THURBER ENGINEERING LTD.

December 19, 2019 File: 13355

Alberta Transportation
3rd Floor, Provincial Building
9621 – 96 Avenue
Peace River, Alberta
T8S 1T4

Attention: Mr. Ed Szmata

GEOHAZARD ASSESSMENT PROGRAM
CALL-OUT INSPECTION
SH013-13 HWY 744:02 LITTLE SMOKY RIVER VALLEY

Dear Sir:

On August 29, 2018, Alberta Transportation (AT) noticed slumping in the east sideslope of Highway 744:02 km 21.5 at the existing GeoHazard Risk Management Program Site SH013-13. Thuber Engineering Ltd. (Thurber) was notified the following day and requested by Ed Szmata of AT to conduct a call-out inspection under the GRMP. The inspection was completed on September 18, 2018, by Mr. Shawn Russell, P.Eng., formerly of Thurber, in the presence of Mr. Szmata.

1. SITE CONDITIONS

The site (SH013-13) is located on the east side of Hwy 744:02 (the highway is oriented approximately north-south) at about km 21.5 within the Little Smoky River valley approximately 12 km south of the junction with Highway 2. Site features and observations are shown on the attached Drawing 13355-1. At this location, the highway is constructed in fill over a drainage course approximately 8 m deep (as measured along the upslope ditch). There is a dugout in the upland field above that drains into this course. Below the site, erosion is creating a significant oversteepened gully that leads down to a drainage channel that is a tributary to the Peavine Creek. This site has been repaired on at least three separate occassions: the repair associated with the gabion basket wall (east sideslope), and the 2002 (east sideslope) and 2017 (west sideslope) repairs discussed further below.

At the time of the visit, there was a significant slump in east sideslope of the highway embankment; however, it was not affecting the roadway surface or guardrail. Comparing to the photographs provided by AT when the slide was first observed, it does not appear that it deteriorated further in the three weeks before Thurber's call-out site visit. The slide was approximately 23 m wide and located north of the culvert encompassing a portion of a previous slump repaired in 2002. The scarp was about 10 m east of the highway shoulder. The backscarp was about 4 m to 6 m in height along the sideslope and consisted of a series of retrogressive lower scarps where it intersected the ditch and backslope. The slide was about 30 m in length extending through an existing gabion basket wall with slide debris past the toe of the embankment fill and extending over the crest of the major gully located downslope of this site. The slide debris

appeared wet but it is unknown if that is due to the recent rainfall or groundwater seepage. Uniaxial geogrid was observed near the toe of the slide which may have come from the 2002 slide repair or from behind the gabion basket wall.

Although not related to this east sideslope failure, it was noted the crack in the west lanes (SBL) associated with the west embankment slump repaired in 2017 has widened somewhat since the GRMP Assessment visit in June 2018. The west sideslope was repaired in 2017 when a new SWSP culvert was jacked through the embankment and the sideslope regraded. The existing 1300 mm-diameter CSP culvert was grouted in place. As the prior slide material was not removed during this repair and additional fill was placed over top, it is likely that this related to continued movement on that slide surface or settlement of the new fill.

2. ASSESSMENT

Fills placed in the Peace River region have a history of a loss of cohesion over time leading to instability. This site was repaired in 2002 using recompacted clay fill so the timeline is appropriate for a similar type of mechanism. However, the ongoing movement in the upslope ditch started ponding water in about 2014 which may have led to saturation of the highway embankment and a loss of strength in both the original highway embankment and the 2002 repair. The culvert installed in 2017 drained the upslope ponded water; however, it is anticipated that the elevated groundwater table will require several years to return to pre-2014 levels. There does not appear to be an immediate triggering factor for this slide such as erosion or construction activity.

The assessed risk level for this site prior to this failure, based on AT's guidelines, was 28, based on a Probability Factor of 7 (inactive with a high probability of remobilization) and a Consequence Factor of 4 (Fill associated with culverts and where a partial road closure would be a direct result of slide occurence). However, this recent movement elevates the Probability Factor to 11 (Active with moderate but increasing rate of movement) for a risk level of 44. This risk level is the same as that applied to the site in 2016 when the upslope slide was still active.

