

**ALBERTA TRANSPORTATION AND
ECONOMIC CORRIDORS GRMP
NORTH CENTRAL (ATHABASCA AND FORT
McMURRAY DISTRICTS)
2024 SITE 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 |
| Legal Description | | UTM Co-ordinates (NAD 83) | | |
| NC091-1: 6 km south of Wandering River | | NC091-1 N6113146.92 | E405688.87 | |
| NC091-2: 5 km south of Wandering River | | NC091-2 N6112146.20 | E405659.10 | |

| | Date | PF | CF | Total |
|-----------------------------|--|--------------|------|--------------|
| Previous Inspection: | June 07, 2022 | 13 | 3 | 39 (NC091-1) |
| | | 11 | 3 | 33 (NC091-2) |
| Current Inspection: | June 04, 2024 | 13 | 3 | 39 (NC091-1) |
| | | 11 | 3 | 33 (NC091-2) |
| Road AADT: | 3,970 | Year: | 2023 | |
| Inspected By: | Tarek Abdelaziz, José Pineda (Thurber) Rocky Wang (TEC) | | | |
| Report Attachments: | <input checked="" type="checkbox"/> Photographs <input checked="" type="checkbox"/> Plans <input type="checkbox"/> Maintenance Items | | | |

| | |
|----------------------------|--|
| Primary Site Issue: | Active landslides toeing out in 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), 30 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), 38 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: Up to 3.5 m high head scarp crack in the farmer's field; eight fence posts hanging. Multiple tension cracks up to 500 mm wide and 1.8 m deep. The toe roll is partially blocking the ditch and it is about 1 m high. Some retrogression of the head scarp crack noted in 2024.</p> <p>NC091-2: 1 Head scarp crack showed some retrogression during the 2024 inspection. The depth of tension cracks ranged between 200 mm and 1.8 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. Some retrogression of the head scarp crack noted in 2024.</p> | <input checked="" type="checkbox"/> |
| <input checked="" type="checkbox"/> Seepage | NC091-1 and NC091-2: wet landslide mass; ponding water within few locations of the landslide mass; 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 landslides. | <input checked="" type="checkbox"/> |

| | | |
|---|--|-------------------------------------|
| <input checked="" type="checkbox"/> Other | <p>NC091-1: A severe erosion gully developed within the farmer's field; the gully is about 12 m long x 12 m wide with 1.5 m drop at the deepest location.</p> <p>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.</p> | <input checked="" type="checkbox"/> |
|---|--|-------------------------------------|

Instrumentation (1SIs and 4PNs):

NC091-1: SI18-1 was installed near the toe roll, and SI18-2 near the crest of the landslide. SI18-2 was sheared off at about 3.0 m depth below ground surface a few months after installation. SI18-1 sheared at a depth of 1.2 m between the Spring of 2023 and Spring of 2024.

Groundwater levels ranged between 8.3 m in PN18-2B to 9.0 m in PN18-1. The water levels did not change significantly since the previous readings.

NC091-2: SI18-3 was installed near the toe roll, and SI18-4 near the crest of the landslide. SI18-4 was sheared off at about 3.4 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.

Groundwater levels ranged between 1.2 m in PN18-4A (near surface clay) to 12.8 m in PN18-4B (in the clay till). The water levels increased since the previous readings in the spring of 2023 by 0.4 m in PN18-4A. The water level did not change significantly in PN18-4B.

Assessment (Refer to attached Figures):

The backslope landslides continued to be active.

The landslides are shallow and do not appear to extend below the highway ditch bottom. The soil 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 he 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 though the sand/silt pockets resulting in softening of the clay and hence loss of its strength. The failure of half pipe at NC92-2 may have aggravated 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.

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.

The presence of open wide cracks and erosion gullies within the private properties is a safety concern.

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.

Recommendations:

It is recommended to reduce the frequency of the site inspections to once per contact.

Short-Term

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.

The local MCI should consider the following:

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

(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, and

(c) place a snow fence around areas impacted by the landslide within the private lands or backfill these areas to eliminate existing hazard. However, this can only take place after consultation with the landowner(s).

