

**ALBERTA TRANSPORTATION
GEOHAZARD ASSESSMENT PROGRAM
PEACE REGION – PEACE-HIGH LEVEL
2020 INSPECTION**



THURBER ENGINEERING LTD.

| Site Number | Location | Name | Hwy | km |
|-------------------|-------------|--------------------------------|-----------|--------|
| PH009-3 | Peace River | Shaftesbury Trail - Shop Slide | Old 2:02 | 0.025 |
| | | | 684:02 | 30.990 |
| Legal Description | | UTM Co-ordinates | | |
| SW¼ 31-083-21 W5M | | 11V E 480339 | N 6232158 | |

| | Date | PF | CF | Total |
|-----------------------------|--|----|---------------------|-------|
| Previous Inspection: | 17-May-2019 | 15 | 5 | 85 |
| Current Inspection: | 3-Jun-2020 | 15 | 5 | 85 |
| Road AADT: | 1000 (Hwy 684:02) | | Year: | 2020 |
| Inspected By: | Rocky Wang, TRANS Ed Szmata, TRANS | | Ken Froese, Thurber | |
| Report Attachments: | <input checked="" type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input type="checkbox"/> Maintenance Items | | | |

| | |
|----------------------------|--|
| Primary Site Issue: | Landslide affecting the Hwy 2 off-ramp. Active landslide movement is most pronounced at NW end of slide, near junction with 99 Avenue. |
| Dimensions: | Active landslide affects approximately 200 m length of off-ramp, while dormant slide extends over approximately 300 m length of road. Slide extends upslope (SW) 90 m and downslope (NE) 80 m (plan distances) of the off-ramp. Crest of dormant slide is at EL. 409 m and toe of active slide is near EL. 353 m. |
| Maintenance: | <p>In 1984 TRANS built a 5 m deep granular shear key at the toe of the slope to the south of the Town's utility pipes. The shear key was constructed to help mitigate material from the landslide flowing into the CNR railway right-of-way.</p> <p>In Fall of 2010, the Town of Peace River replaced pipe rack supports for the above-ground insulated water and sewer line, re-graded the site around the pipes, and covered the disturbed areas with coconut matting.</p> <p>The Town also re-graded area of about 30 m in width by about 50 m to 60 m in length, to the south of the pipe racks, after a surface slide occurred on May 13-14, 2011.</p> <p>In 2013, the Town off-loaded more material and placed geomembrane sheets below the off-ramp embankment to channel the seepage from the springs and the ditches.</p> <p>In 2015/2016 the Town re-aligned the storm and water lines to the north around the slide site and removed the pipes and pipe racks.</p> <p>In 2016 TRANS removed the outer NBL of the Highway 2 off-ramp including some slope off loading along the shoulder of the roadway and removed the concrete median and placed a new steel post guardrail.</p> <p>CNR continuously cleans debris that encroaches into the west side of their right-of-way emanating from the slide activity downslope of the geomembrane. The most-recent excavation was done in May 2020.</p> |

| Observations: | Description | Worsened? |
|---|---|-------------------------------------|
| <input checked="" type="checkbox"/> Pavement Distress | <p>Pedestrian pathway destroyed by movement. The backscarp of the slide feature along the NBL sideslope of the Hwy 2 off-ramp has retrogressed further into the roadway shoulder and cracking extends into the lane further SE.</p> | <input checked="" type="checkbox"/> |
| <input checked="" type="checkbox"/> Slope Movement | <p>Pavement distress and fresh cracking on the slope indicate further movement of the lower (active) slide area.</p> <p>The flow slide in the bush with a 6 m drop off at the end of the geomembrane sheets shows enlargement in the eastward direction.</p> <p>The landslide scarp noted above the rail line at the southern end of the site has a slide block with a vertical offset of about 4.5 m and a backscarp height of 1.5 m to 2 m.</p> <p>There is a shallow failure in the backslope below the cell phone communications tower.</p> | <input checked="" type="checkbox"/> |
| <input checked="" type="checkbox"/> Erosion | <p>There is on-going erosion in the flow slide mass.</p> <p>The gabion mattresses in the SBL ditch of the Highway 2 off-ramp are being undermined and scours are forming along their flanks. The ditch block southeast of the 500 mm diameter SWSP centerline culvert inlet has been compromised.</p> <p>A new erosion gully has formed in the SBL ditch in the vicinity of the new water/sewer crossing.</p> | <input checked="" type="checkbox"/> |
| <input checked="" type="checkbox"/> Seepage | <p>Seepage emanating from several gravel seams within the Highway 2 off-ramp embankment is shedding water over the re-graded area.</p> <p>There is a spring flowing in the southeast ditch bottom of 99 Avenue.</p> | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> Bridge/Culvert Distress | <p>The rip rap armouring at the inlet to a 762 mm diameter centerline smooth wall steel pipe culvert has been dislodged and eroded.</p> <p>A sinkhole has formed above the buried 762 mm SWSP drain pipe connected to the centerline culvert.</p> | <input checked="" type="checkbox"/> |
| <input type="checkbox"/> Other | | <input type="checkbox"/> |