3. RECOMMENDATIONS

It is understood that the slide has not regressed further since it was first observed. However, there is concern that high precipition in spring could further weaken the embankment or lead to erosion of the toe material from ditch flow which would lead to retrogression. It is recommended that this slide be addressed as soon as practical to avoid partial closure of the highway. The several repair alternatives are proposed for this site are discussed below. Given instability on both sides of the highway, the potential difficulty in anchoring, and the high cost, a pile wall is not recommended for this location.

- Reconstruct the failed portion of the embankment using granular material. This material should be reinforced with geogrid and a subdrainage system install along the back and base of the excavation. The slide material should be removed and disposed off-site. During construction, the opportunity should be taken to repair the erosion damage to the riprap apron at the culvert outlet and the minor erosion channels forming downslope of it. This option would repair the immediate distress but not address the long-term concerns at this location. The rough estimated cost for this alternative is about $260,000

(not including replacement of gabion basket or erosion repairs downslope toward the Peavine Creek tributary).

- Given that there is slide debris in the west sideslope and ditch that has not been removed and that there have been at least three slides in the east embankment, a robust repair alternative would be to entirely reconstruct the embankment across this drainage channel. The embankment should be completely excavated, a new culvert installed, and the embankment rebuilt. A full detour will be required which will necessitate first removing the soft and wet slide debris in the upslope ditch. The new culvert should be extended via welded pipe down to the tributary below the site (approximate distance of 65 m and elevation drop of 20 m) to limit further erosion regression. The embankment should be rebuilt with flatter sideslopes (may require a lower grade through this section) or reinforced granular fill. Consideration could also be given to the use of light-weight fill to reduce the overall loading on the slope which would reduce the driving force on the deeper valley-scale movements. The ditches should be protected from erosion and the discharge handled in a similar manner to the culvert. Alternatively, a combined drop structure or large culvert could be used to collect the flow from the ditches and centerline culvert. The rough estimated cost for this alternative is $1,300,000 (not including light-weight fill, replacement of gabion basket, or drop structure down to the Peavine Creek tributary).

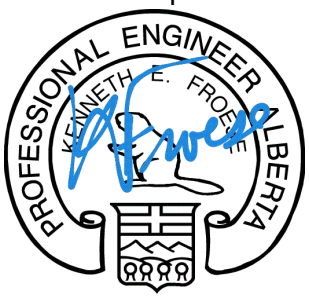
- The highway could be realigned slightly upslope of its current location. This could reduce the requirement for a detour as the existing highway could be maintained while the realignment is constructed. As discussed above, the weak material in the upslope ditch would need to be excavated and replaced. The recommendations for the culvert length and discharge location also apply as do the requirements for ditch protection. However, clay material could be used for the fill as there would be opportunity to flatten the slopes once the old highway embankment is removed. The rough estimated cost for this alternative is $2,000,000 excluding ROW acquistion.

THURBER

4. CLOSURE

We trust this is the information you require at this time. If you have any questions, or if you require further information or recommendations, please contact us at your convenience.

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



December 19, 2019

PERMIT TO PRACTICE
THURBER ENGINEERING LTD.
Signature _____
Date December 19, 2019
PERMIT NUMBER: P 5186
The Association of Professional Engineers and Geoscientists of Alberta

Ken Froese, M. Eng., P. Eng.
Project Engineer
/meg

Attachments:
- Drawing 13355-SH013-13 (February 2019)
- September 18, 2018 Photos

