

SITE NUMBER AND NAME: NC109 - Highway 734 North of BF77316	LOCATION: On Highway 734, about 200 m north of BF 77316	HIGHWAY: 734:22	KM: 27.257
LEGAL DESCRIPTION: NW-16-45-18-W5	NAD83 COORDINATES: UTM11U 5859050 N, 529722 E		
AVERAGE ANNUAL DAILY TRAFFIC (AADT): 130 (2022)		CONTRACTOR MAINTENANCE AREA (CMA): 508	

	DATE	PF	CF	TOTAL
PREVIOUS INSPECTION:	N/A	-	-	-
CURRENT INSPECTION:	June 2, 2023	11	10	110
INSPECTED BY:	Stantec: Leslie Cho TEC: No Presence			
REPORT ATTACHMENTS:	Figure 1 – Overall Site Plan Figure 2 – Landslide Area Figure 3 – Ground Profile Plan August 2003 Emergency Call-Out Site Plan and Geologic Features from Thurber Site Photographs			

PRIMARY SITE ISSUE: Washed-out northbound lane (NBL) of highway
APPROXIMATE DIMENSIONS: 15 m long by 3 m wide
<p>SITE BACKGROUND AND HISTORY:</p> <p>A call-out inspection was conducted by Thurber Engineering Ltd. (2003). Background information obtained by Thurber included:</p> <ul style="list-style-type: none"> • Highway 734:22 was first constructed in 1970s as a gravel surfaced road. • Erosion of the west ditch from about 100 m to 350 m north of the bridge has been occurring during periods of high precipitation. Stantec estimates this to be in the same area as the current call-out inspection. • Silt and sediment have been entering the stream downslope of the road and may impact the Brazeau River. • The road fill extending from 100 m to 350 m north of the bridge is steeply inclined and exhibits signs of settlement, shallow soil slides, and gully erosion associated with a culvert outlet. • There is a problem with ice build-up on the road, in the ditches and at culverts during the winter months. • Riprap up to about 400 mm in size had been placed in the ditch prior to the latest erosion events. • A new bridge over the Brazeau River has been recently completed. <p>Thurber's field observations include:</p> <ul style="list-style-type: none"> • Recent lateral erosion of west ditch approximately 115 m north of the bridge. A 4 m wide eroded ditch was also observed about 290 m north of the bridge. • Sandstone, siltstone shale bed, dipping approximately 10° towards 260°, 35 degree cut slope with gravel-sized talus about 235 m north of the bridge. • At about 235 m north of the bridge, the fill slope was inclined at 33 to 36° on the east side, 2 m to 3 m deep gully eroded at culvert A outlet, 2 m to 3m long tension cracks north of Culvert A. Culvert A inlet partially blocked. • A 6 m wide landslide and 0.3 m deep depression along the outside edge of road were observed on the fill slope at about 250 m north of the bridge. • Some stream flow as observed to be passing into the west ditch about 345 m north of the bridge. • An earth slump approximately 70 m wide and 30 m long was observed approximately 400 m north of the bridge on the north side of the highway. Seepage discharge along the north ditch was also observed which is significantly contributing to the water arriving at Culverts B and C.

- A cut slope between 375 m to 620 m north of the bridge appears to also be significantly contributing to water arriving at culverts B and C.
- Four culverts were observed (A to D) and had some significant damage at the inlets and some outlets. Culvert D was not observed by Stantec during the current call-out inspection.

Thurber concluded that the instabilities were not significantly affecting the road surface at that time. However, icing of the ditch and road surface occurs and regular maintenance is required to keep the road operational in the winter. Short-term recommendations from Thurber include collecting seepage near the earth slump and diverting it into the stream. The erosion gully at Culvert A should be backfilled with riprap and the tension crack be backfilled and levelled.

Medium-term recommendations include controlling the seepage discharge from the north slope and surface water flow and directing the water downslope (north) of the road near Culverts B and C. Surface drainage could be accommodated in the existing west ditch with permanent erosion control measures.

Surficial geology¹ at the site consists of glaciofluvial deposits. Sediment ranges from massive to stratified, poor-to well-sorted coarse to fine-grained and could include till in places.

Barnes (1977)² suggests the site appears to be located within an area with relatively high yield for groundwater wells ranging from probable expected yields of 25 to 500 L/sec. Hydrogeology maps also indicate the bedrock at the site belong to the Brazeau Formation consisting of sandstone and/or shale.

