

**ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION – HIGH LEVEL
2017 INSPECTION**



| Site Number | Location | Name | Hwy | km |
|-------------------|----------------------|------------------|--------|-----------|
| PH047-1 | West of Deadwood, AB | Deadwood Slide | 690:02 | 2.4 |
| Legal Description | | UTM Co-ordinates | | |
| SW28-89-23-W5M | | 11U E 462,972 | N | 6,288,759 |

| | Date | PF | CF | Total |
|-----------------------------|---|---|---|-------|
| Previous Inspection: | 12-June-2014 | 13 | 3 | 39 |
| Current Inspection: | 21-June-2017 | 3 | 3 | 9 |
| Road AADT: | 230 | | Year: | 2016 |
| Inspected By: | Roger Skirrow, TRANS Ed Szmata, TRANS | | Ken Froese, Thurber Don Proudfoot, Thurber | |
| Report Attachments: | <input checked="" type="checkbox"/> Photographs | <input checked="" type="checkbox"/> Plans | <input type="checkbox"/> Maintenance Items | |

| | | |
|---|--|-------------------------------------|
| Primary Site Issue: | Slow slope movement into shallow valley affecting highway | |
| Dimensions: | 50 m length of highway, 80 m overall length | |
| Date of Remediation: | 2015: Constructed toe berm with French drains and routed creek through culvert; adjacent BF culvert replaced 2016: Paving and HTSCB installed | |
| Maintenance: | 2008: 40mm overlay 2011: ACP Patch 2013: ACP Patch 2015: 341 tonne ACP patch placed for winter shutdown | |
| Observations: | Description | Worsened? |
| <input checked="" type="checkbox"/> Pavement Distress | Vertical drop removed with repaving; minor crack noted at west end of site New cracks appearing on north side of highway over BF culvert | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> Slope Movement | Slow creep movement significantly reduced with placement of toe berm | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> Erosion | Minor erosion where ditch flow enters inlet riprap apron at west side of site | <input checked="" type="checkbox"/> |
| <input type="checkbox"/> Seepage | | <input type="checkbox"/> |
| <input type="checkbox"/> Bridge/Culvert Distress | New 1800 mm dia. culvert below toe berm (BF86237) New 2200 mm dia. culvert at km 2.534 (BF73271) | <input checked="" type="checkbox"/> |
| <input checked="" type="checkbox"/> Other | Voids in ACP around HTSC Barrier posts | <input checked="" type="checkbox"/> |
| Instrumentation (as of Fall 2017): | | |
| Destroyed | SP10-2, 3, and -5 and VW10-1 and -2 were destroyed before or during construction in 2015. | |
| Inclinometers | SI15-01 and -02 were installed during construction and initialized in October 14, 2015, about 3 weeks after significant movement occurred in the slide. Cumulative deflections are 46 mm and 58 mm with 8.4 mm and 3.0 mm, respectively, since the toe berm was installed. Movement rates since then average 4.5 mm/yr and 1.6 mm/yr, respectively, down from 580 mm/yr and 850 mm/yr during construction. | |
| Assessment: | | |
| The original failure appeared to be the result of toe erosion by the creek. Movement was relatively slow (creep) requiring patching every two to three years. The groundwater table through the highway | | |

embankment was also relatively high which may have been a contributing factor. In September 2015, the BF culvert to the east of the slide was replaced and the Contractor hauled through the slide area and stockpiled excavated material on the west edge of the slide. This resulted in immediate and significant movements with between 200 mm and 400 mm of height differential across the cracks in the highway surface. The movements continued even after the stockpiles were removed. Construction of the toe berm was completed in November 2015 and consisted of: installing a new 1800 mm diameter CSP culvert for the creek, installing French drains in the slope, placing a toe berm from the highway across the creek valley, and lining the overflow channel located at the south end of the berm. At the same time, BF72371 was replaced with a 2200 mm diameter CSP and the channels on either side realigned. The toe berm culvert (BF86237) was shifted slightly to the east during construction to accommodate a shallow gas line located near the inlet.

