

SITE NUMBER AND NAME: Highway 22 Slide South of TWP 522	LOCATION: Highway 22 southbound, across from 52115 Highway 22, Entwistle, Alberta	HIGHWAY: 22:30:C1	KM: 42.513
LEGAL DESCRIPTION: SW-09-52-07-W5M, SE-08-52-07-W5M	NAD83 COORDINATES: UTM11U 5927044 N, 633771 E		
AVERAGE ANNUAL DAILY TRAFFIC (AADT): 3,340 (2023)		CONTRACTOR MAINTENANCE AREA (CMA): 509	

	DATE	PF	CF	TOTAL
PREVIOUS INSPECTION:	May 14, 2019	7	2	14
CURRENT INSPECTION:	June 14, 2024	11	4	44
INSPECTED BY:	Stantec: Leslie Cho and Sonja Pharand TEC: Kristen Tappenden			
REPORT ATTACHMENTS:	Figure 1 – Site Plan Figure 2 – Site Cross-Section Site Photographs			

PRIMARY SITE ISSUE: Landslide resulting in differential pavement cracking in the southbound lane
APPROXIMATE DIMENSIONS: 20 m long by 33 m wide
SITE BACKGROUND AND HISTORY: <ul style="list-style-type: none"> Fenton, M.M., Waters, E.J., Pawley, S.M., Atkinson, N., Utting, D.J. and McKay, K. (2013): Surficial geology of Alberta; Alberta Energy Regulator, AER/AGS Map 601. <ul style="list-style-type: none"> Surficial geology consists of glaciolacustrine deposits comprising primarily of fine-grained, distal sediments deposited in or along the margins of glacial lakes. Prior, G.J., Hathway, B., Glombick, P.M., Pana, D.I., Banks, C.J., Hay, D.C., Schneider, C.L., Grobe, M., Elgr, R. and Weiss, J.A. (2013): Bedrock geology of Alberta; Alberta Energy Regulator, AER/AGS Map 600 <ul style="list-style-type: none"> Expected bedrock at the site consists of the Paskapoo Formation of the Central Plains. The Paskapoo Formation is described as non-marine, generally fine-grained, recessively weathering, grey to greenish-grey mudstone and siltstone with subordinate pale grey sandstone and minor conglomerate, mollusc coquina and coal. Carlson, V.A. (1970). Bedrock topography of the Wabamun Lake Map-Area, NTS 83G, Alberta, Map 057. Research Council of Alberta. <ul style="list-style-type: none"> The top of bedrock is estimated to be at about elevation 792 m to 793 m. This corresponds to a depth to bedrock of about 5 m to 6 m. The landslide was first observed by the Highway Maintenance Contractor (HMC) as two areas of depression during the 2019 reconstruction of Highway 22. Subsequently, Stantec conducted the initial call-out inspection in 2019. The HMC indicated that pavement cracks were previously observed, and reoccurrence of pavement cracks was observed shortly after resurfacing this section of highway. No existing geotechnical information was available for review. Alberta Environment Water Well records show a 34 m deep water well was drilled approximately 100 m east of the site. The ground elevation at the water well site was approximately 5 m higher than the roadway. The well drilling report shows that the soil stratigraphy consisted of approximately 4 m of brown sandy clay overlying 3 m of sand underlain by sandstone and shale bedrock to the maximum drilled depth. No apparent movement is visible in the available historic Google Earth imagery. However, in the 2004 image, an approximately 50 m long localized patch can be observed on the southbound lane over the area of observed pavement cracking.

