

GEOHAZARD ASSESSMENT PROGRAM
NORTH CENTRAL REGION – ATHABASCA
2020 INSPECTION



Site Number	Location	Name	Hwy	km
NC091-1 NC091-2	NBL - 5 to 6 Km south of Wandering River	HWY 63-02 BACKSLOPE SLUMPS	63:02	39.27 and 40.28
Site		UTM Co-ordinates (NAD 83)		
NC091-1: 6 km south of Wandering River		NC091-1 12 N6113146.92	E405688.87	
NC091-2: 5 km south of Wandering River		NC091-2 12 N6112146.20	E405659.10	

	Date	PF	CF	Total
Previous Inspection:	Sep 26, 2017	9	3	27
Current Inspection:	Jun 24, 2020	11	3	33
Road AADT:	3,630	Year:		2019
Inspected By:	Tarek Abdelaziz, José Pineda (Thurber) Roger Skirrow, Arthur Kavoluk (TRANS)			
Report Attachments:	<input checked="" type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input type="checkbox"/> Maintenance Items			

Primary Site Issue	Active landslides toeing out above the highway east ditch, encroaching into private lands, but not impacting the highway		
Dimensions:	<p>NC091-1: The slide is 150 m wide (parallel to the highway), 26 m long (perpendicular to the highway), and the backslope is 8 m high (from the crest to the toe) and inclined at 3H:1V.</p> <p>NC091-2: The slide is 110 m wide (parallel to the highway), 35 m long (perpendicular to the highway), and the backslope is 7 m high (from the crest to the toe), and inclined at 3H:1V</p>		
Maintenance:	None		
Observations:	Description	Worse?	
<input checked="" type="checkbox"/> Slope Movement	<p>NC091-1: Head scarp crack (approximately 3.5 m deep) retrogressed by approximately 3 m and left four fence posts hanging. The north flank extended approximately 20 m to the north (landslide became bigger in size). The depth of the tension cracks within the landslide mass ranged between 400 mm and 1.2 m and the width generally ranged between 300 mm and 600 mm. The toe roll is partially blocking the ditch and it is about 1 m high.</p> <p>NC091-2: Head scarp retrogressed by about 6 m at the southern portion (at the riprap apron location) and by about 1 m at the central and north portions. The depth of tension cracks ranged between 200 mm and 2 m and the width ranged between 600 mm and 700 mm. The toe of the landslide is about 1.8 m high and it is partially blocking the ditch,</p>	<input checked="" type="checkbox"/>	
<input checked="" type="checkbox"/> Seepage	NC091-1 and NC091-2: wet landslide mass; ponding water at a few locations; toe roll partially blocking water flow along the ditch; catch water ditch near the crest of both slides was impacted by the landslide movement and water from the catch water ditch saturated the landslide.	<input checked="" type="checkbox"/>	

