THURBER ENGINEERING LTD.
GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS

May 4, 2010 File:15-16-224

Alberta Transportation
Unit 2, Jewell Building
3603– 53 Street
Athabasca, Alberta
T9S 1A9

Attention: Mr. Arthur Kavulok

NORTH CENTRAL REGION – ATHABASCA AREA – GEOHAZARD ASSESSMENT (CE102/2008)
CALL-OUT FOR EMBANKMENT DISTRESS
ON HWY 813:02 (KM 0.5)

Dear Sir:

This report presents the results of a call-out for the above-noted site on Hwy 813:02 at 0.5 km. Mr. Tarek Abdelaziz, P.Eng. of Thurber Engineering Ltd. (Thurber) undertook the site inspection on March 31, 2010 in the presence of Messrs. Arthur Kavulok and Len Guay, both of Alberta Transportation (TRANS). Mr. Kavulok made the request for the call-out on March 15, 2010.

1. BACKGROUND

Highway 813:02 at km 0.5 is a paved two lane undivided highway that runs in a NE- SW direction and descends the sidehill of the Athabasca River Valley. The site is located within the outskirts of the Town of Athabasca at the intersection of 43 Street and Hwy 813:02 to the south side of the Athabasca River Bridge. The legal description of the site is S.E. ¼/ S.W. ¼- 21-66-22 W4M. The 2008 AADT on the highway is 2290 vehicles per day and the posted driving speed is 60 km/hr.

We understand that the subject site has not been viewed previously by geotechnical personnel; hence the site visit by Thurber on March 31, 2010 is the first on record.

The following information was obtained from Mr. Kavulok and Mr. Guay of TRANS during the site visit:

- This section of the highway has continued to display distress for several years since 1980's, and has required asphalt patching every 2 to 3 years.
- A remedial measure, consisting of pumping grout into the ground below the highway surface, was implemented in the past (probably 5 to 6 years ago) to fix the problem at this location. However, there are no records of what was done in the past at TRANS Athabasca Office.
- To the south of the site, Hwy 813:02 will be shifted to the west of its current location as part of the Hwy 55:10 and Hwy 813:02 intersection upgrade project, planned for construction in 2011. To the north of the site, Hwy 813:02 may be shifted within the next 3 to 4 years as a part of the future rehabilitation plan for the Athabasca River Bridge.

2. OBSERVATIONS

The roadway surface, the backslope and side slope areas of the highway alignment at the problem area were inspected during the site visit. A sketch plan showing the site features recorded on March 31, 2010, during the site reconnaissance is provided on Figure 1, attached. An approximate cross-section of the highway at the slide location is also presented in Figure 2, attached. Selected photographs taken during the site reconnaissance are included at the end of the letter.

The highway at the slide location was constructed as a side hill cut and fill section. The highway at this location is about 11 m wide with both side slopes inclined at 10 to 12^{o} to the horizontal. The highway embankment height ranged from 1.3 to 1.6 m. A bush line existed downslope of the highway westbound lane, consistent with the top of the river valley natural slope. The highway cut back slope to the east of 43 Street was approximately 1.3- 3.2 m high and sloped at 10-12^{o} to the horizontal. A 1.3 wide x 0.8 m deep catch water ditch was located at the top of the backslope within the John Deere's private property. This wide ditch was noted to become narrower and shallower to the west of the site. The area upslope of the ditch appeared to be relatively flat. A 35 m long CSP culvert existed on the south side of the highway to convey surface water below 43 Street. In general, the highway ditches and side slopes were well vegetated with grass.

The river valley slope to the north of the highway, downslope of the bush line, was approximately 8.5 m in height with an average slope angle of 18^{o}. A 5-6 m wide access road existed along the bottom of the slope. The area to the north of the access road appeared to be relatively flat, and probably constituted an old terrace of the Athabasca River. The area downslope of the highway was generally vegetated with grass, and trees. Old scarps, ridges, and tilting trees were noted at some locations down slope of the highway within the heavily vegetated bush. The highway embankment is probably situated 15-20 m above the Athabasca River.