In 2016, the highway was overlaid and high-tension steel cable barriers (HTSCB) installed through portions of the site. During the 2017 assessment, the toe berm appeared to be performing well as only one crack was noted in the old slide area and seepage was observed from the subdrain outlet. Minor erosion was noted where the ditch flow contacted the culvert inlet riprap (west side of site). A bare spot was noted at the end of the lined swale above the culvert outlet and possible tension cracks were noted along the highway sideslope at the outlet. Cracking was noted in the WBL at the west end of the north HTSCB which may be associated with poorly-compacted fill.

Recommendations:

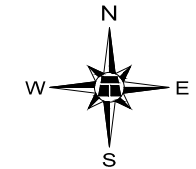
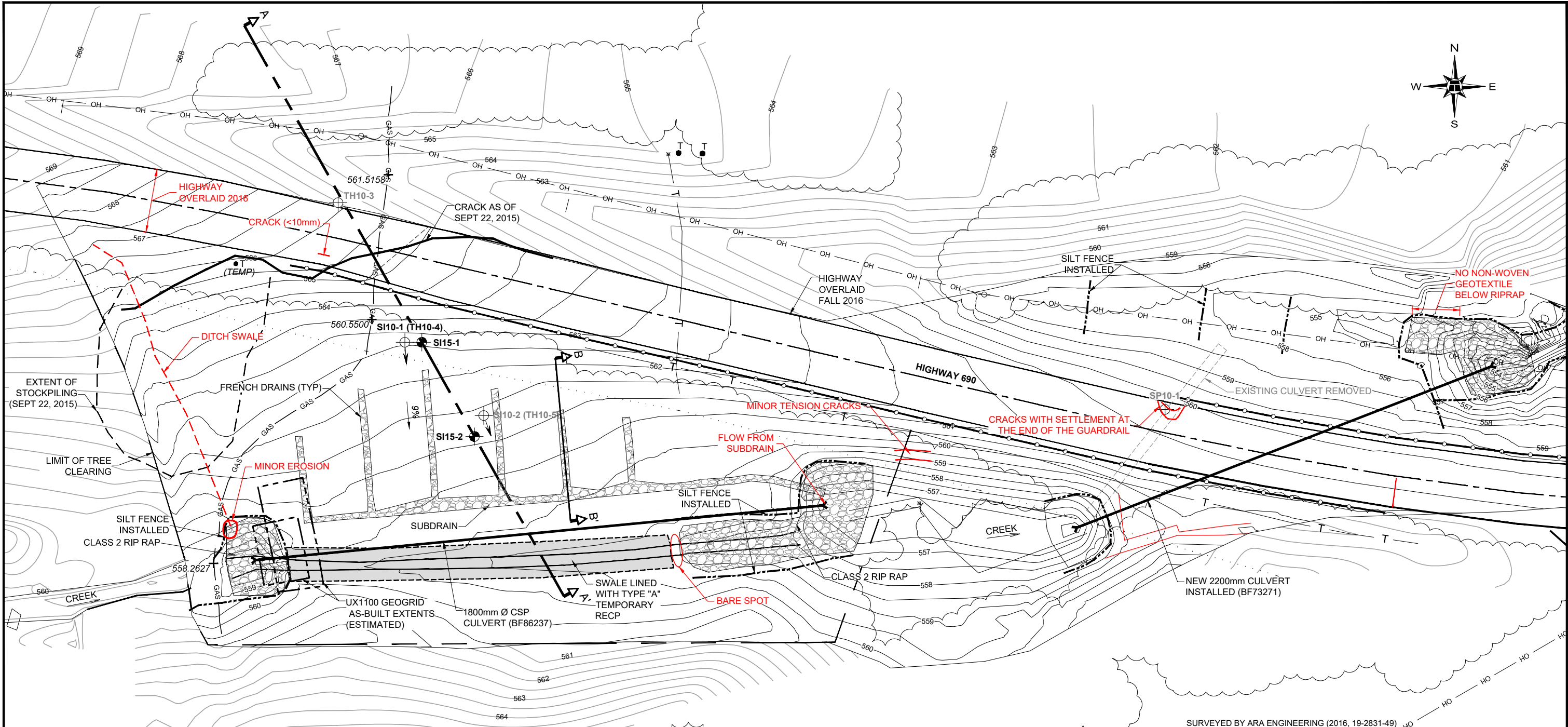
Short-Term:

- Remove or clean the grate at the subdrain outlet to improve flow.
- Consider placing temporary erosion control blanket over erosion at culvert inlet.
- Reseed and protect the bare spot between the end of the swale and the outlet riprap apron.
- Backfill voids around HTSCB posts.

Ongoing Investigation:

- It is suggested that the GeoHazard inspection be carried out at least one more year and that bi-annual instrumentation readings should continue as scheduled.

H:\13000\13351 Geohazard Assessment - Peace RiverHigh Level (CON0017602)\Drafting\2017\KEF13351 PH047-1-1.dwg - 11x17 - Dec. 20, 2017



LEGEND

- SI LOCATION (2015)
- INSTRUMENT NOT IN USE
- STANDPIPE PIEZOMETER
- TEST HOLE
- VIBRATING WIRE PIEZOMETER
- SLOPE INCLINOMETER
- APPROXIMATE DIRECTION OF MOVEMENT IN SLOPE INCLINOMETER
- BOUNDARY OF LIDAR USED TO EXTEND GROUND ELEVATION CONTOURS BEYOND SURVEY LIMITS
- 561.5158+ ELEVATION OF GASLINE AT HYDROVAC POINT
GAS LINE ALIGNMENT SURVEYED BY ARA SEPTEMBER 2015
- LANDSLIDE CRACK
- OVERHEAD POWERLINE (APPROX.)
- UNDERGROUND PIPELINE (APPROX.)
- UNDERGROUND COMMUNICATION LINE (APPROX.)
- HIGH TENSION CABLE BARRIER
- TELUS PEDESTAL (APPROX.)
- POWER POLE LOCATION
- TREELINE (APPROX.)



SURVEYED BY ARA ENGINEERING (2016, 19-2831-49)



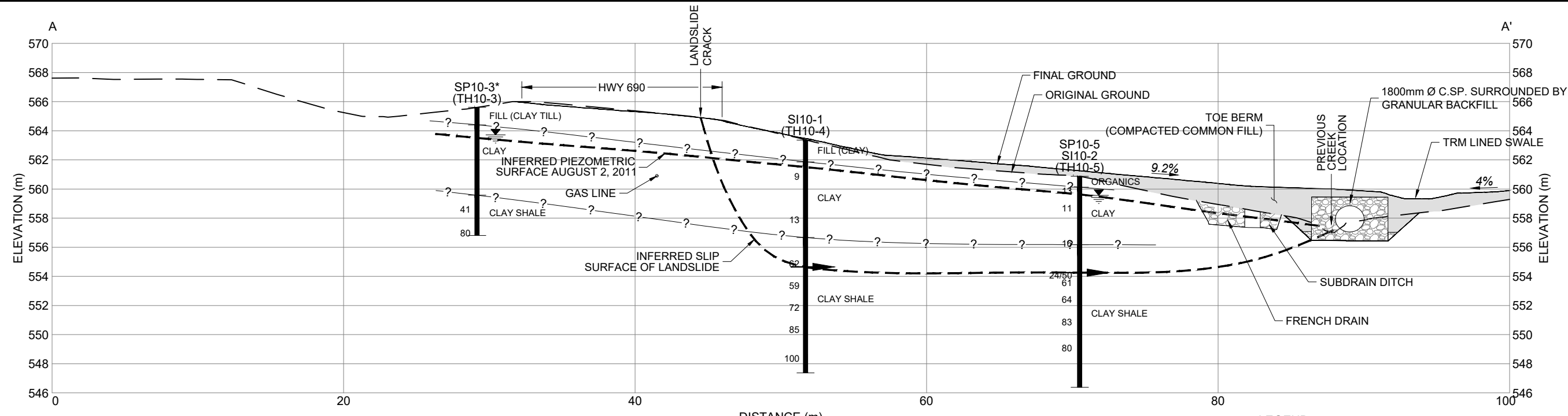
PEACE REGION (PEACE RIVER / HIGH LEVEL)