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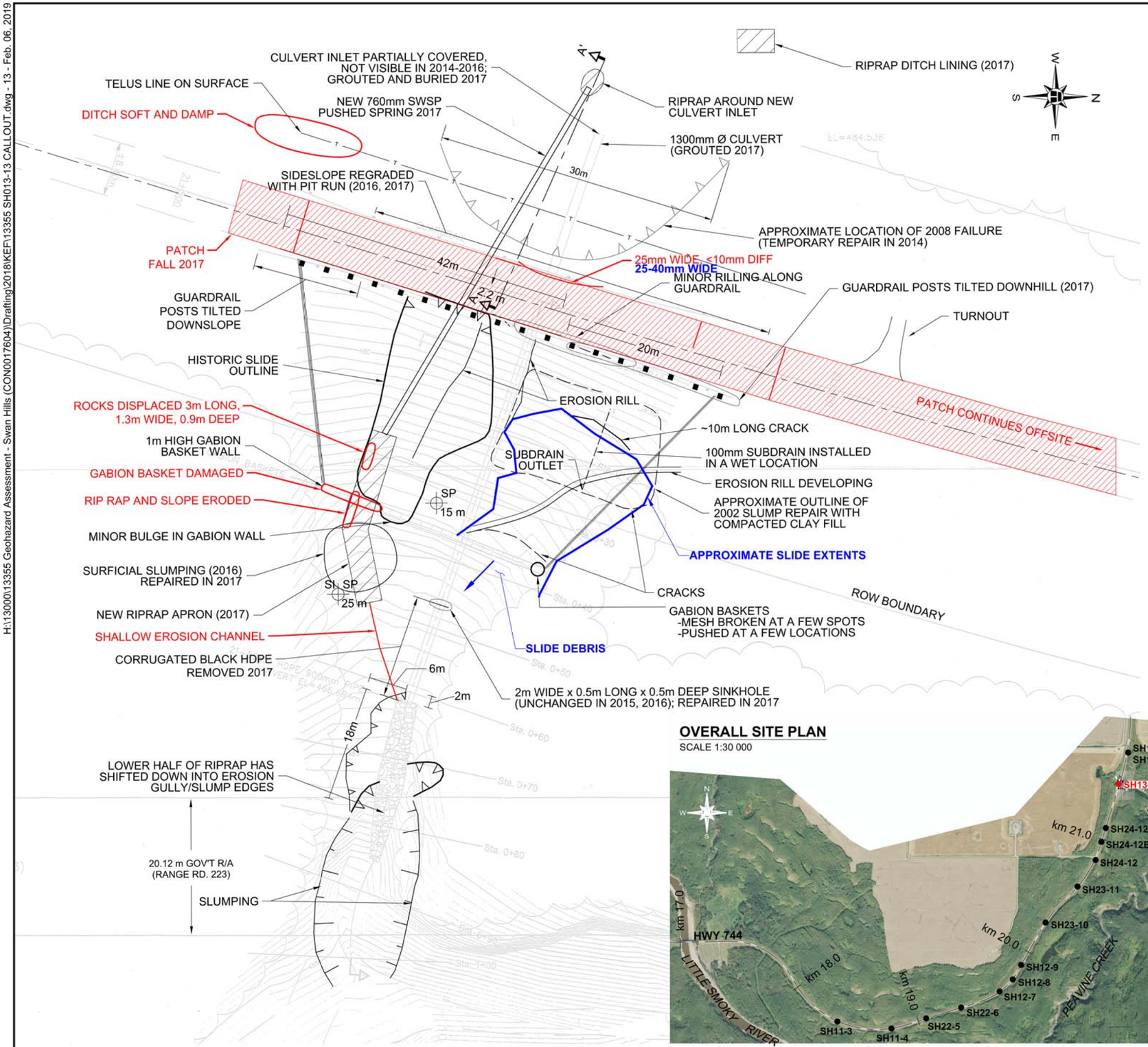

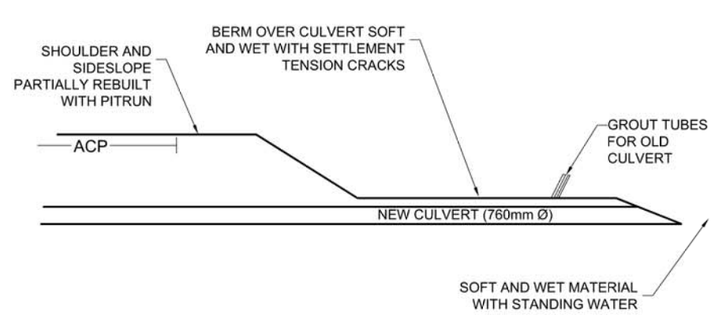

CROSS - SECTION A - A'
APPROX. SCALE: 1:300 (HAND MEASURED)

