July 11, 2018 File: 13351

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

Attention: Mr. Ed Szmata

GEOHAZARD ASSESSMENT PROGRAM
CALL-OUT INSPECTION REPORT
HWY 2:68 KM 12.6
NE08-080-04-W6M
(PH001-2) DUNVEGAN NORTH SITE

Dear Sir:

Under the Geohazard Assessment Program, Thurber was requested by Mr. Ed Szmata of Alberta Transportation (AT) to conduct two separate call-out inspections at the above noted landslide site.

The first call-out inspection was completed by Mr. Shawn Russell, P. Eng. of Thurber Engineering Ltd. (Thurber) with Mr. Szmata on June 26, 2018, following the report by a local contractor of an accumulation of slide debris and sandstone slabs littering the surface of the highway earlier that morning. Mr. Don Proudfoot, P. Eng., of Thurber returned to the site with Mr. Szmata on July 6, 2018, to meet Mr. Steve Johnston and Mr. Josh Palmer of McCaws Drilling and Blasting Inc. to assess the suitability of the site for the removal of the landslide material by blasting.

1. OBSERVATIONS

Selected photographs taken on June 26, 2018 and on July 6, 2018 are attached to the report.

A landslide was observed in the upper part of the highway backslope at approximately km 12.6. At this location the backslope is about 55 m high. The lower 30 m of the backslope, where the bedrock is exposed is inclined at 1H:1V. The upper 25 m, in which the landslide is located in soil material, is inclined at about 2H:1V (Photos 1 to 3). The landslide was overlying an upper 300 mm to 800 mm thick sandstone bedrock ledge situated about 25 m to 30 m above the SBL ditch (Photo 3).

The landslide measured 75 m in overall length. The landslide was about 50 m in width and spanned between a natural drainage gully to the west and a more subdued lower draw in the natural valley slope to the east. The plan outline of the landslide recorded with a handheld GPS is shown on Figure 1.

The exposed backscarp height at the center of the landslide was about 6 m (Photos 9 and 13). A graben had formed along the base of the scarp. The soil exposed in the backscarp and slide mass

appear to consist mainly of silty sand, with some clay and hard/strong sandstone pieces embedded within it (Photos 10 to 14).

Currently, the slide material is toppling over the edge of the steep slope at a slow enough rate that regular ditch cleaning has managed to keep pace with slide debris accumulation.

The landslide debris accumulated in the SBL ditch consisted primarily of small chunks and small to large sized slabs of silty weathered sandstone bedrock and colluvium mixed with organics.

3. ASSESSMENT

In the past, similar landslides and debris flows in this area have typically occurred in the gullies due to the concentration of surface runoff water from heavy rain fall events. The inferred slip surface is likely to be along the top of the upper sandstone bedrock layer at an approximate elevation 428 m.

This landslide is considered to have been triggered by either a temporary rise in groundwater or a concentration of surface water runoff at this location. The primary concern for this site is the potential for further colluvium and weathered sandstone bedrock debris accumulating along the edge of the upper sandstone ledge debris to continue to fall onto the highway causing a risk to public safety. Furthermore, there is also a risk that the cascading landslide debris can dislodge undermined sandstone slabs from the two sandstone layers below that might travel faster and further out into the highway and possibly strike a vehicle.

The maintenance contractor has erected jersey barriers to help contain the debris to keep it off the highway. However, there is still a risk that the remainder of the slide debris volume (about 20,000 m^3) could fall catastrophically onto the highway in a fast-moving mudslide if its gets saturated during a heavy precipitation event. If the slide material came down in a big single event it could dislodge the concrete jersey barriers and flow out into and close the highway.

The assessed risk level for this site, based on AT's guidelines is 150, based on a Probability Factor of 15 (Active with high rate of movement with additional hazards) and a Consequence Factor of 10 (sites with rapid mobilization of a large scale slide is possible and where the safety of the public will occur if slide occurs).

There are no available records of previous geotechnical investigations and there are currently no instruments installed at the site.

4. RECOMMENDATIONS

The remaining failed material over 15 m from the toe of the landslide should be carefully removed to reduce the potential for further debris to fall onto the highway below. Due to the possibility of crumbling of the edge of the sandstone bedrock layer, equipment should be kept back at a minimum distance of 3 m from the crest of the steep backslope.

The remaining slide debris should be left with a slope angle of 2H:1V (See Figure 3). This could be accomplished using a long reach excavator that would access the site from privately owned

land to the north of the landslide. The excavator would push the failed material over the crest of the slope. This would need to be monitored with spotters equipped with two-way radios positioned at the top of the steep backslope section and along the highway.