Five work orders were provided by TEC for review. The following summarizes the work completed at the site:

- November 2001: Remove and replace existing culvert. Cleanout and re-establish drainage. This work is understood to have been cancelled and was not implemented.
- September 2011: Culvert C was replaced with 600 mm diameter culvert. 15 m³ of pit-run was placed to replace washed-out side slope between Culverts B and C.
- March 2013: Dig out ice flow at the site.
- August 2016: Repair eroded shoulder using Designation 6, Class 80 material. Reinstated ditch drainage.
- January 2022: Dig out frozen ditch channel at two locations.
- November 2022: Ditching work and washout repair and culvert alterations.

The exact location of the work orders completed is unknown to Stantec.

ITEM	CONDITIONS EXIST		DESCRIPTION AND LOCATION	NOTICEABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Pavement Distress	X		Highway washed out at NBL about 200 m north of bridge.		
Slope Movement	X		Mature curved trees along upper portion of west backslope.		
Erosion	X		Highway washed out at NBL about 200 m north of bridge. Multiple erosion channels along east highway shoulder. West shoulder eroded down to bridge level.		
Seepage	X		Possible springs in backslope to the west		
Bridge/Culvert Distress	X		Four of five CSP culverts crushed or infilled along highway SBL. Large hole in top of fourth culvert at large erosion channel on NBL.		
Other		X			

ASSESSMENT

- Highway 734:22 continues to be a gravel surfaced road. Currently there are "Be Prepared to Stop" signs leading up to the washed-out area.

¹ 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.

² Barnes, R.G. (1978). Hydrogeology of the Brazeau-Canoe River area, Alberta; Alberta Research Council, ARC/AGS Earth Sciences Report 1977-05, 35 p.

- The NBL of Highway 734 was washed out approximately 200 m north of BF77316 (Photos 1 and 2). The washed-out area was about 15 m long. Approximately 3 m wide of roadway was lost at the north end and 2 m at the south end of the wash-out. At the north end, the wash-out was measured to be about 2.5 m deep while the south end was estimated to be in the order of 4 m to 5 m deep. The downslope (east) side of the wash-out was well-vegetated with mature trees. However, a few trees appeared to be recently knocked over likely due to the wash-out.
- The highway is currently restricted to single-lane traffic at the wash-out location with traffic cones set back approximately 2.5 m from the edge of scarp.
- At approximately 150 m north of the wash-out, significant surface water flow was observed coming from higher up the mountain and within the ditch along the SBL. The two flows joined slightly upstream from the 600 mm dia. culvert (Culvert C). The combined flow becomes divided approximately at the culvert inlet where water can be observed to be going through the culvert and around or under the culvert (Photo 3). No obvious damage was observed inside the wall at the culvert inlet that would suggest water flowing out the side walls. A second 600 mm dia. culvert (Culvert B) was observed about 10 m south of Culvert C. Culvert B was infilled with soil and debris at the inlet and is no longer functional (Photo 5), although a slow drip of water can be observed at the outlet.
- The ditch flow along the SBL has significantly eroded the highway shoulder (Photos 5 and 6). A continuous erosion channel was observed from Culverts B and C down to about the wash-out area. The erosion channel was up to 4 m wide and 0.8 m deep. The NBL also contained a few localized areas with shoulder erosion (Photos 4, 7, and 8).
- A third culvert (Culvert A) of unknown size was observed about 30 m north of the wash-out. The inlet was completely crushed (Photo 6). The outlet appeared to be hanging over the downslope side of the highway by about 0.3 m. An erosion channel and partially washed-out mountain side could be observed adjacent and downslope of the outlet (Photo 7). A few fallen and leaning trees were also observed near the outlet.
- Due to a lack of a ditch near the wash-out, the ditch flow in the SBL was observed to be crossing the highway approximately 20 m south of the third culvert (Photo 9). A potential old toe bulge was observed at the expected ditch location which may have diverted water flow across the road. At the time of the inspection, the water did not reach the washed-out area. Instead, the water flowed approximately along the highway centerline down to another (fourth) culvert and BF77316. It is surmised that the highway was washed out due to significant surface water flow across the highway, likely during the prolonged and heavy rain events received about two weeks prior to the site inspection.
- The soil near the wash-out appeared to be silty sandy gravelly glacial till with trace to some clay. Tree roots could be observed within the wash-out (Photos 1 and 2). The soil appeared to be wet in places. Curved mature trees (Photo 10) were also observed along a vertical portion up the mountainside suggesting the surficial soils could include colluvium.
- A 13 m long erosion channel had developed about 20 m south of the wash-out area (Photo 11). The erosion channel tapered from 0.4 m wide to 2.7 m wide and deepened from about 0.7 m to 2 m deep. At the south end of the erosion channel, a fourth culvert (Culvert E) with an estimated 450mm dia. was observed. The culvert outlet was hanging over the erosion channel by about 2 m. A 400 mm dia. hole was observed at the top of Culvert E about 3.5 m in from the outlet. The inlet was almost completely buried within the ditch and is likely infilled with sediment (Photo 12). Stantec believes that this culvert could have been installed as a response to Thurber's 2003 recommendations to divert water away from the west ditch.
- A fifth culvert (Culvert F, 800 mm dia.) was observed just north of BF77316. This culvert appeared to be in good condition (Photos 13 and 14).
- Based on the site history, there appears to be a history of surface water issues (icing and erosion).
- A Probability Factor of 11 was assessed since the highway contains erodible soils with little or no vegetative cover. In addition, it is anticipated that loss of highway will continue with each precipitation event. It is possible that closure of the road would be a direct result of continued erosion and landslide activity. From Google Earth imagery for August 2022, there appears to be recreational activities (RV or tents) occurring within 60 m of the erosion and landslide areas. There is also a building located about 150 m east of the site. Active erosion and/or landslides at this site could pose a risk to public safety. Furthermore, the Brazeau River is located within 150 m of the washed-out highway with potential for sediment to enter the river. As such, a Consequence Factor of 10 was assessed.

