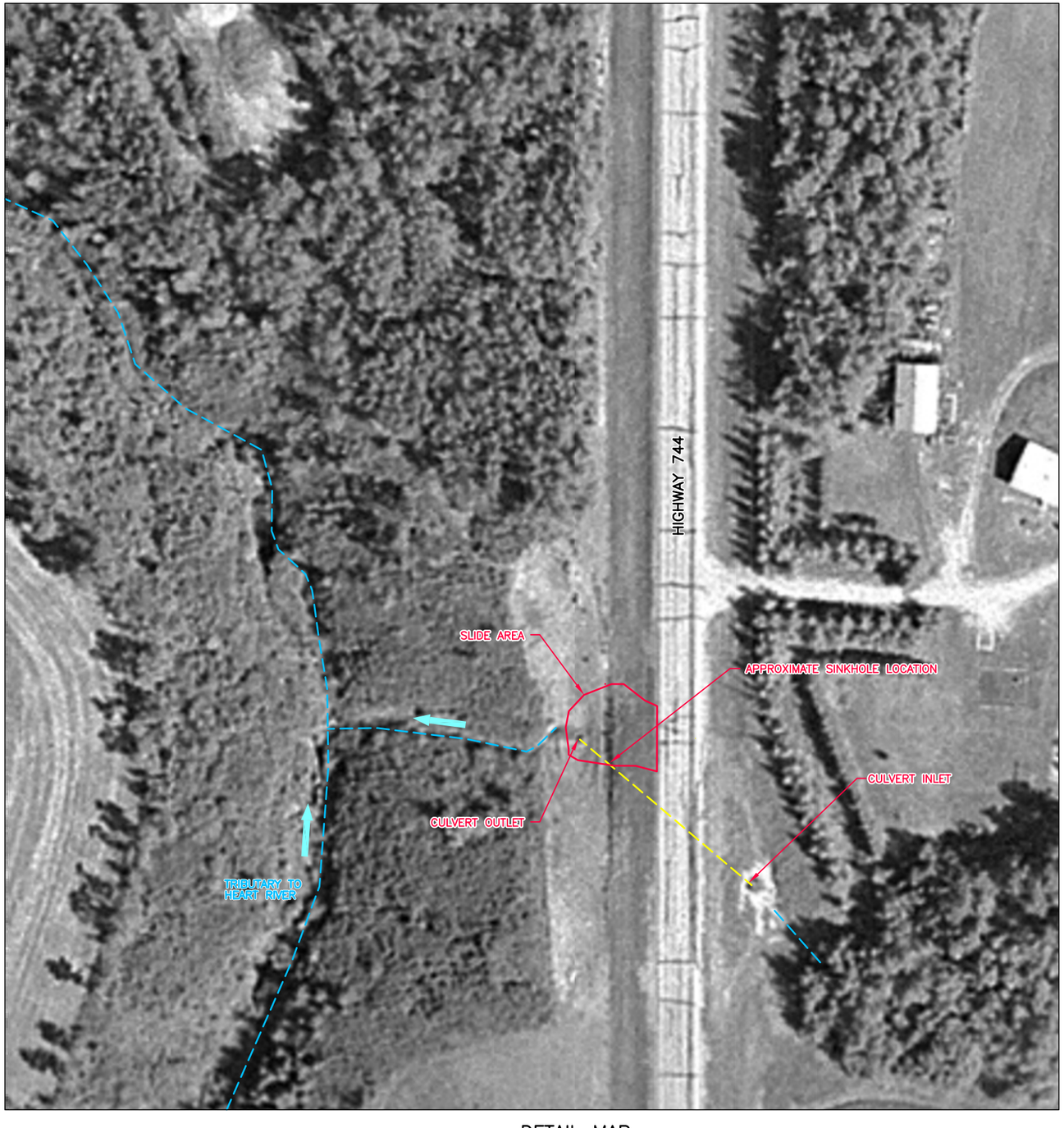
The conduct of engineering and environmental studies frequently requires hiring the services of individuals and companies with special expertise and/or services which we do not provide. We may arrange the hiring of these services as a convenience to our Clients. As these services are for the Client's benefit, the Client agrees to hold the Company harmless and to indemnify and defend us from and against all claims arising through such hirings to the extent that the Client would incur had he hired those services directly. This includes responsibility for payment for services rendered and pursuit of damages for errors, omissions or negligence by those parties in carrying out their work. In particular, these conditions apply to the use of drilling, excavation and laboratory testing services.