Once the outer 15 m of the landslide debris has been removed, the backscarp should be flattened to an inclination of 2.5H:1V and the remaining slide debris should be cut-down and flattened as a buttress with a slope angle of 5H:1V (See Figure 4). Depending on the extent of the backscarp, this may require the acquisition of privately owned land above the current landslide.

The offloading could take a few weeks to complete. Until the work is done, signs should be placed at the top and the bottom of the highway valley section warning traffic about the potential for a rock/mud flow that could affect the highway. Consideration should be given to posting a slower traffic speed through the landslide zone until the slide material has been dealt with.

One of the reasons Thurber was called out to site on July 6, 2018 was to comment on the suitability of blasting the slide material to move it down the slope. It is understood that McCaws Drilling Inc. were initially called to the site to hand drill and blast the overhanging sandstone ledges. They raised a concern that blasting of the rock ledge could bring the bulk of the overlying slide mass down onto the highway in a dangerous uncontrolled manner. We concur and recommend that the decision to do any blasting be deferred until the slide has been offloaded with mechanical equipment as noted above. After sliding down the slope, the material might concurrently remove the overhanging sandstone ledges and reduce or eliminate the need for any follow up blasting.

5. 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.
Principal/Review Engineer

Shawn Russell, B.A.Sc., P.Eng.
Associate/Senior Engineer
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Attachments:
- Photos
- Figures

Photo 1: Looking NE at the landslide site from
the south side of the Peace River Bridge (June 26, 2019)

Photo 2: Looking NE at the landslide site from
the north shore lower flood plain of the Peace River (June 26, 2018)

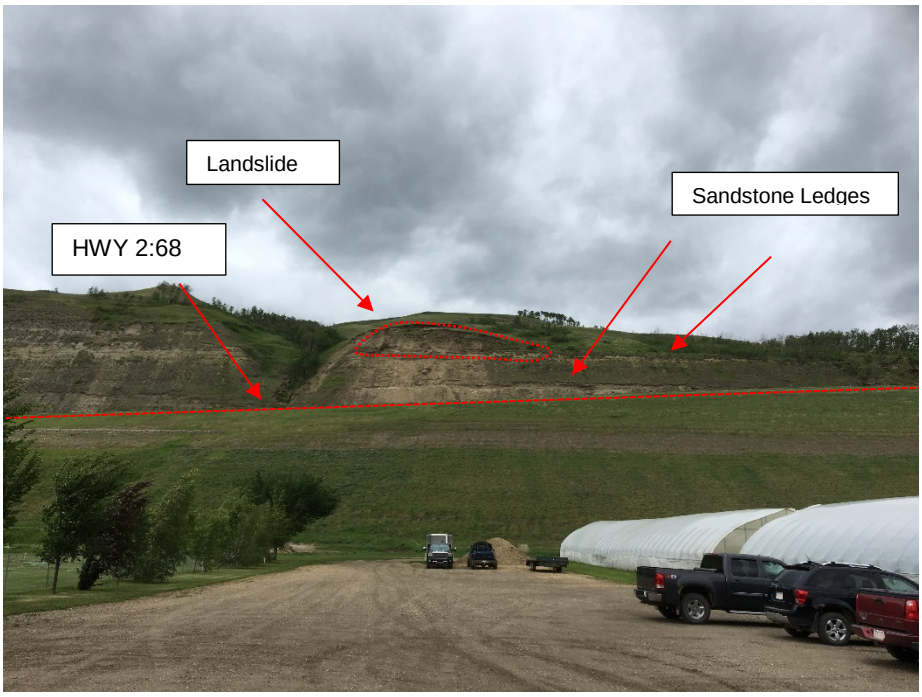

Photo 3: Looking north at the landslide site from
the north side lower flood plain terrace (June 26, 2018)

Photo 4: Looking NE from the SBL ditch of Hwy 2:68 at
the highway backslope below the landslide (June 26, 2018)

Photo 5: Looking west from SBL ditch of Hwy 2:68 at sandstone slabs and soil chunks that have accumulated in the itch below the landslide (June 26, 2018)

Photo 6: Looking NE from SBL shoulder of Hwy 2:68, east of the landslide (June 26, 2018)

Photo 7: Looking south from the natural flatter slope area above the landslide (July 6, 2018)

Photo 8: Looking NE from the west edge of the landslide backscarp (July 6, 2018)

Photo 9: Looking NE along backscarp of the landslide (July 6, 2018)

Photo 10: Looking SE from west side of the landslide backscarp July 6, 2018)