RECOMMENDATIONS

- The area at the southeast toe should be restricted for use as campgrounds to reduce the risk to public safety.
- A small swale should be cut along the west side of the highway to direct surface water flow from the washed-out highway area. This should be completed immediately to reduce the risk of losing more ground.

- All culverts should be inspected to maintain functionality. Damaged culverts should be replaced. The hole in the 450 mm dia. culvert should be repaired or covered to enhance motorist safety.
- Given the icing concerns noted in the history of the site, guardrails could be installed at the bend to enhance public safety.
- Long-term remediation measures could include the following:
 - Diverting water flow into Culverts B and C using a small earth berm.
 - Installing a permanent ditch with erosion protection (riprap or half culvert) along the SBL down to the 800 mm dia. culvert near BF77316.
 - Installing a trench drain along the SBL to intercept groundwater flow and reduce icing issue. A trench drain of about 300 m long and 3 m deep is assumed to be required spanning from Culvert C to Culvert F. The length of trench drain can be refined once a better understanding of the icing issues is developed.
 - Erosion channels along the NBL shoulder should be repaired by backfilling with similar soils to reinstate the road width and placing riprap at eroded locations for erosion protection.
 - Rebuilding the washed-out portion of the highway using granular fill. Given the sensitivity of the site, it may not be possible to properly compact the granular fill. As such, geoweb could be a potential option to improve the performance of the reconstructed embankment and roadway, reinforce the slope, and allow for permeability. It is likely that a full road closure is required during construction.
 - The high-level cost for the above is \$300,000 to \$450,000 excluding engineering costs.
- An alternative to full remediation is to continue restricting the traffic at the washed-out area to a single-lane. Given the low volume of traffic at the site, this could be preferable. However, it may still be beneficial to reinstate some roadway along the SBL ditch and create a permanent ditch in the SBL at the wash-out area where it becomes level with the roadway. Riprap could be placed within the ditches for permanent erosion protection and could also be placed at the base of the washout for buttressing the remaining roadway. A Transportation Engineer should also be consulted to improve highway safety if this option is taken since the wash-out is in the middle of a curve on a steep hill. The high-level cost for this option is \$90,000 to \$150,000 excluding engineering costs.
- The site did not return any records of historic resources based on a search of the Listing of Historic Resources. However, Historical Resources Act approval will be required since the remediation options are not included under its Land Use Bulletin.
- This site should be assigned a formal NC number with site inspections completed annually.

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

2023 Call-Out Inspection Photos at Highway 734:22



Photo 1: North end of washed-out NBL. Looking south.



Photo 2: South end of washed-out NBL. Looking north.

