

<b>SITE NUMBER AND NAME:</b> NC036-2 – Lazy “S” Slide	<b>LOCATION:</b> On Highway 22 approximately 80 m south of Township Road 564	<b>HIGHWAY:</b> 22:32	<b>KM:</b> 30.000
<b>LEGAL DESCRIPTION:</b> NW-32-52-25-W4	<b>NAD83 COORDINATES:</b> UTM11U 5935400N, 323784E		
<b>AVERAGE ANNUAL DAILY TRAFFIC (AADT):</b> 3,670 (2021, Traffic from West Turning Left)		<b>CONTRACTOR MAINTENANCE AREA (CMA):</b> AHD	

	DATE	PF	CF	TOTAL
<b>PREVIOUS INSPECTION:</b>	N/A	-	-	-
<b>CURRENT INSPECTION:</b>	September 15, 2022	9	4	36
<b>INSPECTED BY:</b>	Stantec: Leslie Cho, Sam Toms Alberta Transportation (AT): Amy Driessen, Kathleen Davis			
<b>REPORT ATTACHMENTS:</b>	Figure 1 – Site Plan Figure 2 – Ground Profile of Section A Site Photographs			

<b>PRIMARY SITE ISSUE:</b> Landslide with arc-shaped cracks on highway affecting the northbound lane (NBL).
<b>APPROXIMATE DIMENSIONS:</b> 30 m wide x 15 m long x 3 m high
<b>SITE HISTORY:</b> No files were available from AT for review at this location. Borehole information for the original NC036-1 site approximately 250 m north of the current site suggests the subsurface condition consists of approximately 4 m of firm to stiff high plastic clay fill, overlying 4.5 m of firm high plastic clay, underlain by firm to stiff medium plastic clay till. Piezometric levels at NC036-1 were generally 2 m below ground surface.

ITEM	CONDITIONS EXIST		DESCRIPTION AND LOCATION	NOTICEABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Pavement Distress	X		Arc-shaped crack on NBL.		
Slope Movement	X		Toe bulging along east embankment slope.		
Erosion		X			
Seepage		X			
Bridge/Culvert Distress		X			
Other		X			

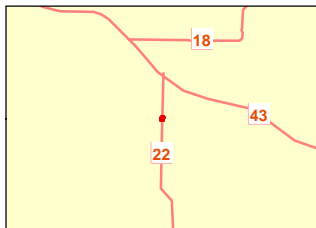
<b>ASSESSMENT</b>
<ul style="list-style-type: none"> <li>The overall embankment is about 3 m high with possible toe bulging observed at the base of the embankment.</li> <li>An arc-shaped crack was observed on the NBL approximately 25 m long with a vertical difference of about 10 mm to 20 mm. An apparent dip towards the east of about 50 mm was observed along the crack.</li> </ul>

- The asphalt thickness within the landslide area was about 400 mm thick. Outside of the landslide limits, the pavement thickness was about 150 mm thick suggesting pavement patches were historically placed to repair pavement distresses. Google Earth imagery suggests historical pavement patching dates to at least 2012.
- Northbound vehicles were observed to travel into the southbound lane (SBL), presumably to avoid the sudden dip in pavement. Tire marks were also observed on the NBL possibly due to vehicles hard braking after driving over the dip.
- Some longitudinal cracking and potholes were observed along the SBL. These do not appear to be related to landslide activity.
- A watercourse exists about 20 m east of AT ROW. The watercourse appeared dry during the inspection.
- Both embankment slopes were well vegetated with grass.
- The landslide appears to be a shallow failure limited to the embankment fill. It is possible that the landslide historically began due to softening of the toe along the east embankment near the watercourse. Once pavement cracking began, subsequent pavement patches increased the net load on the landslide resulting in increased landslide movement.
- A Probability Factor of 9 was assigned since the hazard is active with a moderate rate of movement. A Consequence Factor of 4 was assigned since the landslide could result in closure of the NBL.

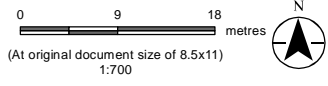
**RECOMMENDATIONS**

- The pavement cracks should be sealed to reduce surface water infiltration into the embankment. This could include milling and paving to improve rideability. Paving should be conducted such that the final highway surface should match the existing elevation or lower (i.e., no net addition of loads).
- Long-term remediation options could include:
  - Excavating the landslide mass and replacing with granular fill. Geogrid may also be considered to enhance slope stability but will require additional analysis to determine if it is required. The high-level cost for removal and replacement is \$200,000 to \$300,000 excluding engineering.
  - Construction of a toe berm. The approximate dimensions required for a toe berm is 40 m wide x 10 m long x 2 m high. Land agreement or purchase may be required depending on the size of toe berm required. In addition, the toe berm may encroach into an adjacent watercourse which may trigger environmental approval. The high-level cost for toe berm construction is \$150,000 to \$200,000 excluding engineering and land purchase.
  - Construction of a driven steel pile wall along the east slope to stabilize the embankment. Assuming a length of pile wall of 40 m, the high-level cost for driven steel pile wall is \$400,000 to \$600,000 excluding engineering.
- The proposed remediation options are not included in Historical Resources Act (HRA) Land Use Procedures bulletins. As such, HRA approval is required prior to construction.
- Site inspections should be completed every two years while inspecting NC036-1.