<input checked="" type="checkbox"/> Other	NC091-2: Severe erosion around the half pipe and the riprap apron; erosion extended to the south of the catch water ditch into private land; half pipe got completely separated from culvert near the top of the slope	<input checked="" type="checkbox"/>
<p>Instrumentation (4SIs and 6PNs):</p> <p>Two slope inclinometers were installed in February 2018 at each site. At site NC091-1: SI18-1 was installed near the toe roll and SI18-2 near the crest of the slide. SI18-2 was sheared off at about 3.0 m depth below ground surface a few months after installation. SI18-1 has a current rate of movement of 4 mm/yr at 1.4 m depth and the change in movement since the previous readings in Spring 2019 is 7.4 mm/yr. At site NC091-2: SI18-3 was installed near the toe roll and SI18-4 near the crest of the slide. SI18-4 was sheared off at about 2.5 m below the top of casing a few months after installation. SI18-3 was damaged, likely by a lawnmower, and has not been read since the spring of 2019.</p> <p>At NC091-1: Groundwater levels ranged between 2.5 m at PN18-2A (near surface clay), 8.4 m at PN18-2B (soils underlying clay), and 9.8 m at PN18-1. The water levels decreased since the previous readings by 1.5 m, 1.37m and 0.02 m in PN18-1, PN18-2A, and PN18-2B, respectively. At NC091-2: Groundwater levels ranged between 2.3 m at PN18-4A (near surface clay) to 12.7 m at PN18-4B (soils underlying clay). The water levels decreased since the previous readings by 0.22 m and 0.1 m in PN18-4A, and PN18-4B, respectively.</p>		
<p>Assessment (Refer to attached Figures):</p> <p>The landslides are active and the backslope conditions have deteriorated since the callout inspections.</p> <p>The landslides are relatively shallow and do not appear to extend below the highway ditch bottom. The soils within the backslopes consist of 3 to 4 m of soft to firm high plastic clay with occasional sand/silt pockets underlain by sand and clay till. A sand layer was however noted in the test hole near the crest of the NC91-1 site. The slip surface is within the high plastic clay at both sites. Piezometer readings indicate that groundwater levels in the clay are much higher than the underlying strata. It is likely that the slumps have been triggered due to ground water seepage (likely from the catch water ditch) into the clay through the sand/silt pockets resulting in softening of the clay and hence loss of its strength. The failure of half pipe at NC92-1 may have aggravate the situation. In addition, the backslopes appear to be relatively steep, when considering the high plasticity of the clay and the heights of the slope, and this may have been another contributing factor to the observed failures.</p> <p>It is anticipated that both slumps will continue to be active and retrogress to cause further loss of private lands. Future prolonged heavy rainfall events are anticipated to increase groundwater levels in the landslides resulting in accelerated movements. In addition, the existing catch water ditches near the crest of both landslides have been impacted by the landslides and water is being discharged into both landslide masses. Surface water discharge into the landslide mass at both sites will continue to elevate groundwater levels in the slopes.</p> <p>The landslide debris is partially blocking the highway ditch at both locations and hence impeding surface drainage in the highway ditch. This may result in elevated groundwater levels in the highway embankment and potential instabilities in the future.</p>		
<p>Recommendations:</p> <p><u>Short-Term</u></p> <p>The owners of the land parcels located near the top of the backslope at both slump locations should be advised of the risk that exists at these locations.</p> <p>The local MCI should consider the following:</p> <p>(a) undertake slight grading of the highway ditch at the slump locations, as needed, to promote surface drainage. Excavated material from the ditch should be pushed back against the toe of the</p>		

slope. Excessive removal of landslide debris from the toe of the slope could result in accelerated movement, and

(b) seal open cracks in the slope surface to reduce surface water infiltration into the slide mass. A small track mounted equipment could be used to smoothen the slope surface and fill in any dips without causing significant changes in grade.