2023 Call-Out Inspection Photos at Highway 734:22



Photo 3: Culvert C inlet. Water flow from ditch and from up the mountain. Looking northwest.



Photo 4: Culvert C discharging water to eroded NBL ditch. Looking southeast.

2023 Call-Out Inspection Photos at Highway 734:22



Photo 5: Culvert C buried at inlet. Severe erosion along west edge of SBL. Looking northwest.



Photo 6: Severe erosion along west edge of SBL. Culvert A inlet crushed within ditch. Looking southeast.

2023 Call-Out Inspection Photos at Highway 734:22



Photo 7: Overhang at Culvert A outlet. Shoulder erosion adjacent to the outlet. Looking southeast.



Photo 8: Eroded shoulder of NBL. Looking southeast.

2023 Call-Out Inspection Photos at Highway 734:22



Photo 9: No ditch in SBL resulting in surface water flow towards washed-out roadway. Looking south.



Photo 10: Curved trees along mountainside to the west. Looking southwest.

2023 Call-Out Inspection Photos at Highway 734:22



Photo 11: Erosion channel undermining Culvert E. Looking north.



Photo 12: Culvert E inlet buried. Some water flow back to SBL ditch.

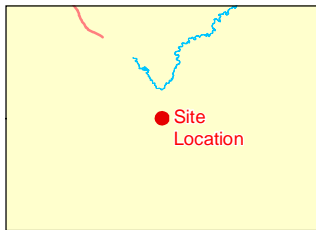
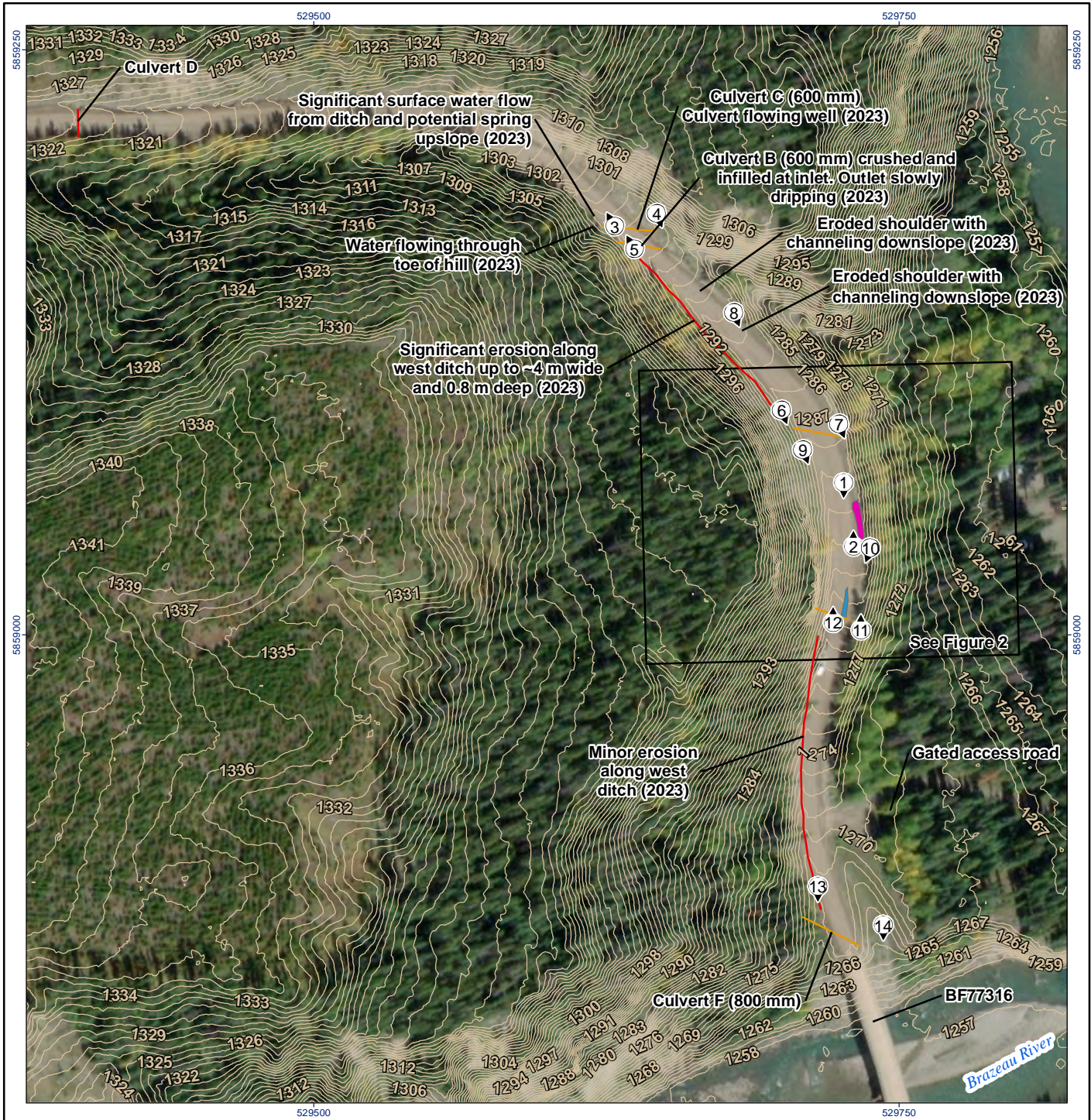
2023 Call-Out Inspection Photos at Highway 734:22