8. CONTROL OF WORK AND JOBSITE SAFETY

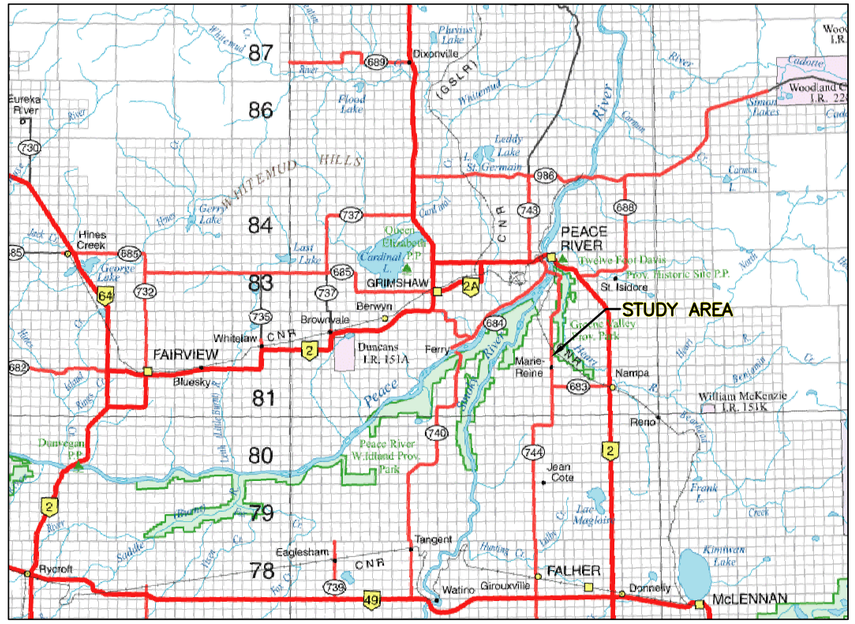
We are responsible only for the activities of our employees on the jobsite. The presence of our personnel on the site shall not be construed in any way to relieve the Client or any contractors on site from their responsibilities for site safety. The Client acknowledges that he, his representatives, contractors or others retain control of the site and that we never occupy a position of control of the site. The Client undertakes to inform us of all hazardous conditions, or other relevant conditions of which the Client is aware. The Client also recognizes that our activities may uncover previously unknown hazardous conditions or materials and that such a discovery may result in the necessity to undertake emergency procedures to protect our employees as well as the public at large and the environment in general. These procedures may well involve additional costs outside of any budgets previously agreed to. The Client agrees to pay us for any expenses incurred as the result of such discoveries and to compensate us through payment of additional fees and expenses for time spent by us to deal with the consequences of such discoveries. The Client also acknowledges that in some cases the discovery of hazardous conditions and materials will require that certain regulatory bodies be informed and the Client agrees that notification to such bodies by us will not be a cause of action or dispute.

9. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on our interpretation of conditions revealed through limited investigation conducted within a defined scope of services. We cannot 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.



DETAIL MAP
SCALE 1:1 000
0 10 20 30 40 50 m



KEY MAP
SCALE 1:1 000 000
0 10 20 30 40 50 km

NOTES:

1 AIRPHOTO BASE FROM TARIN RESOURCE SERVICES LIMITED (1 m/PIXEL) 2006.

2 SLIDE FEATURES ARE SHOWN APPROXIMATELY ONLY.

3 DRAWINGS MUST BE USED IN CONJUNCTION WITH ATTACHED REPORT AND ARE SUBJECT TO THE STATEMENT OF GENERAL CONDITIONS.

DRAWN BY ICB	DESIGNED BY RJS	APPROVED BY WCW
SCALE AS SHOWN	DATE JUNE 30, 2009	FILE No. 15-16-229-A2B

Government of Alberta
Transportation

PEACE REGION (PEACE RIVER/HIGH LEVEL)

PH62 MARIE-REINE
HWY 744:04
SITE LOCATION PLAN

FIGURE 1

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	**Photo 62-01** **May 2009** Looking north at headscarp encroaching into shoulder of southbound lane.
	**Photo 62-02** **May 2009** Looking upslope (southeast) at headscarp at edge of southbound lane.

	**Photo 62-03** **May 2009** Looking downslope (northwest) at slide area from southbound lane.
	**Photo 62-04** **May 2009** Looking upslope (southeast) at slide from toe area.

	**Photo 62-05** **May 2009** Looking south along west ditch at toe of slide and culvert outlet.
	**Photo 62-06** **May 2009** Close-up of sinkhole over culvert on lower third point of slope within slide area.