NOTES

1. PREVIOUS OBSERVATIONS SHOWN IN BLACK
2. JUNE 2018 OBSERVATIONS SHOWN IN RED
3. THIS DRAWING TAKEN FROM EXH ENGINEERING SERVICES LTD. PROJ. NO. 1202177 WITH 2013-2015 OBSERVATIONS FROM AMEC FIGURE 1, PROJECT EG10030 (PROVIDED BY AT)
4. SEPTEMBER 2018 OBSERVATIONS SHOWN IN BLUE.

OVERALL SITE PLAN
SCALE 1:30 000

0 5 10 15 20 30m
SCALE 1:600

Alberta

PEACE REGION (SWAN HILLS)
SH013-13: HWY 744:02 km 21.4 CALLOUT

2018 CALLOUT PLAN

DWG No. 13355-SH013-13

DRAWN BY	ML
DESIGNED BY	KEF
APPROVED BY	DWP
SCALE	1:600
DATE	FEBRUARY 2019
FILE No.	13355

THURBER ENGINEERING LTD.

Photo 1: Looking east from the edge of the highway.

Photo 2: Looking south at upper portion of the slide.

Photo 3: Looking northwest up at slide mass.

Photo 4: Looking north where slide mass went over the gully crest.

Photo 5: Looking north along existing gabion basket wall.

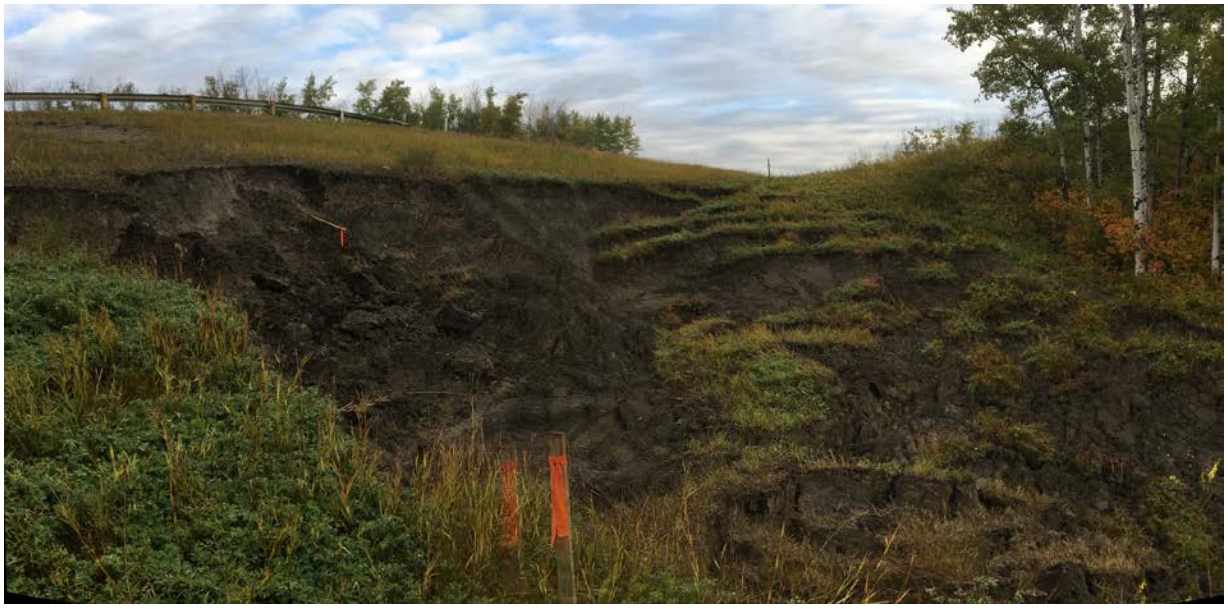

Photo 6: Looking northwest at top scarp of slide.