Long-Term

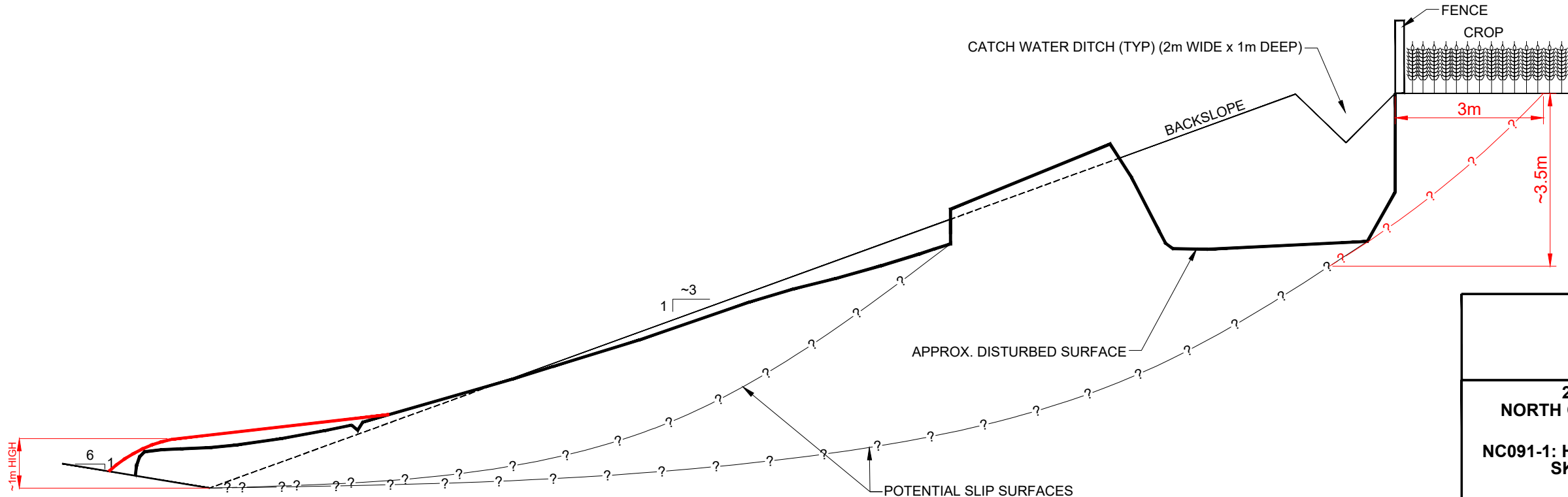
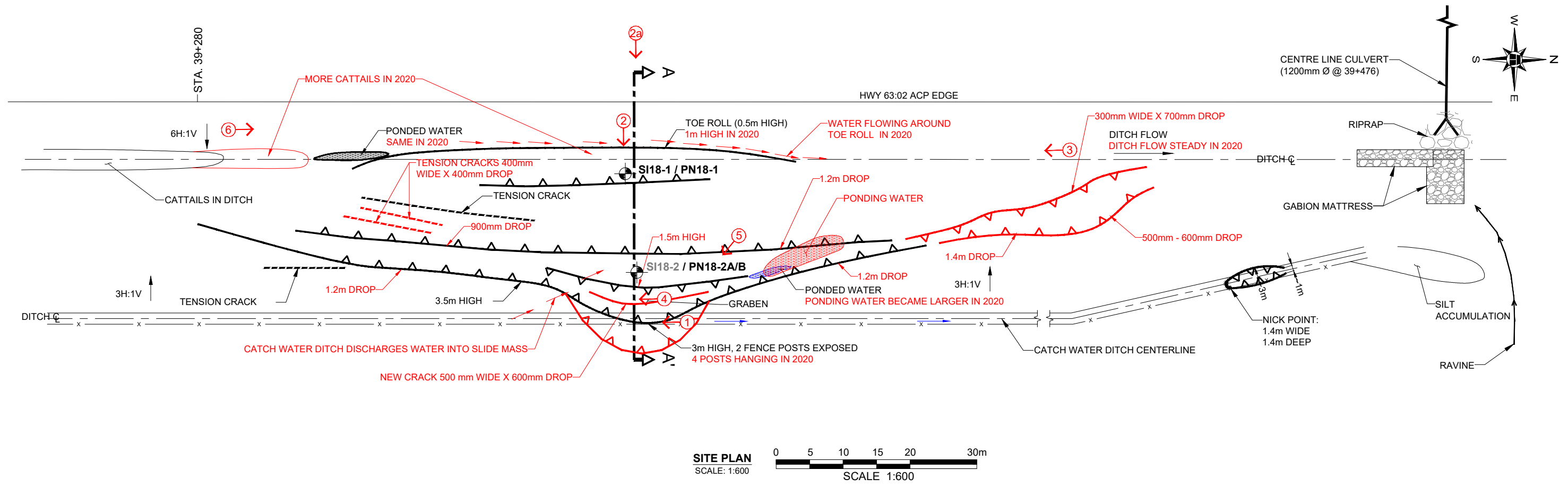
There are two potential general approaches that could be considered for the repair of these sites:

1. Excavate and replace the slide material with imported low to medium plastic clay and reconstruct the slope at the original inclination (3H:1V). In this option, a gravel drainage blanket should be included along the back and at the base of the excavation to promote drainage. At least two subdrain pipes will need to be included along the base of the excavation within the drainage blanket to direct the flow into a controlled manner into the ditch; or
2. Excavate and reconstruct the backslope to 4H:1V or flatter. In this option, excavated materials will need to be reworked (moisture conditioned) before being recompacted, if the material is deemed suitable. A drainage blanket and closely spaced subdrains will need to be included in the reconstructed slopes to promote drainage. Acquisition of additional ROW will be required if it is decided to pursue this option.

For any of the above options, the subdrain pipes will need to daylight into the highway ditch. Riprap protection of the ditch will be needed within the repaired area to prevent future erosion issues.