**PH047: HWY 690:02 DEADWOOD SLIDE
GEOHAZARD ASSESSMENTS**

DWG No. 13351-PH047-1-1

| | |
|-------------|---------------|
| DRAWN BY | KLW |
| DESIGNED BY | KEF |
| APPROVED BY | DWP |
| SCALE | 1:600 |
| DATE | DECEMBER 2017 |
| FILE No. | 13351 |

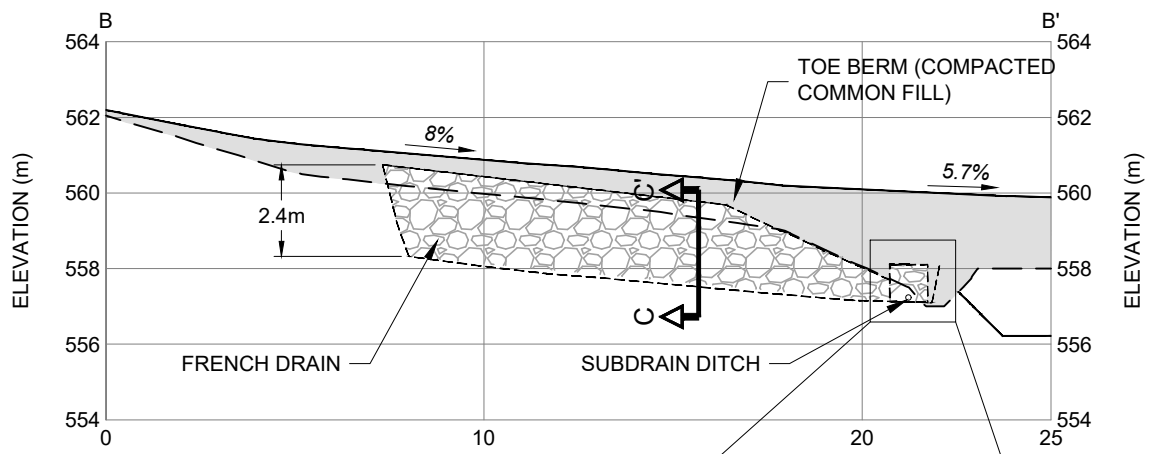




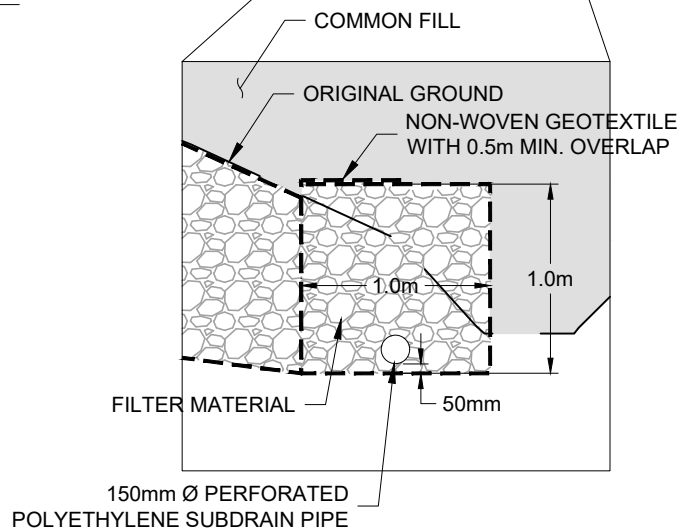
CROSS-SECTION A-A'
SCALE 1:300

- LEGEND**
- 15 | SPT N VALUE
 - ▼ WATER LEVEL IN PIEZOMETER: WATER LEVELS TAKEN BY THURBER IN SP10-5 ON JUNE 2, 2014 AND IN SP10-3 ON OCTOBER 1, 2012
 - SP STANDPIPE PIEZOMETER
 - TH TEST HOLE
 - VW VIBRATING WIRE PIEZOMETER
 - SI SLOPE INCLINOMETER
 - ➔ DEPTH OF MOVEMENT IN SLOPE INCLINOMETER