Long-Term

There are two potential general approaches that could be considered to repair 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 NC091-2, 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 repairing each site would range from \$600K to \$700K excluding engineering.

Closure:

It is a condition of this letter report that Thurber's performance of its professional services will be subject to the attached Statement of Limitations and Conditions.

Yours very truly,
Thurber Engineering Ltd.
Tarek Abdelaziz, Ph. D, P.Eng.
Partner | Senior Geotechnical Engineer

José Pineda, M.Eng., P.Eng.
Associate | Senior Geotechnical Engineer



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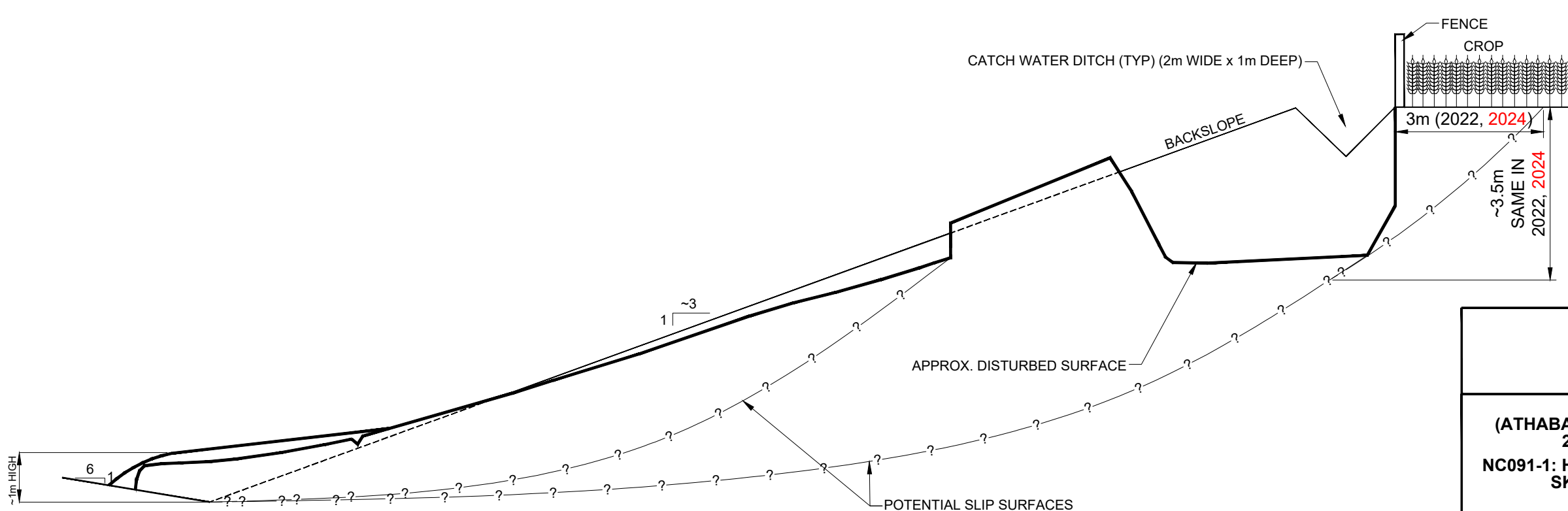
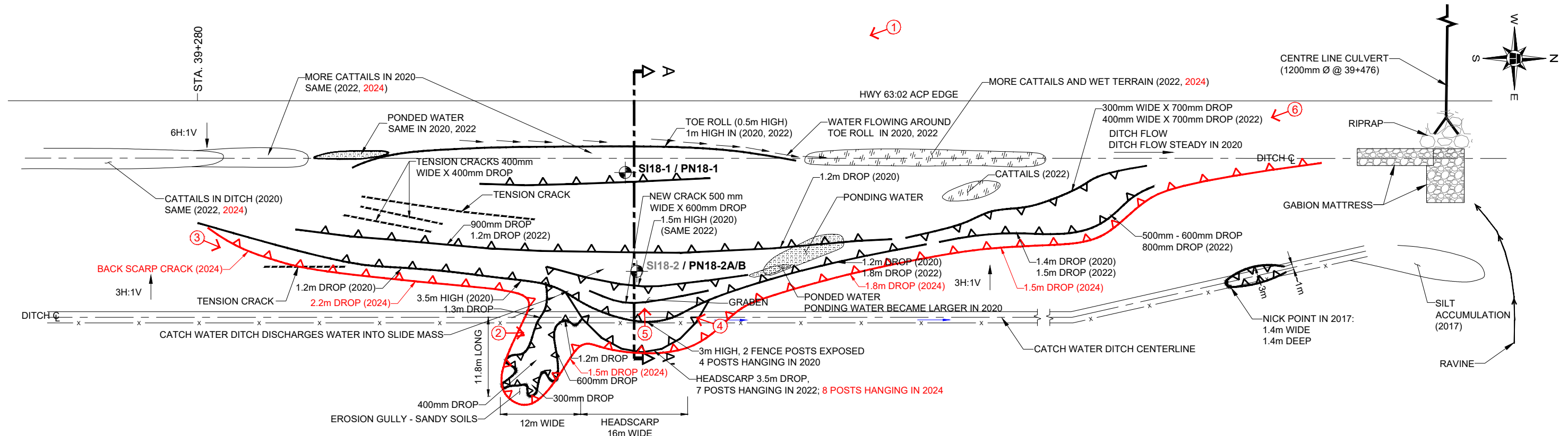
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- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
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- d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