- LiDAR data from 2014 (Hexagon Digital Reality) shows several bulges and drainages to the west of the site, within the treed area. From a high-level analysis, it appears that the bulge feature extends west all the way to the tributary from Moon Lake to the Pembina River (approximately 125 m from the edge of pavement)

ITEM	CONDITIONS EXIST		DESCRIPTION AND LOCATION	NOTICEABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Pavement Distress	X		Differential, curved cracking, totaling up to 200 mm wide in the southbound lane of Highway 22 at south slide.	X	
Slope Movement	X		Two landslides along west slope of Highway 22. South slide is located at the end of the guardrail. North slide is a vegetated slump/depression about 40 m north of the south slide.	X	
Erosion		X			X
Seepage		X			X
Bridge/Culvert Distress		X			X
Other		X			X

ASSESSMENT

- Highway 22 appears to be constructed as a sidehill cut-fill based on the surrounding topography.
- The crest of the landslide appears to be within the southbound lane of Highway 22, approximately 0.8 m east from the painted white line.
- Pavement cracking is apparent within the southbound lane of Highway 22, with cracks up to 10 mm wide, collectively creating a curved cracking path up to 200 mm wide and 33 m long. In 2019, no vertical difference was observed in the pavement cracking; however, a vertical difference up to about 50 mm was observed on either side of the cracks during the current inspection. The cracks start and stop at the edge of the pavement. Vegetation is growing out of the cracks toward the south end of the crack (Photos 1 & 2).
- A rough road warning sign is posted approximately at the vegetated slump (north slide) (Photo 3).
- A 150 mm diameter drain pipe was observed in 2019 near the toe of the slope within the treed area. This drain pipe was not observed during the 2024 inspection, possibly due to relatively thick grass cover.
- The west slope is generally vegetated with horsetail, which is a plant that favours moist to wet environments suggesting potentially wet embankment slope.
- The toe of the landslide appears to be just beyond the western tree/fence line. Many of the trees are leaning upslope (Photos 4 & 5).
- A vegetated slump approximately 12 m long and 0.7 m deep is located on the upper west slope, approximately 0.5 m to 1.0 m from the edge of the pavement. This slump is north from the pavement cracking (Photos 4 & 6). Little to no change was observed at the vegetated slump since 2019.
- A bulge, approximately 0.5 m high and 4 m long is present on the upper west slope to the south of the pavement cracking.
- 2014 LiDAR shows two features downslope from the pavement cracking and highway Right of Way that appear to be drainage channels. It is possible that subsurface water continues to flow through the old drainage channels leading to the softening of the foundation soils at this section of Highway 22, and resulting in the observed slope failure.
- A Probability Factor of 11 was assessed since there appears to be active movement, with a moderate but increasing rate of movement. Continued movement may result in partial closure of the highway, and as such a Consequence Factor of 4 was assigned.