| Instrumentation (as of Fall 2020): | |
|---|--|
| SI05-1 | Decreasing movement trend in upper 3 m over last two years – no movement pattern at depth. |
| SI05-2 & 3 | Sheared at depths of 10.7 m (SI05-2) and 17.5 m (SI05-3). Significant movement at 10-12 m depth in SI05-2 (73 mm) and 16 -18 m in SI05-3 (24 mm). |
| SI05-4 | Sheared at a depth of 6.7 m in 2012 at 54 mm total cumulative movement. |
| SI09-1 and 2 | Located near the former water and sewer pipeline alignment at the NW end of the site. SI09-1 had about 150 mm of movement in upper 2 m, about 3 mm at 8 m, and 11 mm at 12 m prior to shearing off at 1.8 m in 2011. Near surface movement of roughly 155 mm (upper 2 m) in SI09-2 before it was destroyed during the sewer line pipe rack repair in Fall 2011. |
| SI09-3 | Located at toe of slope between rail line and Shaftesbury Trail but hasn't developed distinct movement pattern. |
| SI09-4 | Located at edge of the off-ramp midway down the slope. A camera was used to determine that the SI casing has a misaligned joint and it was lined with a smaller diameter SI in June 2020 and a movement pattern has not yet developed. |
| SI11-01, | No movement pattern has developed. No movement pattern has developed. |
| S19-5 | Located mid-slope between highway and railroad and was repaired (groove misalignment) in June 2019 by grouting smaller diameter casing inside original. Movement patterns appear to have developed at about 10.2 m (4 mm cumulative displacement) and about 20 m (5 mm cumulative displacement). |
| SP05-1 and SP05-3 to SP05-5 | SP05-1 had decreasing trend since Spring 2017 but the groundwater rose in 2020. SP05-3 spiked in Spring 2019 but dropped to prior stable levels thereafter. SP05-4 and SP05-5 are relatively stable. |
| VW09-3 and VW09-4 | Overall decreasing trend in water levels measured at VW piezometers with only VW09-4 still operational and at historical low. VW09-3 has been dry since installation. |
| SP09-6, SP09-7, SP09-10, and BH13 | SP09-6 water level has dropped to historical low in Fall 2018 and has stabilized at that level. SP09-7 relatively stable within historical range. SP09-10 elevated in Fall 2020 relative to the trend of the last two years. BH13 replaced SP09-11 in Fall 2017 and is dropping. |
| SP09-8 and -9 | Have remained dry since installation in 2009. |
| SP19-1, 2, and -3 | Water level in SP19-2 has continued to increase since installation to current high of 12.1 m BGS. SP19-3 peaked in Spring 2020 at 3.4 m BGS and dropped in Fall 2020 to 3.8 m BGS. SP19-1 was also increasing until it became blocked in Spring 2019. |
| PN19-5A and -5B | PN19-5A water level has been rising slightly since Fall 2019 but remains within the historic range. is down about 0.5 m from Spring 2019 and PN19-5B has also be rising and is now at new high about 0.3 m above the installation reading. The groundwater regime at this location has upward flow from the deeper clay till to the overlying sand. |

Assessment:

As indicated in previous Geohazard inspection reports, this site is characterized by a complex, deep-seated slide movement affecting the hillside above and below the road. The slide bowl above the road appears to be currently inactive, while the lower slide is active. The highest rates of movement appear to be at the NW corner of the lower slide bowl, where the Town of Peace River had to re-grade the slope to protect a sewer and water supply line in 2008 and again in 2013, replaced the pipe rack supports for the water and sewer lines in 2010, and relocated both utility lines further to the north outside the limits of the landslide in 2015/16. The lower slide scarp remains active. The previous semi-active slide scarp has reflected through the recent overlay with a 20 m long crack appearing on the northeast portion of the highway just southeast of the 99 Avenue intersection.

