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THURBER

October 18, 2004 15-16-203

Alberta Transportation
Room 301, Provincial Building
Bag 900, Box 29
9621 – 96 Avenue
Peace River, AB T8S 1T4

Attention: Mr. Ed Szmata

PEACE REGION SWAN HILLS AREA GEOHAZARD ASSESSMENT
SH20 (CE047/2004)
CALL-OUT FOR EMBANKMENT FAILURE
ON HWY 679:06, 3 KM WEST OF HWY 750

Dear Sir:

This report presents the results of a call-out for the above noted site located on the graveled portion of Hwy 679:06, approximately 3 km west of the intersection with Highway 750. Mr. Barry Meays, P. Eng. of Thurber Engineering Ltd. conducted the inspection on October 4, 2004. Mr. Ed Szmata of Alberta Transportation (AT) made the request for the call-out, who was present during the site reconnaissance along with Mr. Rodney Johnston of AT.

1. BACKGROUND

The slump has resulted in cracks along the road surface. Based on information obtained from Mr. Rodney Johnston, this slump was first observed the week of September 12 to 18, 2004. It was understood that during the period of about 1 month prior to this observed movement, about 200 mm of rain had fallen in the area. There was no known past history of slide movements or highway distress at this location prior to the current observed movements.

It is understood that this highway is in the plans to be re-constructed within the next 10 years. Based on observations made during the site visit, the traffic volume on this road is low.

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2. OBSERVATIONS

A sketch plan showing the extent of the slide on October 4, 2004, is provided on Figure 1. Selected photographs taken during the site reconnaissance are also attached.

The slide occurred on the south side of the highway. The backscarp of the slide is located along the eastbound driving lane of the graveled road surface, marked by an intermittent crack along its length, containing a double crack over a portion of this distance.

The highway embankment is a fill along the slide area (estimated to be about 3 to 4 m in vertical height), containing a slope varying between about 15^0 to 18^0. The toe of the highway embankment coincides with a fence line likely marking the south boundary of the highway right-of-way. South of the fence line for a distance of about 30 m, a slightly hummocky area existed which had average slopes varying between 8^0 to 10^0 over this distance. Two shallow debris mounds containing old wood/soil marked the southern boundary of this hummocky area. Beyond the debris mounds further south, the ground surface was nearly flat. A second fence line was located about 45 m south of the highway embankment toe. The highway embankment was grassed, while the area between the two fences contained a grass/weed pasture surface.

The crack marking the slide along the highway surface was observed to extend about 60 m wide along the highway surface, and the slip surface appeared to extend below the highway embankment sideslope, toeing out about 10 m to 12 m down slope of the fence line (for a total length of about 25 m). The backscarp of the slide is well defined, with the crack as much as 50 mm wide, and containing a vertical drop as much as 75 mm across the crack. The toe roll was only observed over two or three distances of 8 to 9 m in length, with no continuous toe roll observed along the entire slide length. It is possible that the above described toe could be an intermediate toe roll, with the final toe extending further south at the terminus of the hummocky ground at the south end of the debris mounds.

The outlet to an 800 mm diameter CSP culvert was exposed at the eastern edge of the slide area, exiting at the fence line. An erosion gully and scarp about 6 m wide and 1.4 m deep existed immediately around the culvert outlet. Adjacent to the east side of the erosion gully, a larger slump was observed, with the 400 mm deep scarp extending north a few meters into the highway embankment, and about 20 m south of the fence. A number of successive slope tears and intermediate scarps were observed within this well defined slump. A steady trickle of water was observed emanating from the CSP outlet.

Based on the shape and crack pattern in the road surface, it is anticipated that the slide could join the slumping around the culvert in the future, a distance of about 20 m further east. Similarly, the west boundary of the slide may continue further

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southwest to the toe of the knoll, but more likely extends southeast towards the more identifiable toe roll observed. The soil exposed in the scarp around the CSP outlet consisted of highly plastic clay. The slide movement has bowed out the barbed wire fence by about 1 m adjacent to the CSP culvert outlet, and a more gradual bow appeared to be visible in the fence down slope of the western end of the crack observed in the fence. No seepage or ponding of water was observed from the scarp or toe of the slide.

3. ASSESSMENT

The highway embankment failure appears to be mainly due to saturation of the slope as a result of a prolonged period of rainy weather, where the roadway embankment fill was placed over and at a somewhat steeper slope than the relatively flatter native ground surface below the toe of the fill (at 7^0 to 10^0). The subsurface conditions below the slope appear to consist mainly of high plastic clay. Over time, the clay may have become desiccated and weakened by freeze thaw and wet dry cycles which resulted in fissures and /or softened soil into which surface infiltration could permeate.

In addition, the significant erosion and associated slumping observed around the CSP outlet at the toe of the embankment fill adjacent to the east end of the slide could possibly have triggered the slope movement.