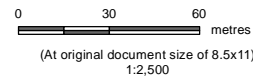
Photo 13: Erosion along SBL leading up to Culvert F. Note water flow along road coming from geohazard site uphill. Looking south.



Photo 14: Culvert F discharging near Brazeau River. Note sediment buildup at beveled end. Looking south.



- Culvert
- Cracks / Erosion
- Photos and Direction
- Quarter Section
- Ground Elevation Contours (m) (2012 LiDAR)



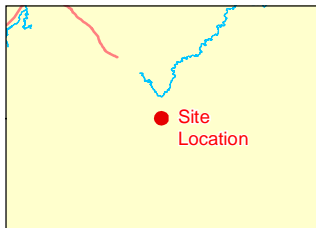
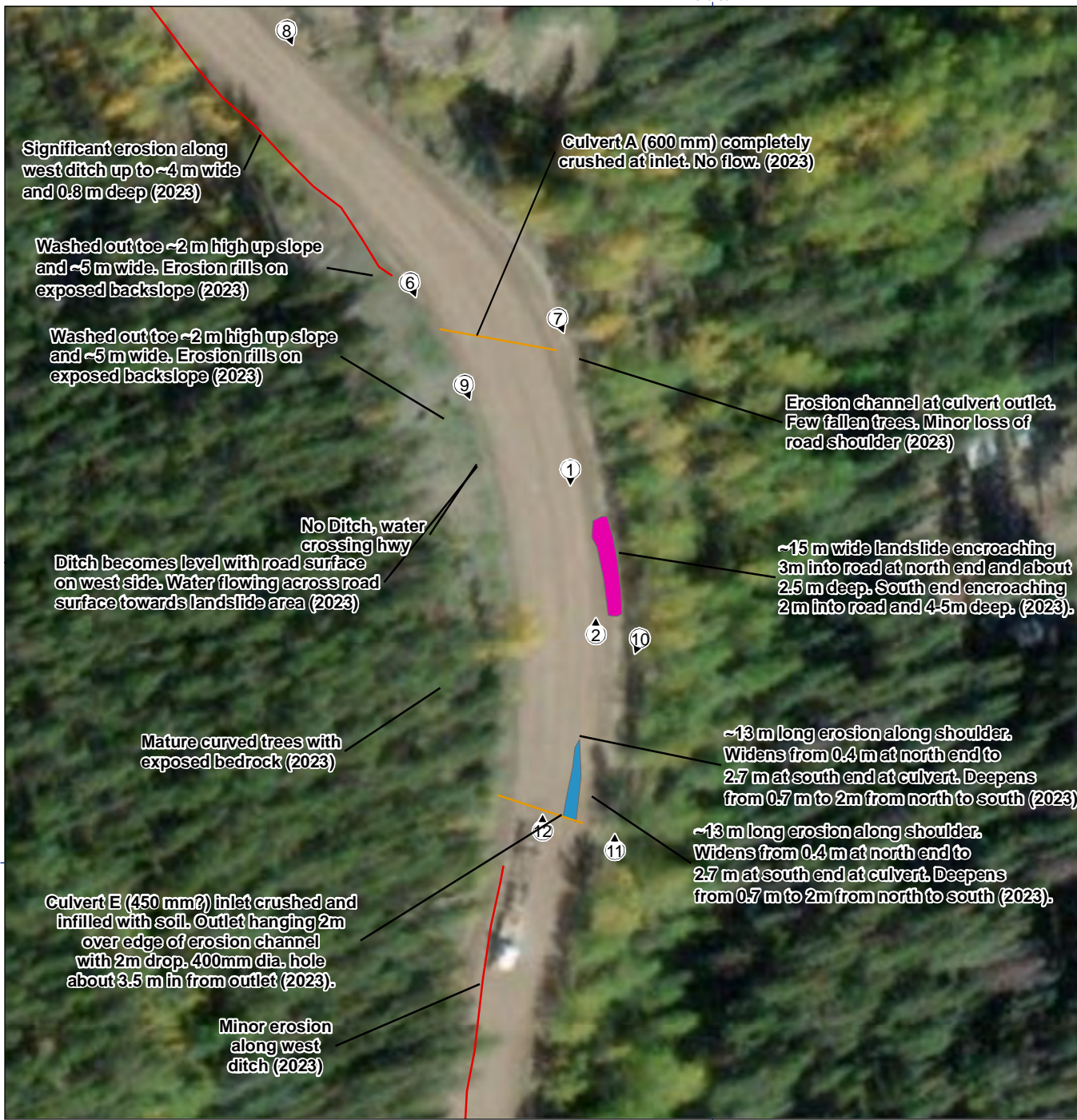
Project Location: Highway 734, Alberta
 Prepared by CLoewen on 2023-07-21
 TR by LCho on 2023-07-24
 IR by XLiu on 2023-07-25