Photo 11: Looking south from the middle of the backscarp of the slide (July 6, 2018)

Photo 12: Looking SW from the middle of the slide from the backscarp (July 6, 2018)

Photo 13: Looking SW from middle of the landslide along the backscarp (July 6, 2018)

Photo 14: Looking NW from the east end of the backscarp (July 6, 2018)

Photo 15: Looking SW from the east end of the backscarp (July 6, 2018)

Photo 16: Looking west along the slide at the possible toe roll of the landslide (July 6, 2018)

Photo 17: Looking west along the toe of the slide (July 6, 2018)

Photo 18: Looking SW from the toe of the slide towards Hwy 2:68 (July 6, 2018)

PH1N

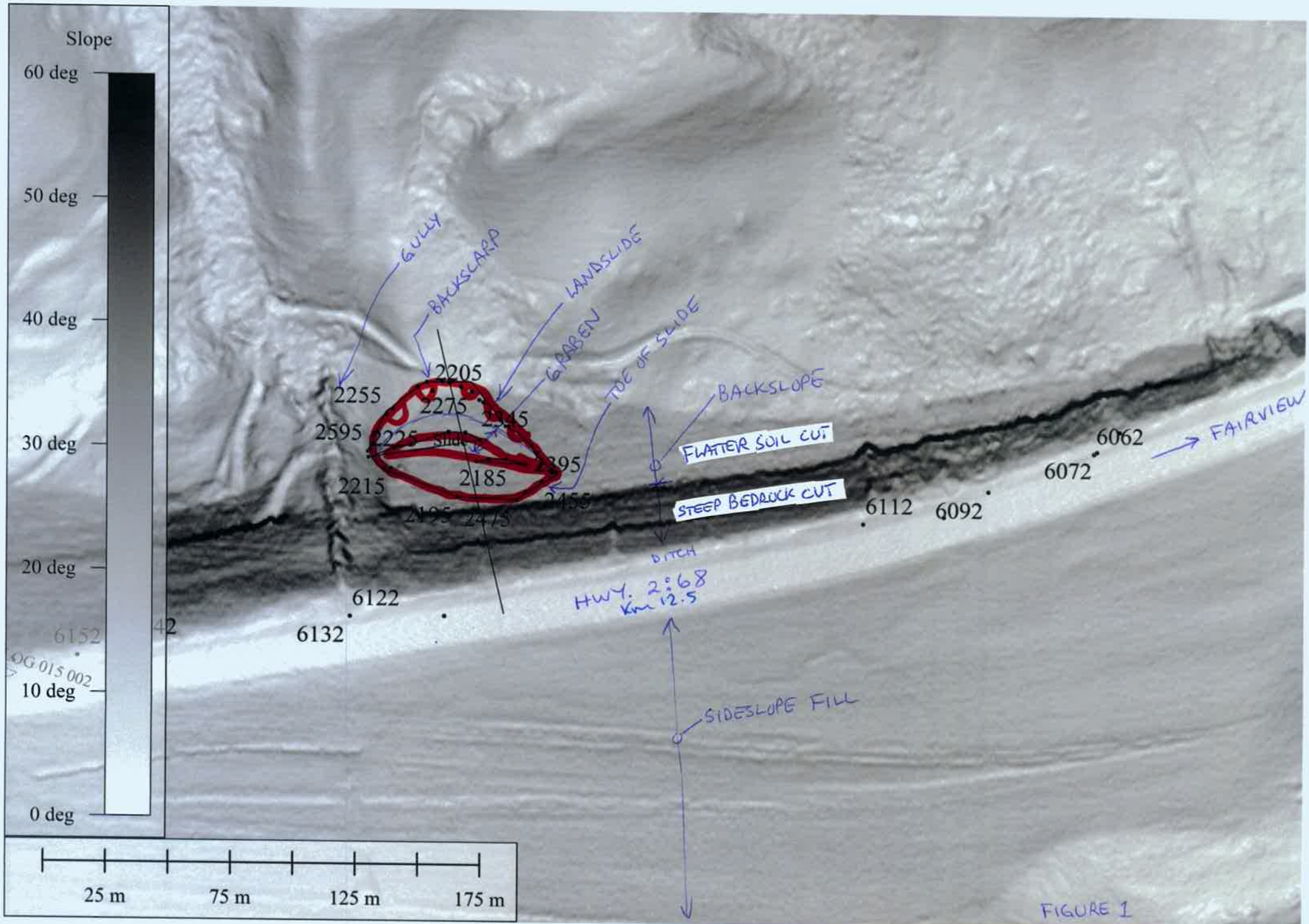

FIGURE 1

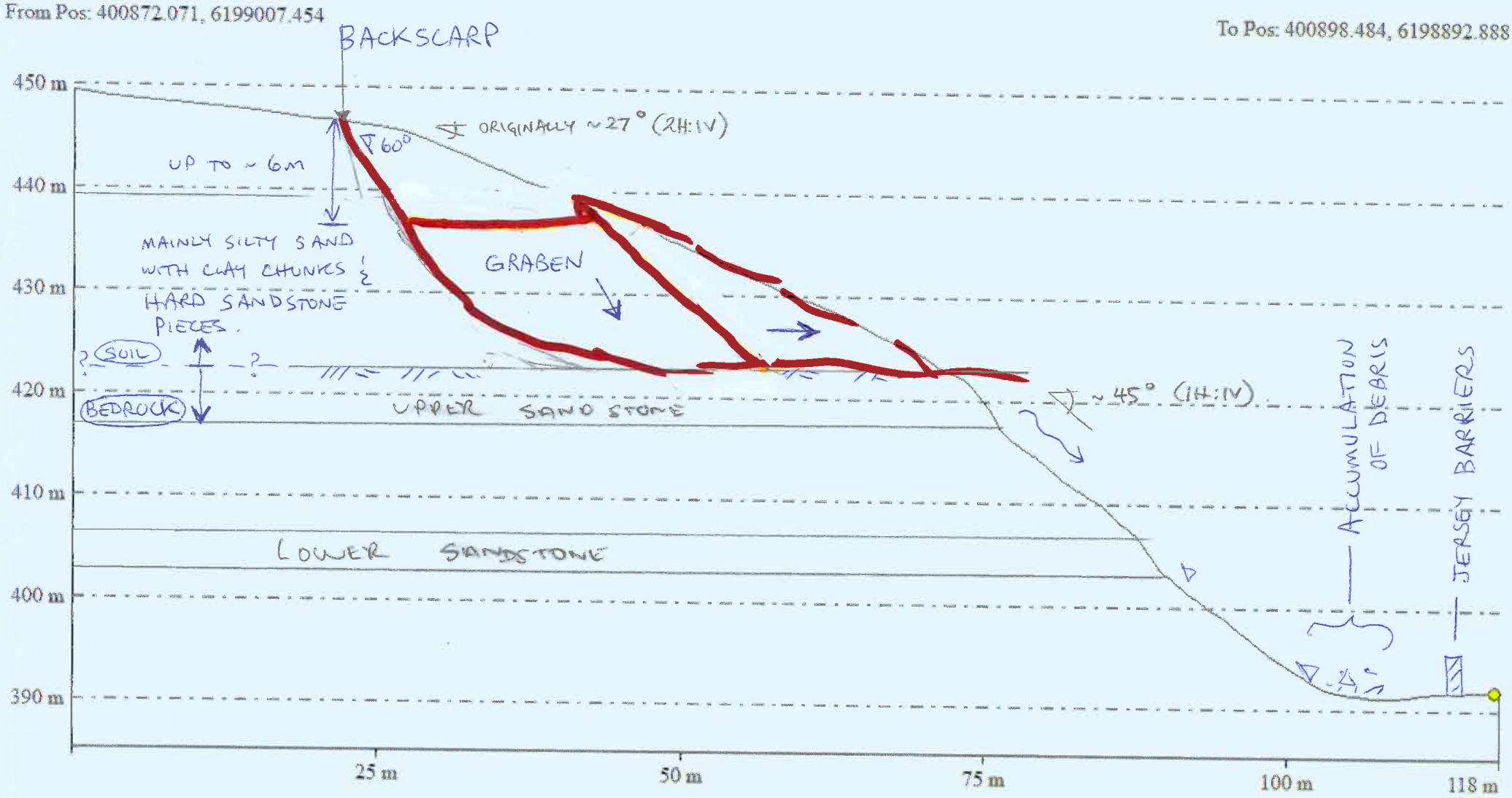
From Pos: 400872.071, 6199007.454
To Pos: 400898.484, 6198892.888
BACKSCARP
450 m
440 m
430 m
420 m
410 m
400 m
390 m
UP TO ~ 6M
60°
ORIGINALLY ~27° (2H:1V)
MAINLY SILTY SAND WITH CLAY CHUNKS & HARD SANDSTONE PIECES.
GRABEN
SOIL
BEDROCK
UPPER SAND STONE
~45° (1H:1V)
LOWER SANDSTONE
ACCUMULATION OF DEBRIS
JERSEY BARRIERS
25 m
50 m
75 m
100 m
118 m