At both sites, the catch water ditch will need to be reconstructed using low to medium plastic clay, realigned to be a few meters away from the top of the slope in the vicinity of the landslides, and lined with an impervious barrier to prevent further erosion and saturation of the slopes. At Site 2, it is possible to re-grade the catch water ditch to drain towards a centerline culvert located south of the site at approximate km 40.090. During construction, the catch water ditch flow will need to be temporarily diverted away from the slope repair area.

The estimated cost of the repair for each of the sites would be in the range of \$500,000 to \$650,000, excluding engineering.



NOTE:
 1. CROSS - SECTION DRAWN BASED ON SIMPLE FIELD MEASUREMENTS AND MAY DEVIATE FROM THE ACTUAL GROUND PROFILE.
 2. JUNE 24, 2020 SITE INSPECTION OBSERVATIONS SHOWN IN RED.

LEGEND

- APPROXIMATE INSTRUMENT LOCATION
- SCARP CRACK (APPROXIMATE)
- PHOTOGRAPH NUMBER, AND APPROXIMATE DIRECTION AND LOCATION

Alberta

**2020 GEOHAZARD ASSESSMENT
 NORTH CENTRAL REGION (ATHABASCA AREA)**

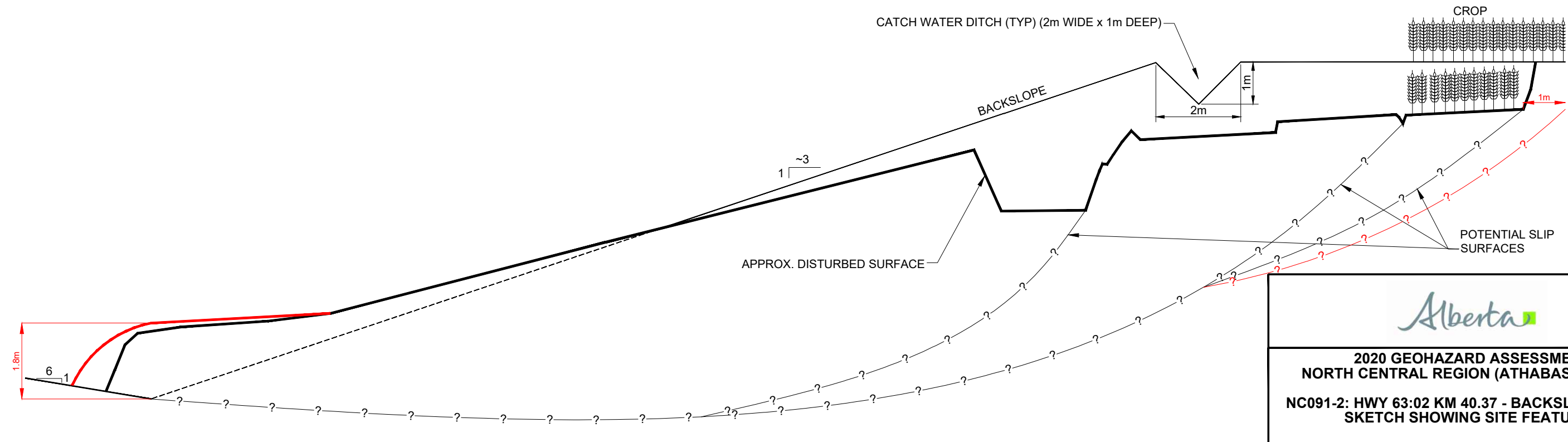
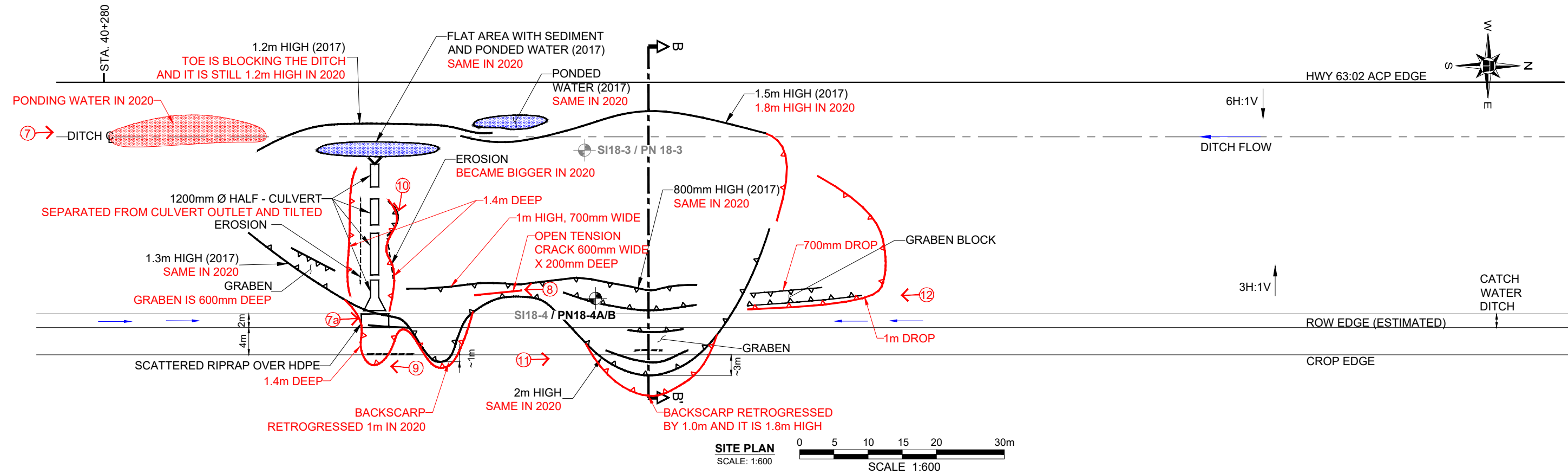
**NC091-1: HWY 63:02 KM 39.35 - BACKSLOPE SLUMP
 SKETCH SHOWING SITE FEATURES**