RECOMMENDATIONS

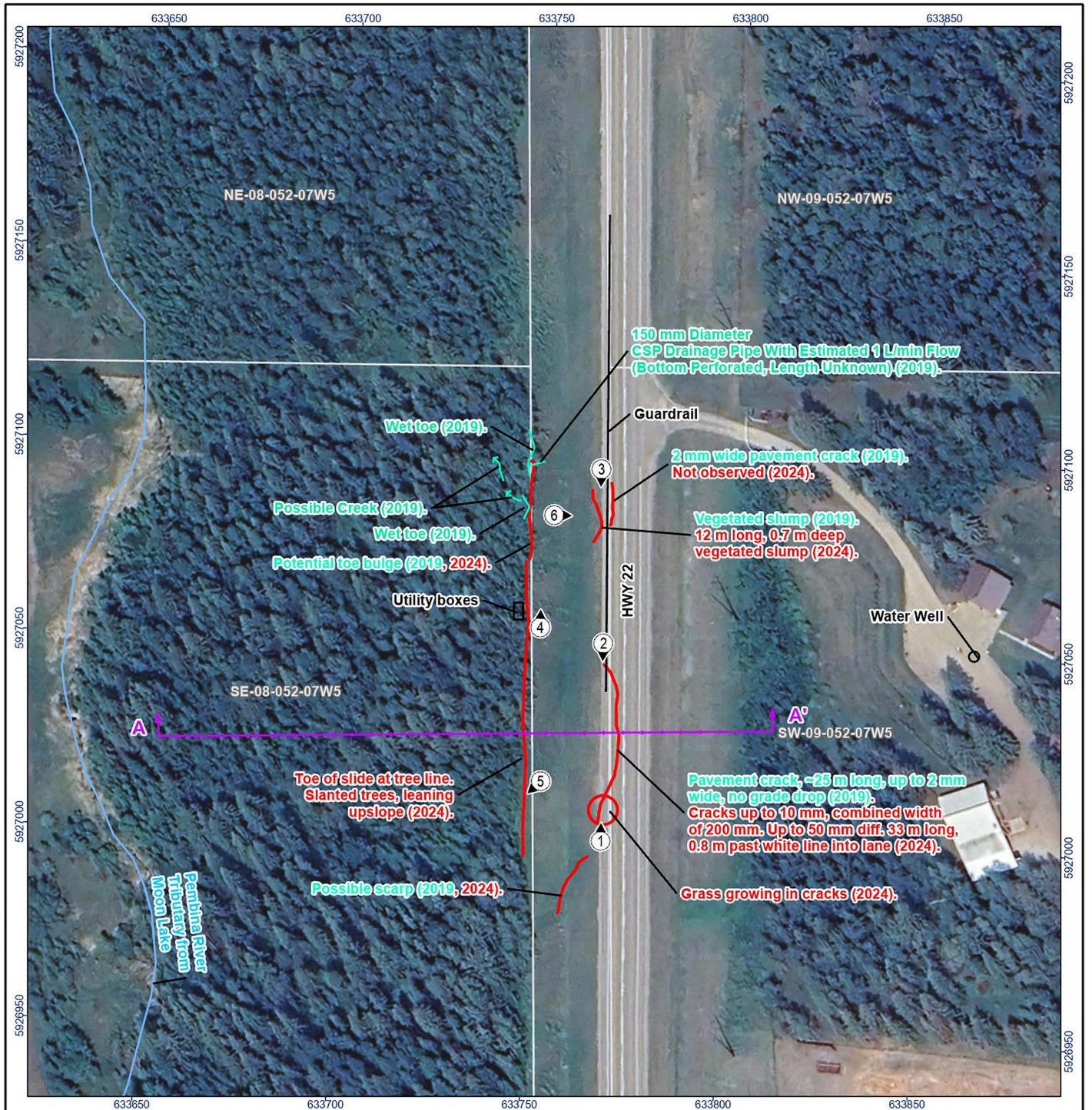
- In the short term, the pavement on the highway surface could be milled and re-paved to reduce any hazards the pavement difference and cracking may present to road users. The final paved surface should not be higher than the current roadway surface such that no net addition of load is applied to the embankment slope.

Furthermore, pavement crack sealing could be completed to prevent surface water infiltration into the embankment.

- A geotechnical investigation should be undertaken at the site prior to any long-term remediation. It is recommended that at least 2 slope inclinometers are installed, along with piezometers to monitor conditions within the slope as part of the geotechnical investigation to better characterize the landslide for remediation design.
- Long-term landslide remediation could consist of the following:
 - The slide material could be removed and replaced with well-draining granular fill accompanied by subdrains. Assuming just the south slide area is to be repaired, the high-level cost of construction is \$325,000 to \$425,000 including contract administration costs. The cost estimate is based on a 23 m wide x 45 m long excavation and includes repairing the southbound lane of Highway 22.
 - A pile wall could be installed on the west edge of the highway. Assuming a pile wall length of 45 m, the high-level cost for the above is \$1.0 million to \$1.3 million.
- The site did not return any records of historic resources based on a search of the Listing of Historic Resources. However, the remediation activities are not covered by a Land Use Bulletin and therefore the project must be submitted to Alberta Culture for screening under the Historical Resources Act.
- Work taking place between March 15 and August 31 will also require a nest sweep prior to construction.