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LEGEND

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

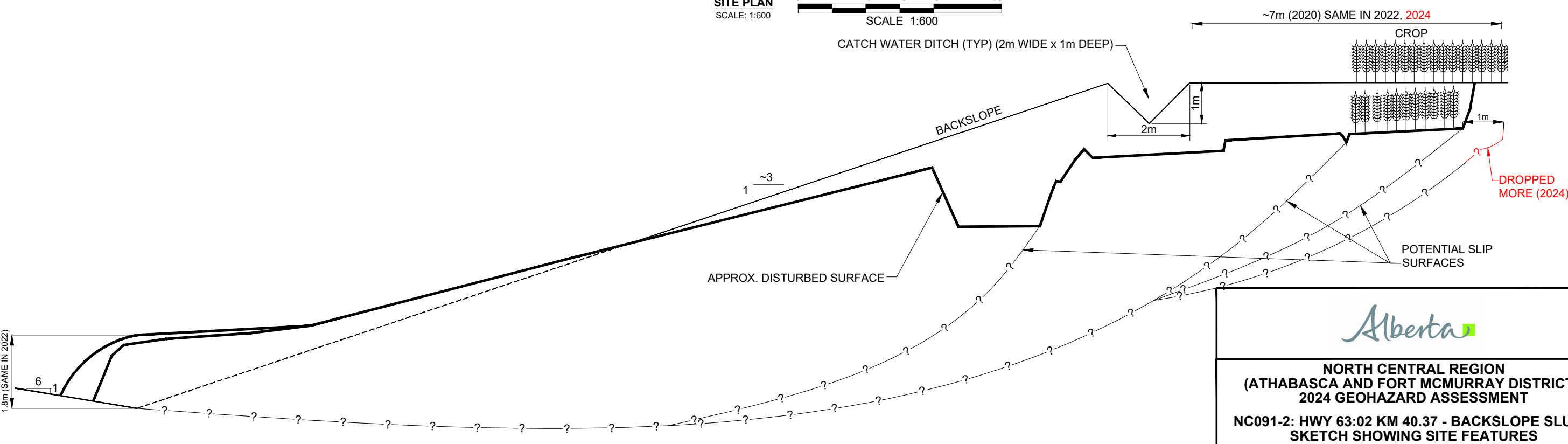
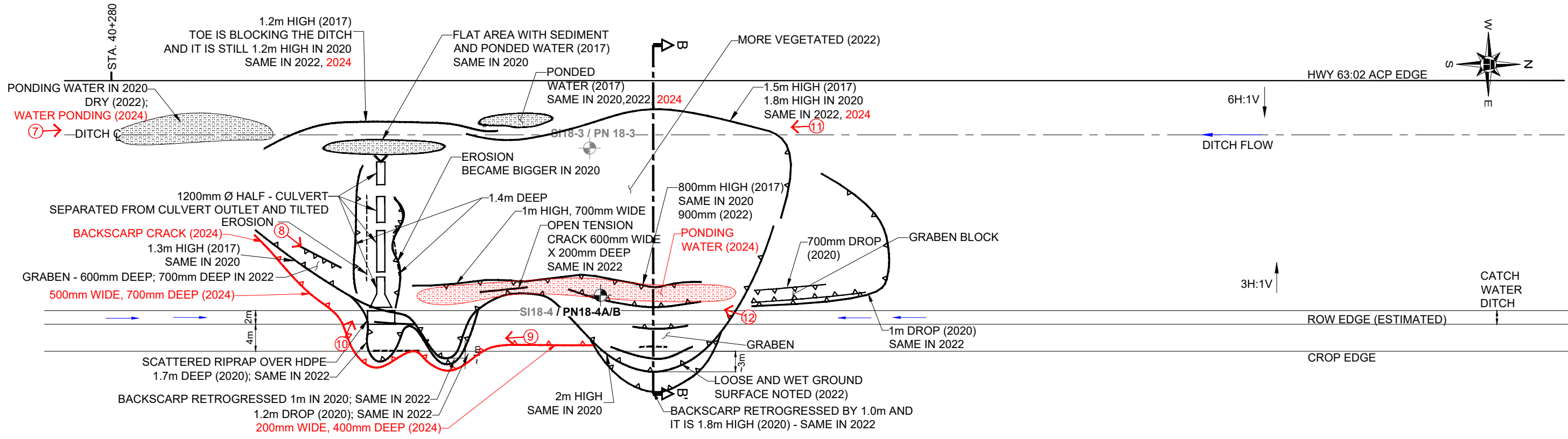
Alberta