<b>PREPARED BY:</b> Leslie Cho, M.Eng., P.Eng.	<b>REVIEWED BY:</b> Xiteng Liu, M.Sc., P.Eng., PMP	<b>PERMIT TO PRACTICE</b>



- Cracks / Damaged Area
- Ground Elevation Contours (m)
- Culverts
- x Fence Line
- Photo Number
- ← Photo Direction



Project Location: SE-29-056-08W5, SW-28-056-08W5, NE-20-056-08W5 and NW-21-056-08W5, Alberta  
 Prepared by CL on 2022-11-22  
 Quality Review by LC on 2022-11-22  
 Independent Review by XL on 2022-11-22

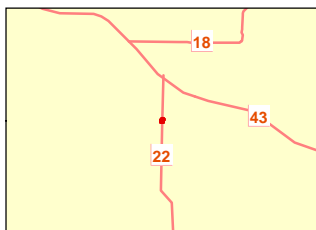
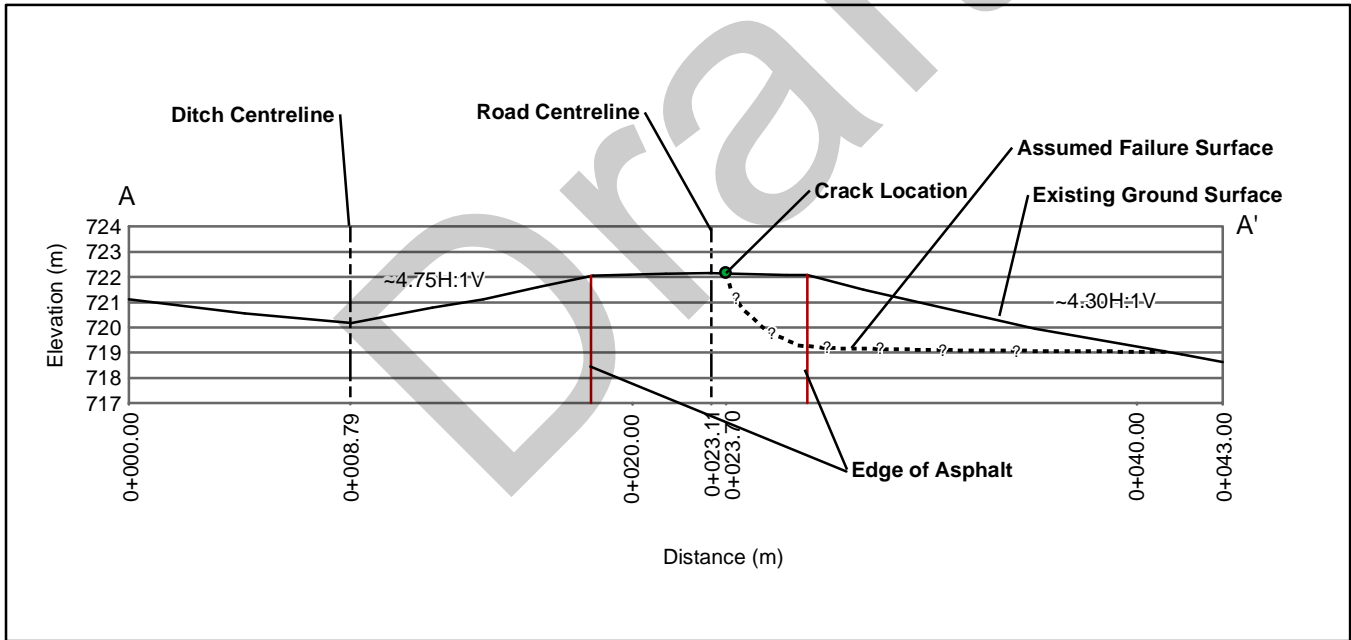
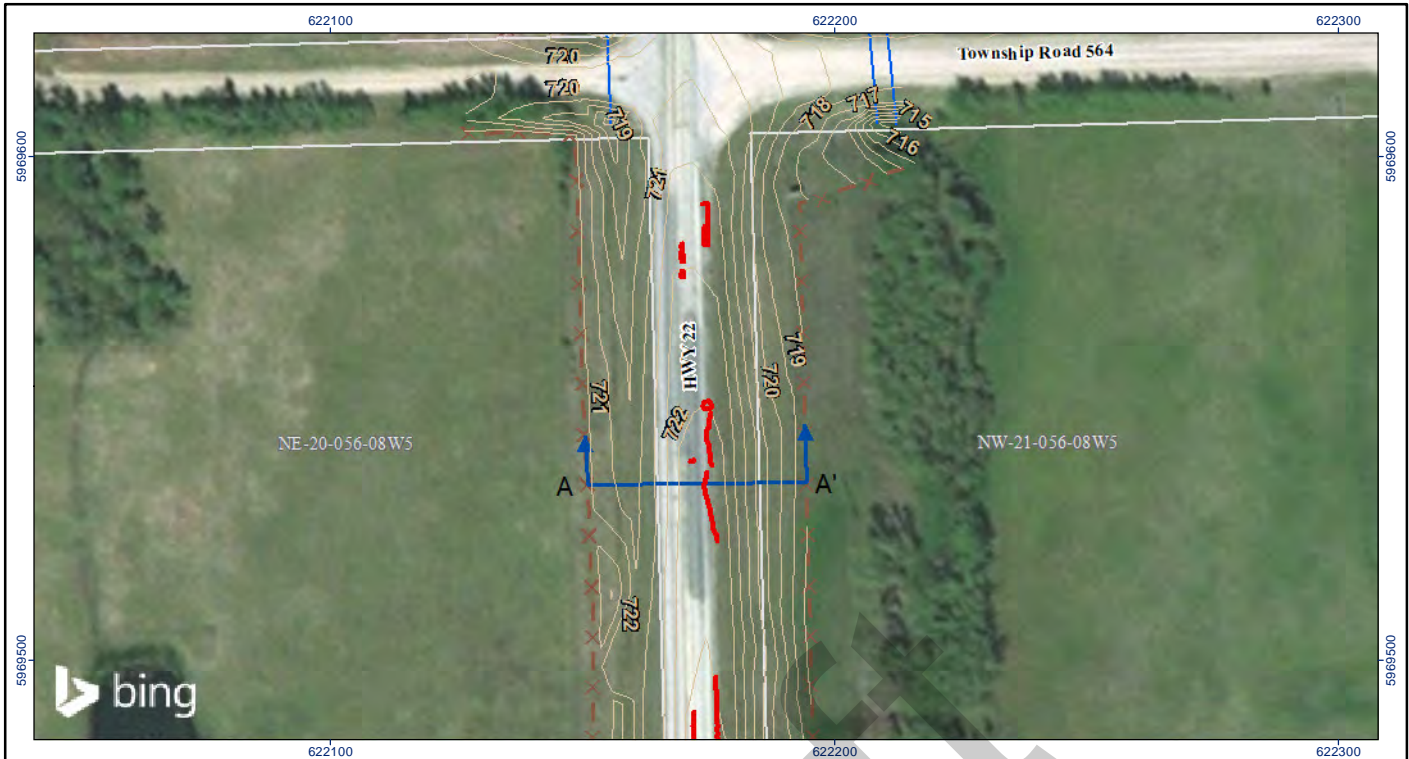
Client/Project: Alberta Transportation  
 Geohazard Monitoring Program  
 NC036-2 Highway 22 Lazy "S" Slide