PREPARED BY: Sonja Pharand, P.Eng.	REVIEWED BY: Xiteng Liu, M.Sc., P.Eng., PMP	PERMIT TO PRACTICE

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- Photo and Direction
- 2024 Observation
- 2019 Observation
- Cross Section
- Surface Contour (m AMSL, 1 m Interval)
- Watercourse
- Quarter Section

0 10 20 metres
(At original document size of 8.5x11)
1:1,500



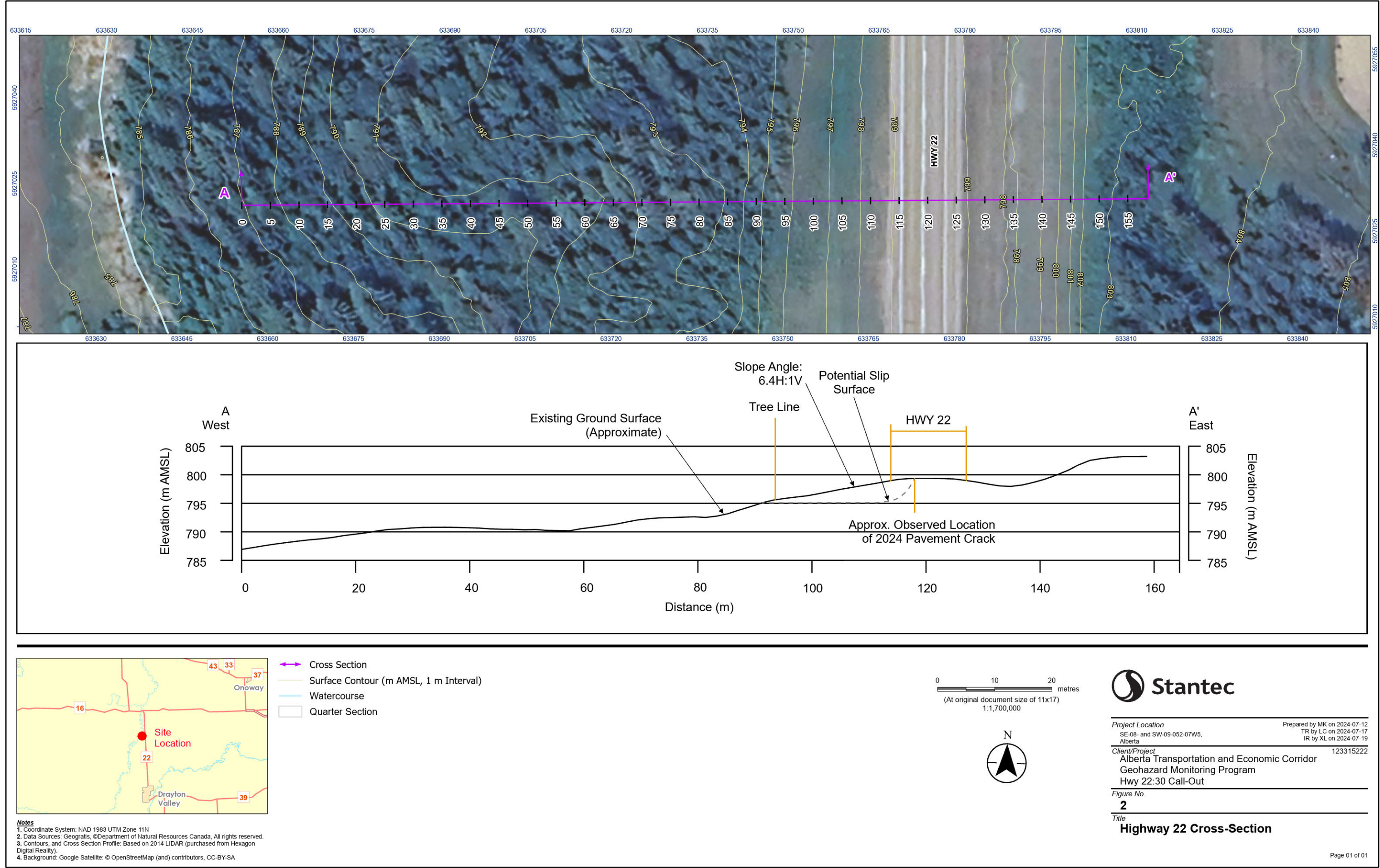
Project Location SE-08- and SW-09-052-07W5, Alberta
Prepared by MK on 2024-07-12
TR by LC on 2024-07-17
IR by XL on 2024-07-19