FIGURE 1

DRAWN BY	ML
DESIGNED BY	JGP
APPROVED BY	TSA
SCALE	AS SHOWN
DATE	SEPTEMBER 2020
FILE No.	13357

THURBER ENGINEERING LTD.

H:\130001\13357 Geohazard Assessment - Athabasca (CON0017605)\Drafting\2020\JGP\13357-NC091 FIGURE 1-2.dwg - 2 - Oct. 09, 2020



CROSS - SECTION B - B'
APPROX. SCALE: 1:100

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Alberta

**2020 GEOHAZARD ASSESSMENT
 NORTH CENTRAL REGION (ATHABASCA AREA)
 NC091-2: HWY 63:02 KM 40.37 - BACKSLOPE SLUMP
 SKETCH SHOWING SITE FEATURES**

FIGURE 2

DRAWN BY	ML
DESIGNED BY	JGP
APPROVED BY	TSA
SCALE	AS SHOWN
DATE	SEPTEMBER 2020
FILE No.	13357

THURBER ENGINEERING LTD.



Photo No. 1- NC091-1: Looking south where the landslide cuts through catch water ditch; catch water ditch discharges water into the landslide mass



Photo No. 2- NC091-1: Looking east at multiple scarp cracks within the slope



Photo No. 2a- NC091-1: Looking east at the landslide mass



Photo No.3 - NC091-1: Looking south at the landslide mass



Photo No. 4 - NC091-1: Looking south at the head scarp crack from central portion of slide



Photo No. 5 - NC091-1: Looking southeast at exposed sandy soils of backslope.



Photo No. 6 – NC091-1: Looking north at a distinct toe roll in the ditch



Photo No. 7 – NC091-2: Looking north at the landslide mass; note the presence of a distinct toe roll in the ditch



Photo No. 7 a– NC091-2: Looking north from the culvert riprap apron at the top of the slope.



Photo No. 8 – NC091-2: Exposed sandy soils at main scarp.



Photo No. 9 – NC091-2: Looking south at erosion developed within the crest of the slope at the riprap apron location



Photo No. 10 – NC091-2: Looking east at scarp through the riprap apron and into the adjacent field (south scarp).



Photo No. 11 – NC091-2: The second portion of the scarp that cuts into the adjacent field (north portion).



Photo No. 12 – NC091-2: Looking south from north portion at the graben block below the main scarp.