Client/Project: Alberta Transportation and Economic Corridor
 Geohazard Monitoring Program,
 Highway 734
 Figure No. 1

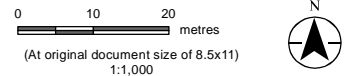
Title: **Site Plan**

Notes
 1. Coordinate System: NAD 1983 UTM Zone 11N
 2. Data Sources: Geogatis, ©Department of Natural Resources Canada, All rights reserved.
 3. Background: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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- Culvert
- Cracks / Erosion
- Photos / Direction
- Quarter Section
- Eroded Shoulder
- Landslide Area



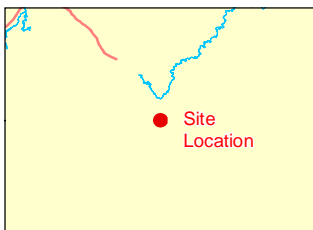
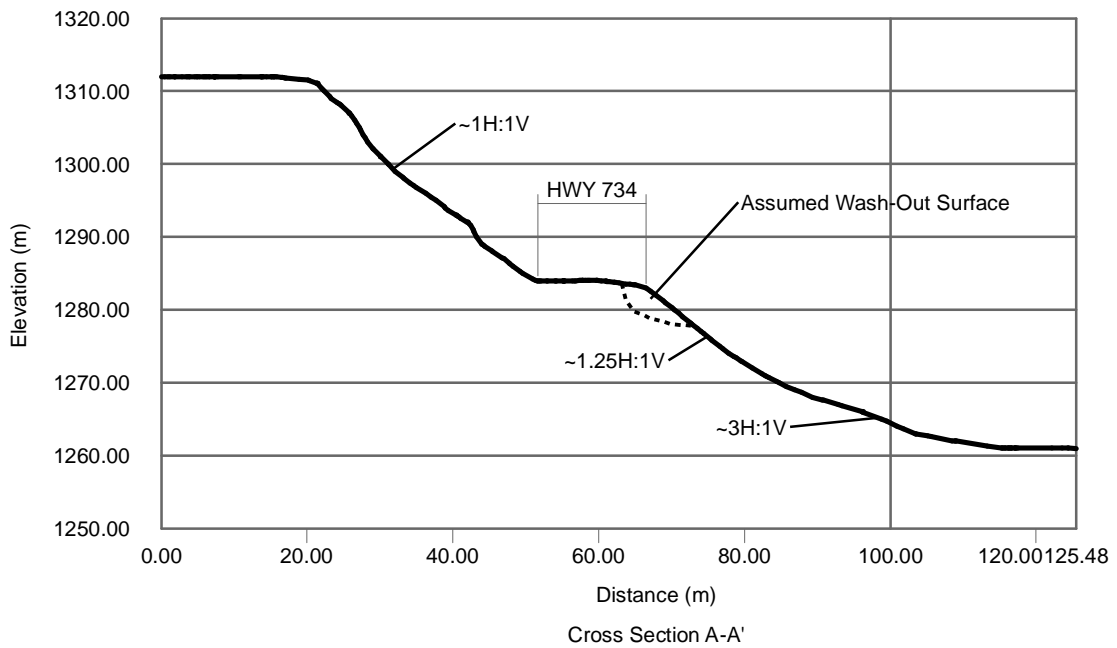
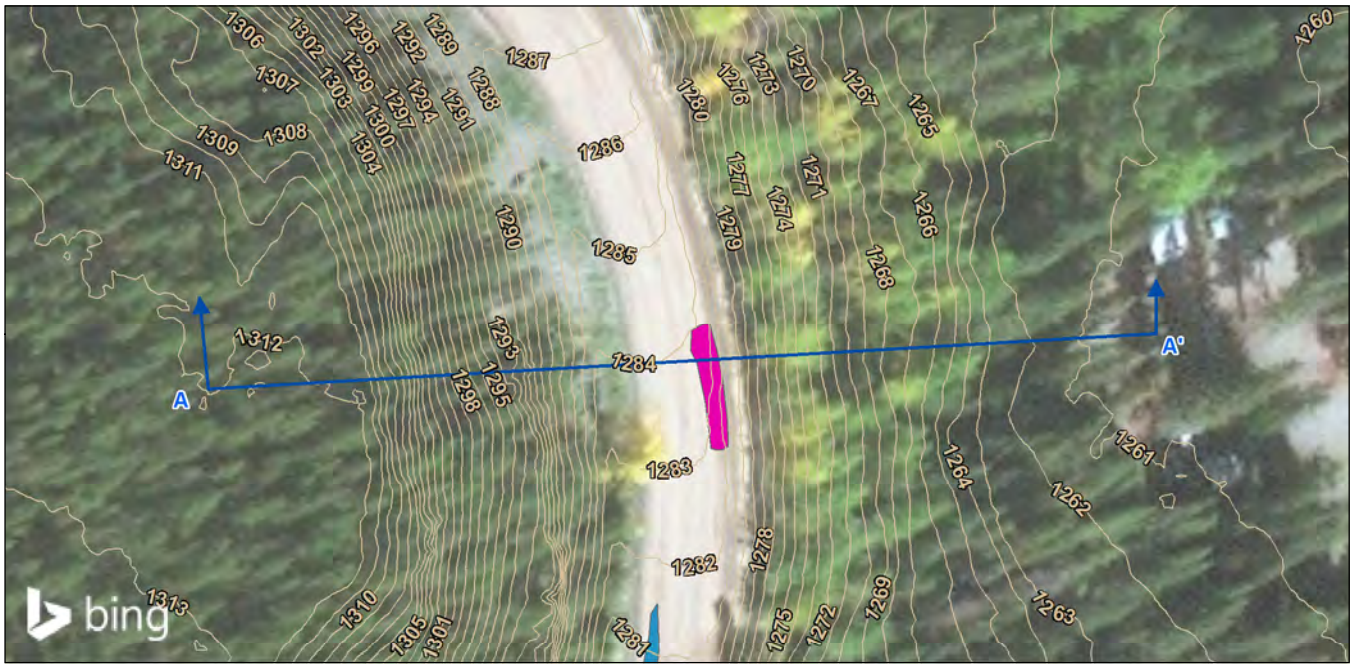
Project Location: Highway 734, Alberta
 Prepared by CLoewen on 2023-07-21
 TR by LCho on 2023-07-24
 IR by XLiu on 2023-07-25





Client/Project: Alberta Transportation and Economic Corridor Geohazard Monitoring Program, Highway 734
 123315222