Signs of instability were noted along the highway surface and side slopes. Detailed site features are presented in Figure 1. The highway east and west bound lanes appeared to be slightly depressed by no more than 10 mm over a distance of 140 m along the highway. A 45 m long ACP patch was located at the east side of the site and marked the east flank of the potential slide area. A 25 m long diagonal crack was noted downslope of the patched area. The crack appeared to be connecting to an old scarp crack in the bush down slope of the highway. This extended as a faint diagonal crack on the highway WBL (Crack A), which joined a 15 m long longitudinal faint crack on the highway EBL. The area bounded by the eastern diagonal crack downslope of the highway sideslope appeared to be slightly dishing by approximately 5 mm. A 20 m wide infilled diagonal crack (Crack E) was also noted at the west side of the highway and probably marked the western limit of the affected area by the slide movement along the highway. Additional cracks were noted on the highway surface; however they were not believed to be slide related cracks (Cracks B and C, refer to Figure 1). A potential toe roll was noted along the bottom of the slope to the south side of the access road. Cracks were not noted on the surface of the access road.

Wet spots were noted at several locations along the south ditch of the highway and at the bottom of the slope to the south of the access road. The existing culvert below 43 Street appeared to be distressed and partially blocked with ice at the inlet and outlet locations.

3. ASSESSMENT

The site observations suggest that the highway embankment has been creeping towards the Athabasca River at a very slow rate. The slow movement experienced by the highway is probably related to the ongoing creep movement of the Athabasca river valley slope. Existing slope inclinometers installed at the intersection of Hwy 55:10 and Hwy 813:02 to the south of the subject area indicate that the natural river valley slopes are typically creeping at rates of 1 to 8 mm/yr along pre-sheared slip planes formed in a bentonitic clay shale layer.

At this location, signs of seepage and high groundwater conditions were noted in the highway south ditch and at the bottom of the natural slope below the highway. It appears that high ground water levels at this location promoted a local slide, moving slowly but presumably at slightly higher rates than the movement rates of the Athabasca river valley slope. The local slide appears to be about 140 m long (along the highway alignment) x 70-80 m wide (perpendicular to the highway alignment) x 8.5 m deep (refer to Figure 2).

4. RISK LEVEL

Based on the TRANS's Risk level rating system, the risk level for this site has been assessed as follows:

Risk (28) = PF (7) x CF (4)

This risk level was based on a Probability Factor (PF) of 7 (creeping with perceptible movement rate) and a Consequence Factor (CF) of 4 (site where partial closure of the road would be a direct and unavoidable result of continued movement with time).

5. RECOMMENDATIONS

In the short term, the roadway surface should be watched for any new cracks or extension of existing cracks. Any open cracks should be sealed to prevent further rise in ground water levels. If the highway conditions further deteriorates, the highway surface should be patched to maintain the quality of ride. The highway south ditch should be reshaped to drain surface water away from the slide area. The existing CSP culvert should also fixed to avoid accumulation of surface water in the south ditch. The disturbed area in the vicinity of the recently installed utility box should be smoothed out, topsoiled and seeded to prevent erosion and reduce potential surface water runoff downslope of the highway.

In the interim, it is recommended to add this site to TRANS's Annual Geo-hazard Assessment Program. Consideration should also be given to obtain LIDAR information, if available, which would be useful to augment this preliminary assessment and plan for intermediate and long-term remedial measures. A Part A file review is also recommended to obtain more background on the grouting and any other remedial measures carried out in the past.

In the long term, it may be required to look at the option of relocating this section of the highway and include it within the Athabasca River Bridge rehabilitation study, or alternatively to implement a suitable remedial measure at this location to reduce the potential slide movement. A possible remedial measure may include the installation of two arrays of sub-horizontal drain fans at the bottom of the slope subject to the findings of a geotechnical investigation program. The ballpark cost of the sub-horizontal drains including engineering costs is approximately $250,000- $300,000.

It is recommended to drill test holes, complete with piezometers and slope inclinometers, along the area of the observed distress to monitor groundwater conditions and slope movements over the next year or so before a decision is

made regarding potential long-term remedial measures. The locations of proposed instruments are presented in Figure 1.

6. CLOSURE

We trust that the above information is sufficient for your present requirements. A scope of work and cost estimate for a geotechnical investigation and preliminary engineering can be prepared, upon request. If you have any questions or require additional input please do not hesitate to call us.

Yours truly,
Thurber Engineering Ltd.
Don Proudfoot, P. Eng.
Review Principal

May 4/2010

Tarek Abdelaziz, Ph.D, P.Eng.
Project Engineer
/nnp

cc: Mr. Roger Skirrow, P. Eng.
Mr. Neil Kjelland, P. Eng.

THURBER ENGINEERING LTD.