Figure No. 1  
 Title: Site Plan

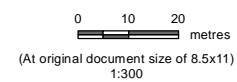
**Notes**  
 1. Coordinate System: NAD 1983 UTM Zone 11N  
 2. Base features: Geogratis, ©Department of Natural Resources Canada, All rights reserved.  
 3. Background: © 2022 Microsoft Corporation © 2022 Maxar ©CNES (2022) Distribution Airbus DS.

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- Cracks / Damaged Area
- Ground Elevation Contours (m)
- Culverts
- X Fence Line



Project Location: SE-20-056-08-W5M, SW-20-056-08-W5M, NE-20-056-08-W5M and NW-21-056-08-W5M Alberta  
 Prepared by CL on 2022-11-22  
 Quality Review by LC on 2022-11-22  
 Independent Review by XL on 2022-11-22  
 Client/Project: Alberta Transportation 123315222  
 Geohazard Monitoring Program  
 NC036-2 Highway 22 Lazy "S" Slide

Figure No. 2  
 Title: **Ground Profile of Section A - A'**

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2022 Call-Out Inspection Photos at NC036-2



**Photo 1:** Pavement cracking at north extent. Tire marks visible. Looking south.



**Photo 2:** Pavement cracking on northbound lane. Dip towards east. Looking south.



2022 Call-Out Inspection Photos at NC036-2



**Photo 3:** Pavement cracking approximately at south extent. Looking north.



**Photo 4:** Northbound lane dipping to the east. Looking west.



2022 Call-Out Inspection Photos at NC036-2



**Photo 5:** Slight toe bulging at base of embankment. Looking south.



**Photo 6:** Overall west embankment. Looking south.