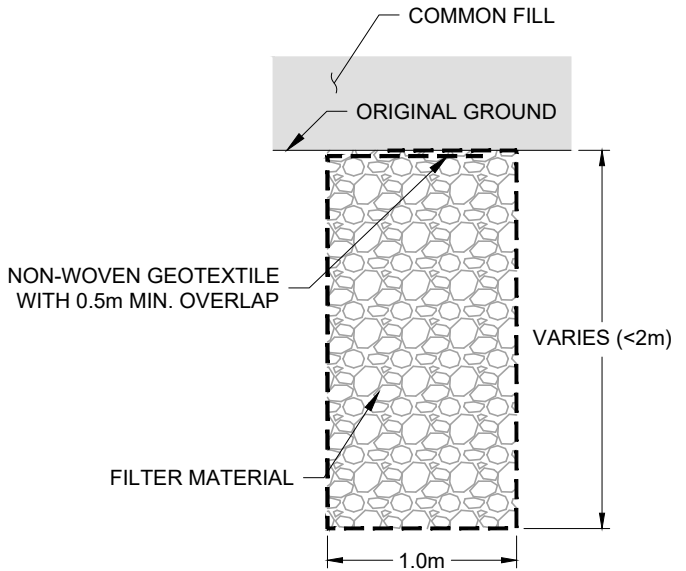
- NOTES**
1. DATA CONCERNING THE VARIOUS STRATA HAVE BEEN OBTAINED AT THE TEST HOLE LOCATIONS ONLY. THE SOIL STRATIGRAPHY BETWEEN TEST HOLES HAS BEEN INFERRED FROM GEOLOGICAL EVIDENCE AND SO MAY VARY FROM THAT SHOWN.
 2. ORIGINAL TOPOGRAPHIC DATA TAKEN FROM BASE PLAN PROVIDED BY HOGGAN ENGINEERING & TESTING LTD. (2011).



CROSS-SECTION B-B'
SCALE 1:200



SUBDRAIN DETAIL
SCALE 1:40



SECTION C-C'
SCALE 1:40

SURVEYED BY ARA ENGINEERING (2016, 19-2831-49)



PEACE REGION (PEACE RIVER / HIGH LEVEL)

**PH047: HWY 690:02 DEADWOOD SLIDE
GEOHAZARD ASSESSMENTS**

DWG No. 13351-PH047-1-2

| | |
|-------------|---------------|
| DRAWN BY | KLV |
| DESIGNED BY | KEF |
| APPROVED BY | DWP |
| SCALE | AS SHOWN |
| DATE | DECEMBER 2017 |
| FILE No. | 13351 |



THURBER ENGINEERING LTD.



Photo 1 – Looking east over repaired highway and toe berm.



Photo 2 – Looking at voids around HTSCB on south side of highway at the west end.



Photo 3 – Looking east at small crack at west end of slide area near the end of the HTSCB.



Photo 4 – Looking west at bare area at culvert outlet where possible tension cracks may be forming. Subdrain outlet is just on the far side of the culvert outlet.



Photo 5 – Looking east from lined swale at bare spot between the swale and riprap apron.



Photo 6 – Looking west along lined swale located at the south end of the toe berm.



Photo 7 – Looking east at voids around HTSCB posts and settlement cracking of the pavement at west end of the north barrier located by the outlet of BF72371 culvert.



Photo 8 – Looking at riprap placed over bare ground (no nonwoven fabric below) at east end of north ditch the outlet of BF72371.