Movement has continued in the area unloaded by the Town at the north end of the slide, as the slope inclinometers have sheared in the area. Cracking and retrogression of slide movement continues upslope of the unloaded area – i.e. the area of the road affected by slide movement is expected to expand to the north in the near future. Water continues to seep onto the slope from gravel seams within the roadway embankment. Although the Town has placed geomembrane sheets to line a channel to contain the water, this only extends about partway down the slope and the scour below the end of the membrane continues to grow, with the flow slide encroaching into CNR's right of way and the resulting debris fan regularly obstructing the west railway line ditch. CNR has been removing the slumped soil from the west ditch and placing it on the east side of the railway trunk which appears to have been done shortly before the 2020 inspection. The active erosion scarp downslope of the end of the membrane is still increasing in size with tension cracks noted along the east flank in 2019.

The Town of Peace River has relocated the utility pipes that used to run through the site. This has reduced the consequence of failure for the site as reflected in our revised risk rating, although the value is still very high.

TRANS removed the outer NBL of the Highway 2 off-ramp in 2018 and performed some minor off-loading of the slope at the same time. This helped to slow the deep-seated landslide movements. However, the recovered S119-5 is showing some movement and cracks are starting to reflect through the pavement confirming ongoing creep of the larger, deep-seated landslide block.

Thurber undertook a geotechnical investigation with instrumentation installation in February 2019 that was documented in the May 2, 2019, summary report. The repair of this site is going to tender in late 2020 for construction in 2021. The repair will consist of a 240 m long pile wall which will be predominantly cantilever except for a 70 m long section of tie-backs at the more-active end of the wall at 99 Avenue. Drainage measures will be implemented behind the wall and further upslope. There will be significant grading to remove material below the wall and convey overland flow in a controlled manner to bottom of the slope.

Recommendations:**Short-Term:**

- Road maintenance should continue as necessary to maintain a safe roadway surface and may consist of milling, patching, and crack sealing of the ACP.
- Routine inspection of the roadway to confirm that retrogression has not impacted public safety on the roadway.

Medium/Long-Term:

- Repair as per TND0018262.

Ongoing Investigation:

- It is recommended that the annual GeoHazard inspection should continue as scheduled.



Photo 1: Looking northwest along shoulder of the Hwy 2 off-ramp on the east side of 99 Avenue intersection.



Photo 2: Looking southeast towards the backscarp along the east shoulder of the Hwy 2 off-ramp.



Photo 3: Looking southeast along the NBL shoulder of the Hwy 2 off-ramp at retrogressing backscarp.



Photo 4: Looking west at springs flowing from the embankment below the Hwy 2 off-ramp at 99 Avenue.



Photo 5: Looking east at seepage from gravel layer in the Hwy 2 off-ramp sideslope draining onto the geomembrane lining.



Photo 6: Looking west along the membrane installed by the Town below the 99 Avenue intersection.



Photo 7: Looking northeast at lower portion of the geomembrane installed by the Town below the 99 Avenue intersection.



Photo 8: Looking south at backscarp of the Shop Slide below 99 Avenue intersection.



Photo 9: Looking southeast at the debris fan of the Shop Slide. New SI19-5 can be seen at left hand edge of photo on bench constructed for installation.