SITE SKTECH AND APPROXIMATE CROSS SECTION A-A’

Z:\15\15-16-224\15-16-224_ATH-CALLOUT.dwg - FIG 1 - May. 4, 2010 3:30 PM

ATHABASCA RIVER

POTENTIAL OLD RIVER TERRACE

5m WIDE ACCESS ROAD

GAS

SI/PZ (20m)

LIGHT POST

RIDGE

N

W E

S

TO ATHABASCA BRIDGE

DENSITY VEGETATED AREA WITH TILTY TREES

OLD SCARP

VARIES

SLIGHTLY DEPRESSED SIDE SLOPE AREA

DITCH

DISTURBED AREA DUE TO UTILITY BOX INSTALLATION

BURIED CABLE LINE SIGN (AGT)

CRACK A (FAINT-NO DIFFERENTIAL HEIGHT)

POTENTIAL TOE ROLL

UTILITY BOX (INSTALLED 2010)

SUBDUED AREA

HWY 831:02

CRACK B (25mm WIDE, INFILLED)

SI/PZ (25m)

60

0 10 20 30 40 50m

SCALE 1:750

TRAIL

VARIES

SI/PZ (25m)

10-12°

12°

HIGHWAY DITCH

CATCH WATER DITCH 1.3m WIDE x 0.8m DEEP, BECOMES NARROWER TO THE WEST (DRY AT TIME OF SITE VISIT)

PATCH OVERLAY (2008) ~250mm OF ACP OVERLAY

CRACK C (25mm WIDE, INFILLED)

CRACK D (20mm WIDE, INFILLED)

WOODEN CABIN

10mm DIP ON HIGHWAY EBL

CRACK E (20mm WIDE, INFILLED)

STOP

CSP CULVERT BLOCKED WITH ICE

GENTLY SLOPING GROUND (JOHN DEERE FARM AREA)

DEPRESSION 1.4m WIDE x 0.7m DEEP

BUILDING

43 STREET

JOHN DEERE BUILDING

TO HWY 55 WEST

LEGEND

- PONDED WATER
- BUSH LINE
- OVERHEAD POWERLINE POLE
- LIGHT POST
- GAS LINE MARKER
- CRACKS
- SCARP
- SLOPING GROUND
- STOP SIGN
- MAXIMUM DRIVING SPEED
- SI — PROPOSED SLOPE INCLINOMETER
- PZ — PROPOSED PIEZOMETER
- (25m) — DRILLING DEPTH

THURBER PROJECT #15-16-224

ALBERTA TRANSPORTATION

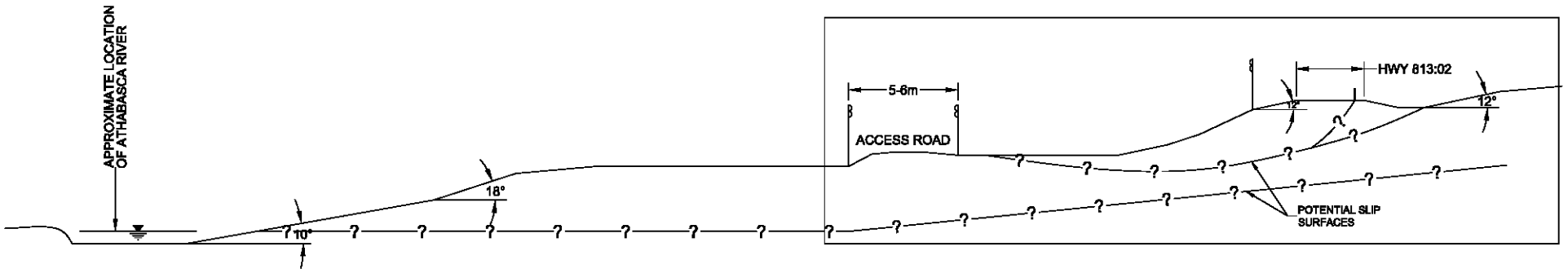
SITE SKETCH PLAN SHOWING APPROXIMATE CONDITIONS DURING CALLOUT ON MARCH 31, 2010