Client/Project Alberta Transportation and Economic Corridor
Geohazard Monitoring Program
Hwy 22-30 Call-Out

Figure No. 1
Title

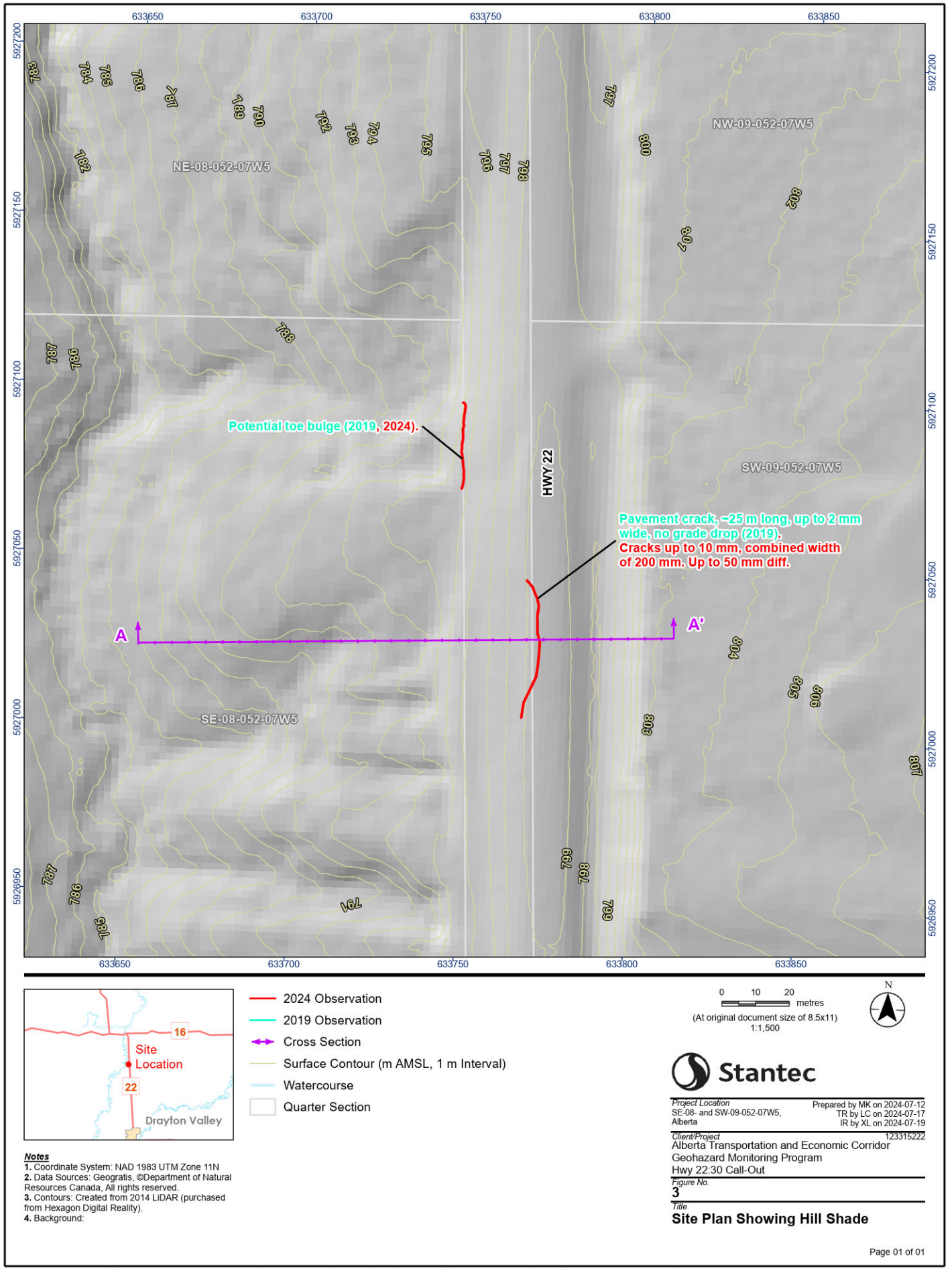
Site Plan

For the layout location path, please use the Layout Properties/Metadata Description Figure: fig_2_cross_section_hwy22 Revised: 2024-07-18 By: MKuni



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2024 Call-Out Inspection Photos at Highway 22:30



Photo 1: Highway 22 cracking in the southbound lane, south end. Looking north.