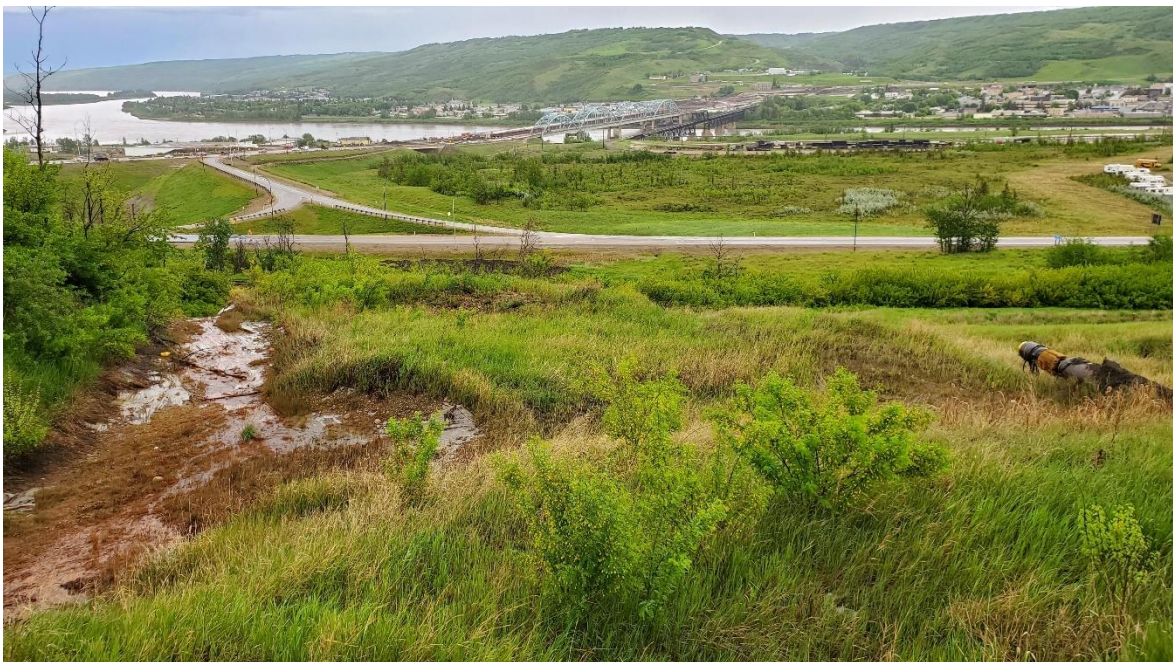


Photo 10: Looking east at the upper portion of the slide and down toward the debris fan at the toe.



Photo 11: Looking northwest at severed and abandoned storm utility pipe. The new line was installed farther north by the Town in 2016.



Photo 12: Looking northeast at seepage from 99 Avenue southeast ditch.



Photo 13: Looking southeast from culvert outlet at 99 Avenue. Note leaning posts and damaged gabion basket ditch lining.



Photo 14: Looking southeast at the scour below gabion mattress in southeast ditch of Hwy 2 off-ramp.



Photo 15: Cracking forming in ACP at the guardrail on the southeast side of 99 Avenue intersection. Crack is coincident with previous semi-active slide scarp. It appeared to be slightly depressed on the guardrail side of the crack.



Photo 16: Looking southeast at continuation of crack from Photo 15.



Photo 17: Looking southeast at damaged gabion basket in ditch bottom with leaning power poles in the background.



Photo 18: Looking northwest at previous scarp crack faintly visible in NBL through 2016 patch.



Photo 19: Looking west at shallow slide in Hwy 2 backslope below communications tower.



Photo 20: Looking south at riprap pile in ditch north of 500 mm SWSP centerline culvert inlet.



Photo 21: Looking southeast at erosion in ditch downslope inlet of 500 mm SWSP centerline culvert.