Since the existing natural slope below the toe of the embankment fill is sitting so flat, this area may have been a previously failed area, and was only re-activated by either one, or both, of the above triggers.

4. RISK LEVEL

Based on the Alberta Transportation Risk level rating system, The risk level for this site has been assessed as follows:

Risk (36) = PF (12) x CF (3) [Eq. 1]

This risk level was based on a Probability Factor (PF) of 12 (active with a moderate to high rate of movement, steady or increasing) and a Consequence Factor (CF) of 3 (site having a moderate fill where private land may be affected, and partial closure of the road is a possible result of a slide movement).

5. RECOMMENDATIONS

The slide is currently affecting the roadway, and could continue to move. Hence, barricades and warning signs should be maintained around the slide area to warn motorists of the hazard and the slide should be inspected on a daily basis so that signs can be moved, or a detour constructed if the slide worsens.

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For the short term, it is recommended that the top edge of the slide area across the roadway surface should be graded and replenished with gravel to reduce water infiltration into the slide cracks, and to taper runoff off of the graveled roadway surface onto the sideslope. It is anticipated that continued movements should slow or possibly cease during the winter, due to the anticipated shallow nature of this slide.

It is understood that since this road is scheduled to be reconstructed in the future, long-term remedial recommendations will likely not be undertaken in the immediate future. Consideration should be given to installing 4 slope inclinometers (SI's) at this site to track the magnitude and depth of movements, and also to define the position of the slide toe. The test holes as part of the inclinometer installations would also be used to assess the soil conditions down slope of the highway embankment, where the relatively flat natural slope exists. The proposed locations and depths of the SI's are shown on Figure 1. Piezometers should also be installed in separate holes near each SI location to determine the governing piezometric surface at the site. Surveying of this site is recommended prior to implementing permanent remedial measures, to properly assess drainage and to better define quantities.

The recommended potential long-term solutions would be to construct a toe berm, or alternatively, install a gravel shear key, to stabilize the slide area.

The berm would have to extend beyond toe area, and about 1/3 of the way up the highway embankment. The failed portion of the slope located above the berm level should be subexcavated and reconstructed with well-compacted drier clay or preferably gravel, benched into the intact portion of the highway embankment. A subdrain should also be installed along the base of the slide excavation to drain any surface/subsurface water that may enter the rehabilitated slide mass. Another requirement will be to strip the topsoil from the slide area and replace and seed it upon completion of the repairs.

A gravel shear key would consist of excavating a trench below or through the slide toe, having an appropriate width determined in design. The trench would then be backfilled with well-compacted gravel to surface. A subdrain should be installed along the base of the shear key, and allowed to drain to the southeast along the natural drainage run.

The erosion and slump around the CSP culvert outlet would also need to be repaired as part of these long term remedial measures. This would involve excavate/remove all fallen trees and any soft/wet material in the eroded scour hole and slump area, and backfill the area with clay fill to the underside of the existing culvert in thin lifts to a minimum of 95% of standard proctor maximum dry density.

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The tapered end section of the culvert should be removed and replaced if it is damaged. If necessary, a smooth wall steel drop pipe should be attached to the proposed culvert liner to lower the culvert outlet until it meets grade downstream of the scour hole. Riprap, over a non-woven geotextile should be placed around and downstream of the outlet. It may be desired to place silt fence at the base of the slope along the edge of the drainage channel.

The above repairs will extend into private land and hence right-of-way negotiations will be required before the work can commence.

The ball park cost of the toe berm or gravel shear key work, excluding land and engineering costs, is $200,000 to $300,000.

6. CLOSURE

We trust that the above information is sufficient for your present requirements. However, if you have any questions or require any additional input please do not hesitate to call us.