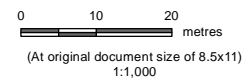
Figure No. 2
 Title: Landslide Area

Notes
 1. Coordinate System: NAD 1983 UTM Zone 11N
 2. Data Sources: Geogratis, ©Department of Natural Resources Canada, All rights reserved.
 3. Background: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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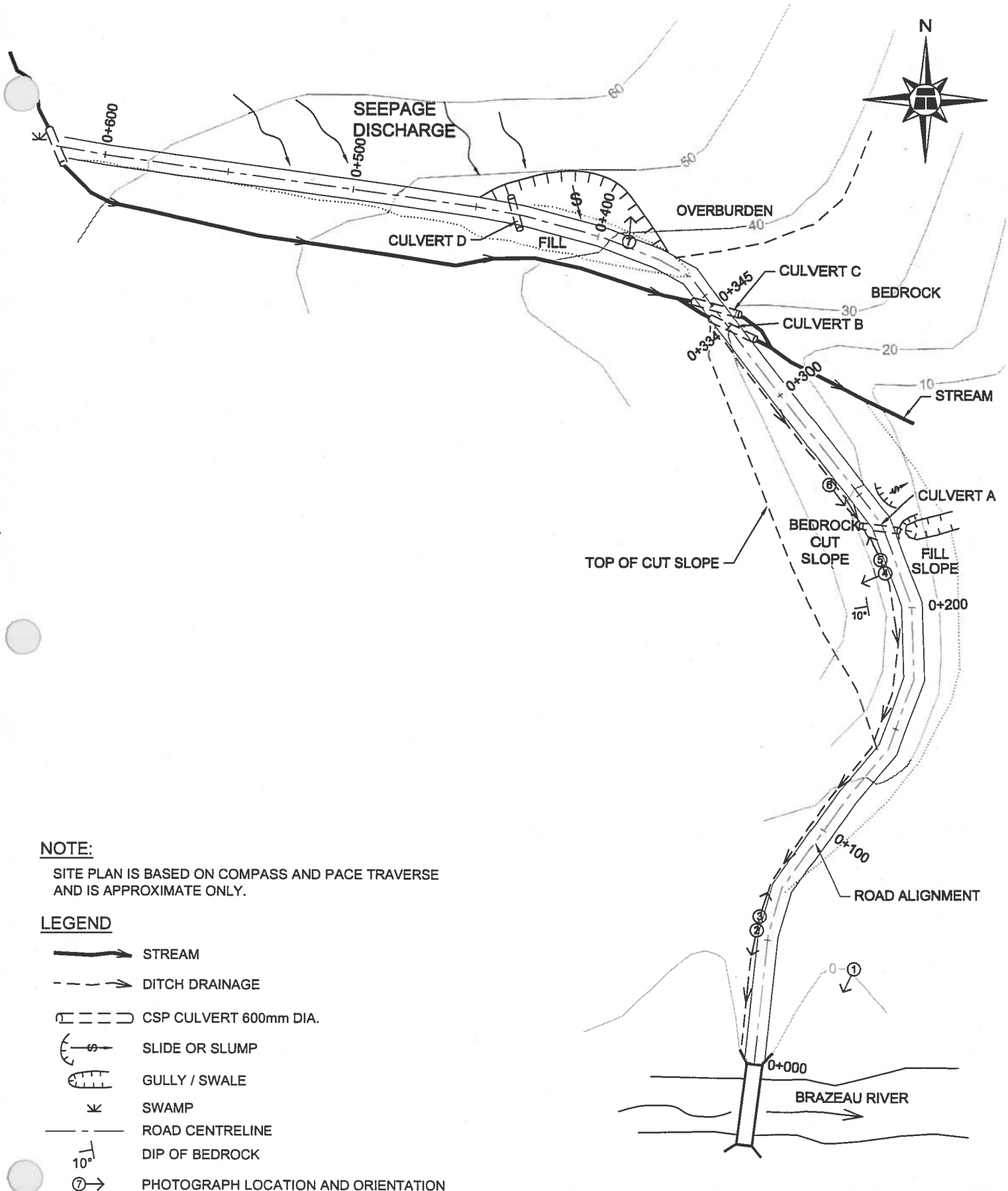
-  Cross Section
-  Ground Elevation Contours (m) (2012 LiDAR)
-  Landslide Area
-  Eroded Shoulder



Project Location: Highway 734, Alberta
 Prepared by: CLoewen on 2023-07-21
 TR by LCho on 2023-07-24
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Client/Project: Alberta Transportation and Economic Corridor
 Geohazard Monitoring Program,
 Highway 734

Figure: 3
 Title: Ground Profile Plan



HWY 734:22 EMERGENCY CALL OUT - AUGUST 2003
FIGURE 1 SITE PLAN AND GEOLOGIC FEATURES

SCALE 1:2000 (APPROX.)
THURBER PROJECT #15-16-173