Photo 2: Highway 22 cracking in the southbound lane, north end. Looking south.

2024 Call-Out Inspection Photos at Highway 22:30



Photo 3: Rough road warning sign posted north from the pavement cracking. Looking south.

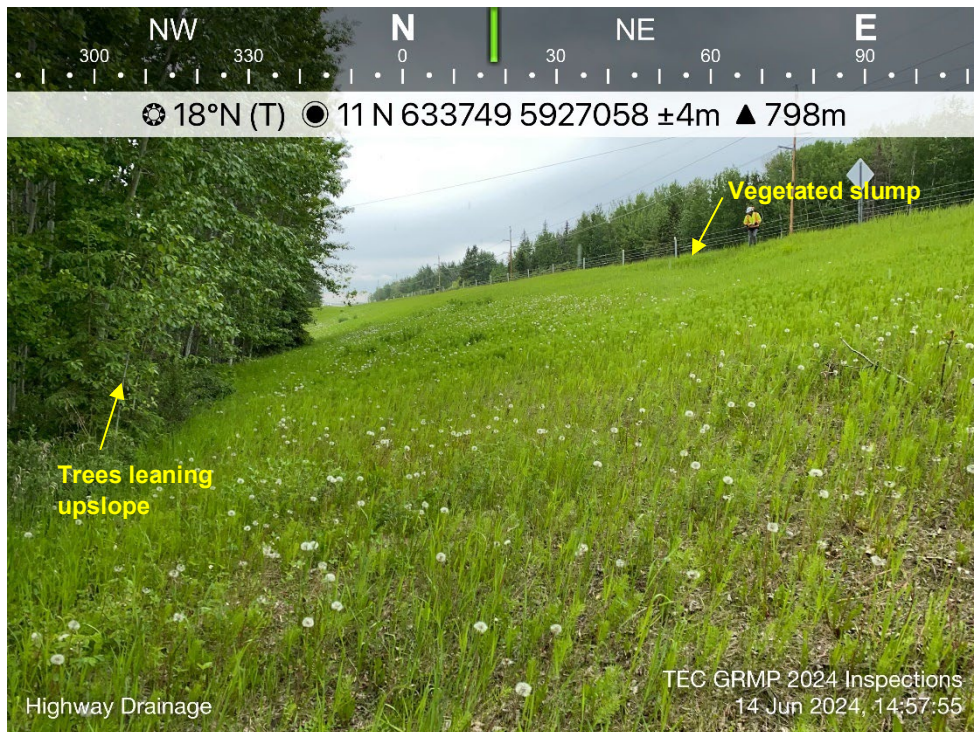


Photo 4: West embankment slope and tree line. Looking north.

2024 Call-Out Inspection Photos at Highway 22:30



Photo 5: Toe of landslide just behind tree line. Fence present. Looking south.



Photo 6: Vegetated slump, looking east towards highway from bottom end.