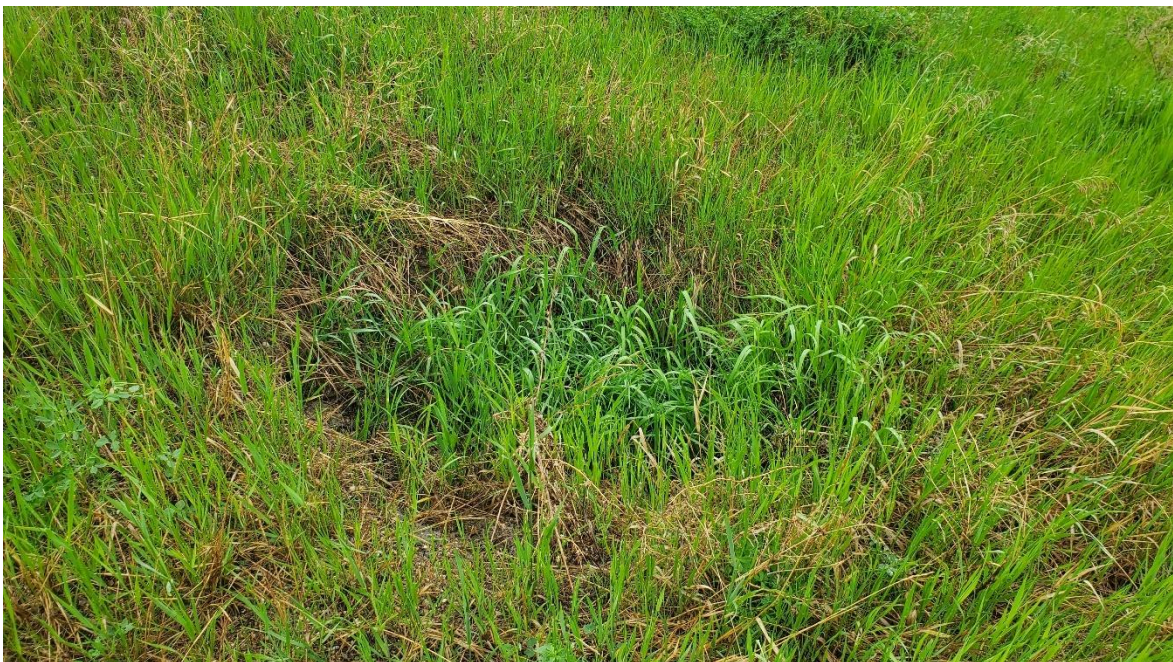


Photo 22: Looking north at a sink hole above the 500 mm SWSP centreline culvert on the sideslope of the NBL of Hwy 2 off-ramp.



Photo 23: Looking northwest along the backscarp of the landslide downslope of the Hwy 2 off-ramp (below SP09-11).



Photo 24: Looking northwest where water has previously ponded below the hanging outlet of the 600 mm CSP that connects to the 500 mm SWSP centreline culvert.



Photo 25: Looking northwest along toe bulge of the landslide below SP09-11 (Photo 23) at the west side of the CNR track.