**NORTH CENTRAL REGION
(ATHABASCA AND FORT McMURRAY DISTRICTS)
2024 GEOHAZARD ASSESSMENT
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 | JULY 2024 |
| FILE No. | 32122 |

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NOTE:
1. CROSS - SECTION DRAWN BASED ON SIMPLE FIELD MEASUREMENTS AND MAY DEVIATE FROM THE ACTUAL GROUND PROFILE.
2. JUNE 4, 2024 SITE INSPECTION OBSERVATIONS SHOWN IN RED.

LEGEND

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

Alberta

**NORTH CENTRAL REGION
(ATHABASCA AND FORT MCMURRAY DISTRICTS)
2024 GEOHAZARD ASSESSMENT**

**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 | JULY 2024 |
| FILE No. | 32122 |

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Photo No. 1- NC091-1: Looking southeast at the landslide area



Photo No. 2- NC091-1: Looking north at an erosion gully developed within the farmer's field; vegetation grew within the gully



Photo No. 3- NC091-1: Looking north at landslide backscarp crack showing a 2.2 m drop approximately 5 m west of the upslope ditch



Photo No.4 - NC091-1: Looking south at a backscarp crack retrogressing into the farmer's field. Eight barbed wire posts were hanging in 2024.



Photo No. 5 - NC091-1: Looking west at graben feature developed in the middle of the landslide mass



Photo No. 6 – NC091-1: Looking south at landslide features. The north flank extended further north in 2024



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



Photo No. 8 – NC091-2: Looking northeast at the southern flank of the landslide mass; note the presence of multiple tension cracks within the backslope



Photo No. 9 – NC091-2: Looking south at a scarp crack developed within the crest of the backslope



Photo No. 10 – NC091-2: Looking at the failed riprap apron



Photo No. 11 – NC091- 2: Looking south at landslide features; note the well-defined toe roll at the ditch and the presence of multiple tension cracks within the backslope



Photo No. 12 – NC091-2: Looking south at water ponding within the landslide mass