FIGURE 2

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Prepared by SAR Date 9 July 2018

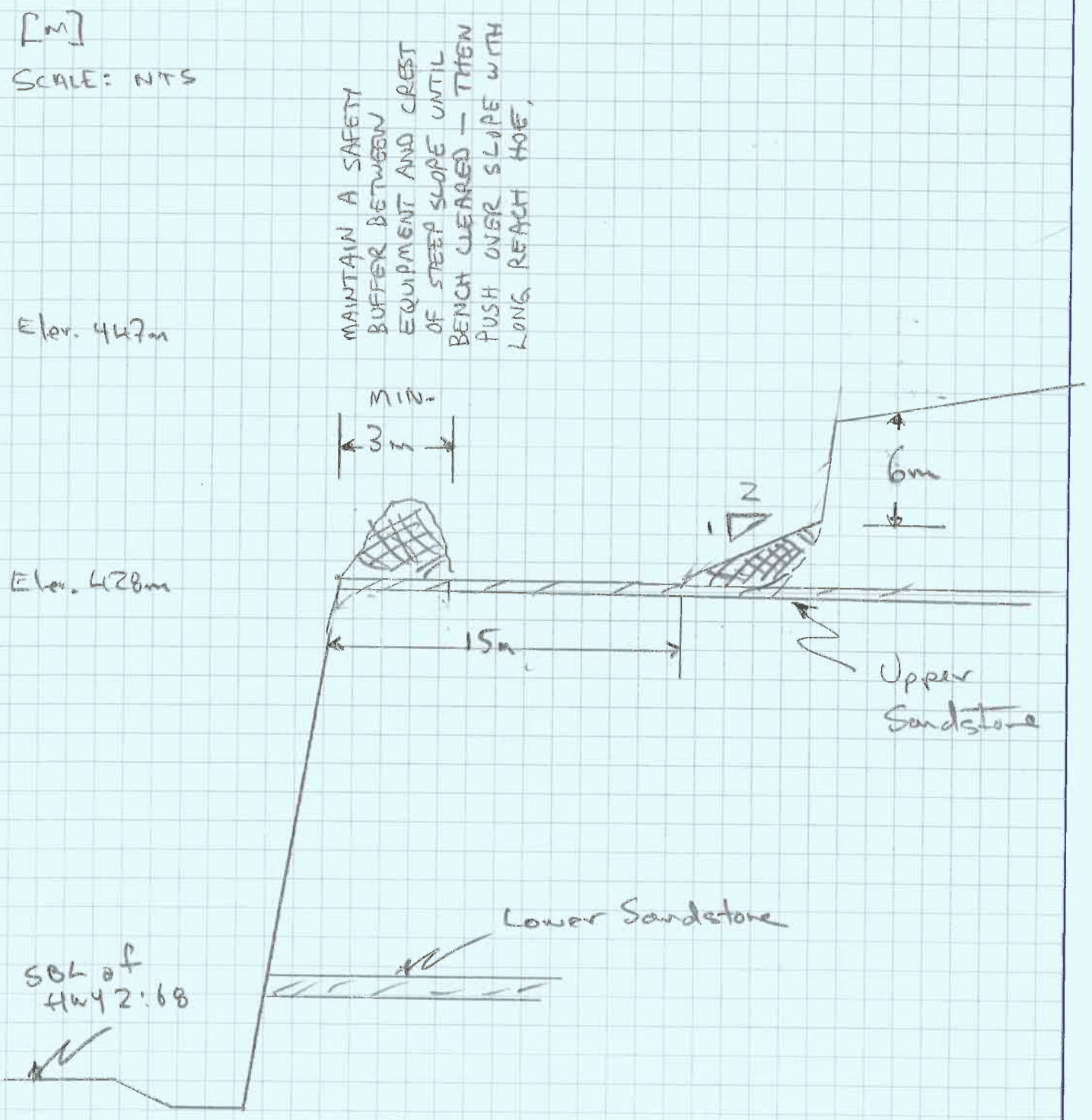
Checked by Date

Client ALBERTA TRANSPORTATION Project PH KEOHAZAKOS / PHIN CALLOUT

FIGURE 3: SHORT TERM EXCAVATION

[m]

SCALE: NTS



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Sheet 2 of File N° 13351 1819.D

Prepared by SHR Date 9 July 2018

Checked by Date

Client ALBERTA TRANSPORTATION Project PH Geohazards / PHIN Callout

FIGURE 4: LONG TERM EXCAVATION