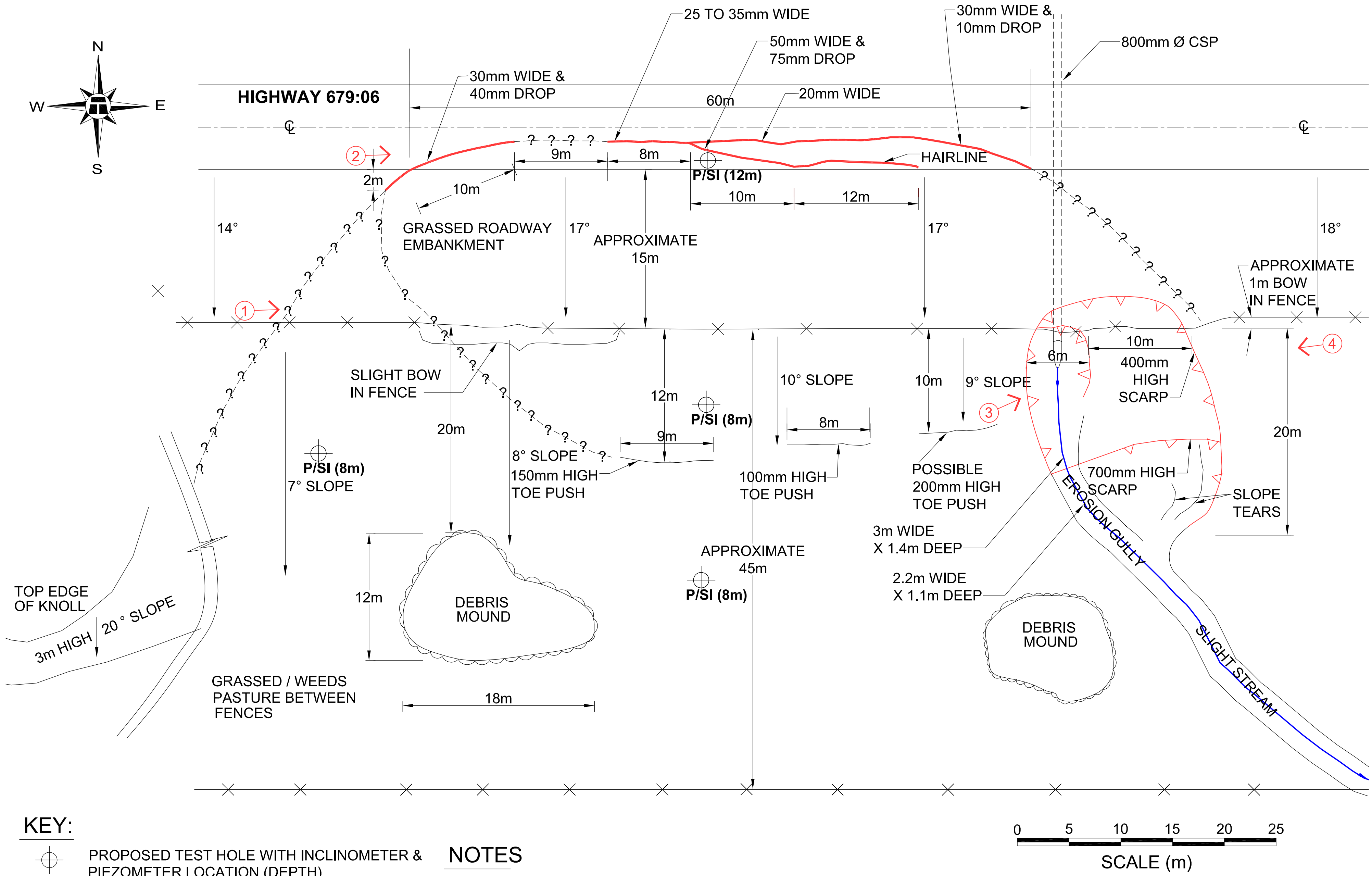
Yours truly,
Thurber Engineering Ltd.
Don Proudfoot, P. Eng.
Review Principal

Barry Meays, P.Eng.
Project Engineer

/slp

cc: Mr. Roger Skirrow, P. Eng.
Geotechnical Director, Alberta Transportation

SITE SKETCH PLAN



KEY:

- PROPOSED TEST HOLE WITH INCLINOMETER & PIEZOMETER LOCATION (DEPTH)
- FENCE
- CRACK
- SCARP
- WATERSTREAM (STEADY TRICKLE)
- POTENTIAL SLIDE SURFACE
- PHOTO NO. & DIRECTION

NOTES

1. SLIGHTLY HUMMOCKY SURFACE FROM NORTH FENCE TO SOUTH END OF DEBRIS MOUNDS.
2. NEARLY FLAT GROUND SOUTH OF SOUTH END OF DEBRIS MOUNDS.

FIGURE 1 - SITE PLAN

CALL OUT FOR SLIDE ON HWY 679:06
3 Km WEST OF HIGHWAY 750
SH20 PEACE REGION SWAN HILLS AREA

SCALE: 1:500
DATE: OCT. 4, 2004
THURBER PROJECT #15-16-203

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SITE PHOTOS

PHOTO 1 - LOOKING EAST ALONG FENCELINE ACROSS SLIDE AREA
NOTE SLIGHTLY BOWED FENCE

SH20 - HWY 679:06
SELECTED PHOTOGRAPHS
CALLOUT OCT. 4, 2004
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PHOTO 2 - LOOKING EAST ALONG ROAD AT CRACK IN HIGHWAY. THE PILONS MARK THE SLIDE SCARP BOUNDARY

PHOTO 3 - LOOKING NORTHEAST AT EROSION / SLUMPING ADJACENT TO 800mm Ø CULVERT OUTLET

PHOTO 4 - LOOKING SOUTH TO WEST ACROSS SLIDE AREA FROM EAST END OF SLIDE. NOTE BOWED FENCE AND TWO DEBRIS PILES

SH20 - HWY 679:06
SELECTED PHOTOGRAPHS
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