HWY 813:02 EMBANKMENT DISTRESS (km 0.5) ATHABASCA, AB

THURBER ENGINEERING LTD.
GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS

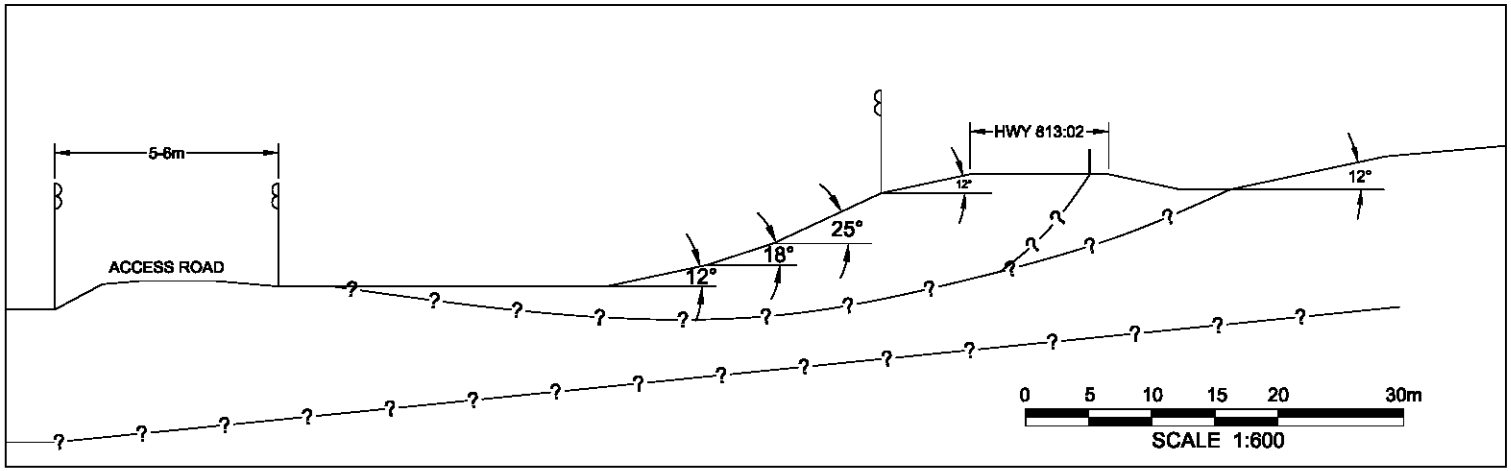
ENGINEER:	DRAWN:	APPROVED:
TSA	HH	DWP
DATE:	**SCALE:**	**DRAWING No.**
MAY 2010	1:750	**FIGURE 1**

Z:\15\15-16-224\15-16-224_ATH-CALLOUT.DWG - FIG 2 - May. 4, 2010 3:30 PM



NOTE

CROSS-SECTION A-A' IS BASED ON APPROXIMATE FIELD MEASUREMENTS AND MAY NOT REPRESENT THE ACTUAL PROFILE THROUGHOUT THE SLIDE AREA ALONG THE HIGHWAY.



THURBER PROJECT #15-16-224

ALBERTA TRANSPORTATION

CROSS-SECTION A-A' (APPROXIMATE)

HWY 813:02 EMBANKMENT DISTRESS (km 0.5) ATHABASCA, AB

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GEOTECHNICAL ▪ ENVIRONMENTAL ▪ MATERIALS

ENGINEER:	DRAWN:	APPROVED:
TSA	HH	DWP
DATE:	SCALE:	DRAWING No.
MAY 2010	AS SHOWN	FIGURE 2

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SELECTED SITE PHOTOGRAPHS
(MARCH 31, 2010)

Photo 1 – General view of the subject site- Looking north from 43 Street

Photo 2 - Looking at the highway north side slope from the east side of the site

Photo 3 - Looking south towards the highway backslope

Photo 4 - Looking west at the highway south side slope and backslope

Photo 5 – Looking south at Crack A from the north ditch

Photo 6 – Looking west at the catch water ditch at the top of the backslope

Photo 7 – Ponding water in the south highway ditch- Looking west

Photo 8 – Multiple wet spots in the south highway ditch- Looking east

Photo 9 – Looking at ponded water at the outlet of the CSP culvert and erosion in the vicinity of the culvert

Photo 10 – Closer look at the culvert outlet. Note the cracks formed to the left of the culvert and formation of ice inside the culvert

Photo 11 –Crack E at the west side of the site- Looking south from the north ditch

Photo 12 –Looking east at the existing access road at the bottom of the slope. Note the ponded water by the tree line

Photo 13 –Looking east at the ridge in the bush downslope of the highway.

Photo 14 –Looking at falling trees in the bush downslope of the highway

Photo 15 –Looking north at tilting trees downslope of the highway