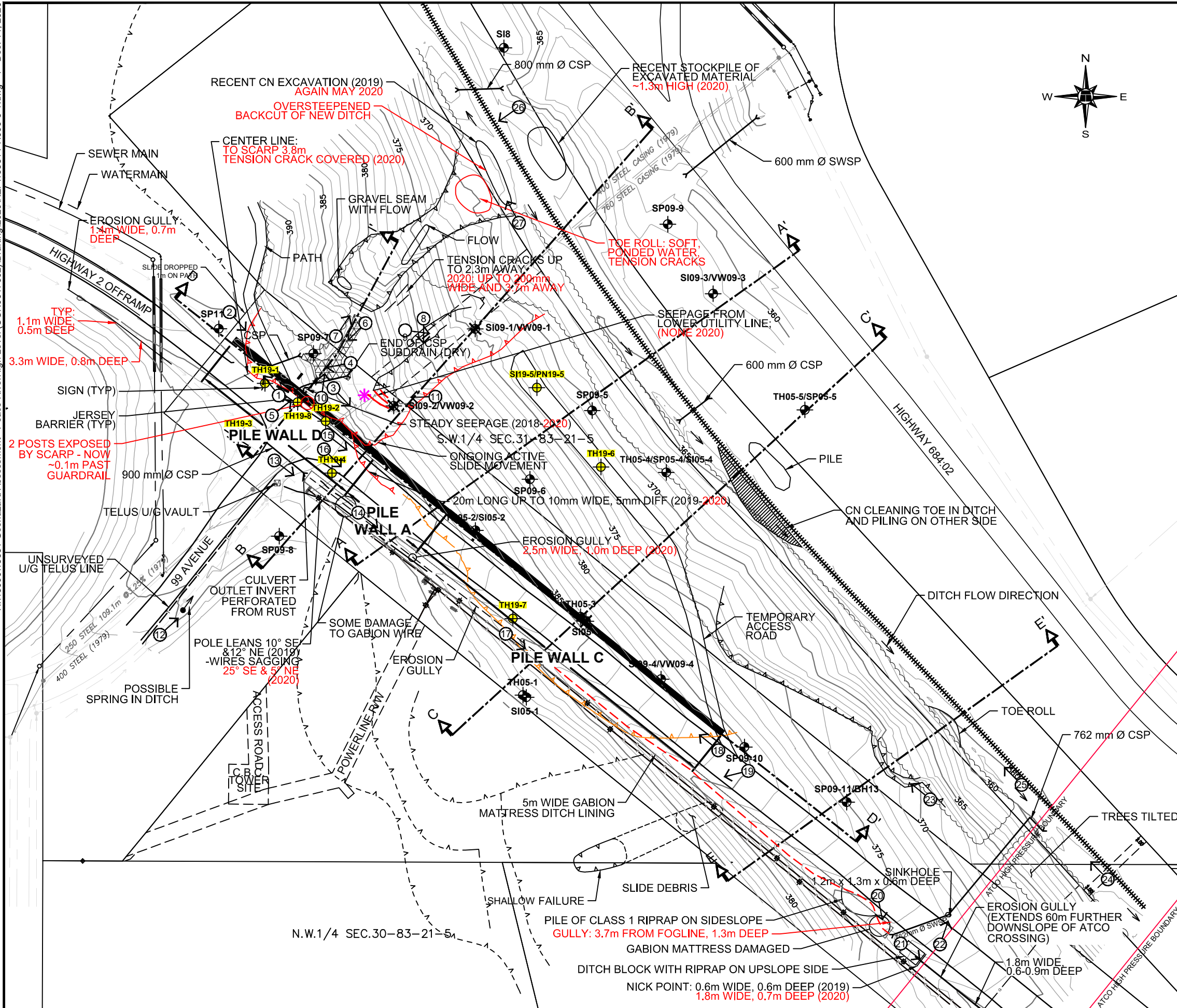


Photo 26: Looking southwest at the debris flow material immediately upslope of the CNR line. Material appears to have been recently excavated.



Photo 27: Looking northeast at seepage/ditch flow around debris fan flowing into nearly buried culvert below CNR tracks.

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LEGEND

- 2019 TEST HOLE LOCATION
- INSTRUMENT LOCATION
- INSTRUMENT (INACTIVE)
- TH TEST HOLE
- SI SLOPE INCLINOMETER
- VW VIBRATING WIRE PIEZOMETER
- SP STANDPIPE PIEZOMETER
- GUARDRAIL
- ACTIVE SLIDE SCARP / CRACK
- SEMI-ACTIVE SLIDE SCARP / CRACK
- HISTORIC SLIDE SCARP / CRACK
- TELUS LINE (BURIED)
- GAS LINE
- POWER LINE AND POWER POLE
- GUY WIRE
- RAIL LINE
- ROW BOUNDARY
- MEMBRANE
- PROPOSED PILE WALL LOCATIONS
- DIRECTION AND PHOTO NUMBER
- LOCATION WHERE ABOVE-GROUND WATER (400mm Ø INSIDE 760mm Ø CASING) AND SEWER (250mm Ø INSIDE 400mm Ø CASING) LINES CUT OFF

NOTES

- SITE PLAN RESET IN 2019 USING SURVEY BASE PLAN. SEE HISTORICAL DRAWINGS FOR PREVIOUS SITE FEATURES AND COMMENTS.
- JUNE 2020 OBSERVATIONS SHOWN IN RED.

SCALE 1:1500
 0 20 40 60 80 m
 BASE PLAN BY WSP (SURVEYED FEBRUARY 2019)



PEACE REGION (PEACE RIVER/HIGH LEVEL)

PH009-3 SHAFTESBURY TRAIL SHOP SLIDE

DWG No. 13351-PH009-3

| | |
|-------------|---------------|
| DRAWN BY | KLW |
| DESIGNED BY | KEF |
| APPROVED BY | DWP |
| SCALE | 1:1500 |
| DATE | DECEMBER 2020 |
| FILE No. | 17016 |

