

SITE NUMBER AND NAME: C011-I & -II Erosion and Sinkholes		HIGHWAY & KM: 837:02, 5.637	PREVIOUS INSPECTION DATE: June 24, 2021	INSPECTION DATE: May 30, 2022
LEGAL DESCRIPTION: C011-I: 10-04-30-21-W4M C011-II: 10-04-30-21-W4M	NAD 83 COORDINATES: UTM Northing Easting 12 5711672 368445 12 5711584 368473		RISK ASSESSMENT: PF: 1 CF: 2 TOTAL: 2 PF: 2 CF: 5 TOTAL: 10	
AVERAGE ANNUAL DAILY TRAFFIC (AADT): 280 (north) & 290 (south) (Ref No. 106230 & 107250)			CONTRACT MAINTENANCE AREA (CMA): 517	

SUMMARY OF SITE INSTRUMENTATION: There is no instrumentation at the C011 site. LAST READING DATE: N/A	INSPECTED BY: Chris Gräpel (KCB) James Lyons (KCB) Rocky Wang (AT) Tony Penney (AT)
PRIMARY SITE ISSUE: Erosion in the ditch on the east side (northbound lane) of Hwy 837 near the geocell armoring; and of the unarmored fill that was placed in either 2015 or the spring of 2016.	
APPROXIMATE DIMENSIONS: The site is approximately 200 m long, and the highway embankment above the ditch is approximately 1.2 m high sloped at approximately 4H:1V.	
DATE OF ANY REMEDIAL ACTION: October 2002 – geocell and gabion basket drop structures installed; Spring 2016 – unarmored fill placed downstream of the gabion basket drop structures to divert water away from the edge of the highway. 2018 and 2019 – the HMC has regraded the unarmored fill from the C018 site downslope of geocell on the backslope above the existing erosion gully. 2020 – The HMC replaced approximately 60 m of the geocell armoring (upstream of the gabion basket drop structure).	

ITEM	CONDITION EXISTS		DESCRIPTION AND LOCATION	NOTICABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Pavement Distress	X		Pavement cracked on westbound shoulder		X
Slope Movement	X		Steep gully slopes in unarmoured fill are failing		X
Erosion	X		Erosion of ditch and unarmored fill stockpile. Continued erosion of gully.	X	
Seepage		X	None observed		X
Culvert Distress		X	Culvert inlet open		X

COMMENTS
During the 2021 inspection, KCB and AT discussed potentially separating the C011 site into two subsites (i.e., C011-I and -II). C011-I would be the north portion of the site (ditch erosion that was partially repaired in 2020) and C011-II, which would capture the gully erosion downslope of the geocell armoring/gabion drop structures and the sinkholes on the east and west side of Hwy 837. The site was separated into two subsites in late-2021.
C011-I: <ul style="list-style-type: none"> The geocell armoring upstream of the gabion drop structure was repaired in fall 2020 (Photos 1 and 3). Overall, the repaired geocell armoring appears to be in good condition and vegetation has started growing on the ditch side slopes. However, between the 2021 and 2022 inspections, some of the geocell fill in the center of the ditch has washed away, most likely due to a period of increased precipitation in late-2021 or early-2022 (Photo 3) The CSP culvert upslope of the geocell armoring is corroding and appears to be in similar condition as during the 2021 inspection (Photo 4).

C011-II:

- The unarmoured fill stockpile continues to be affected by gully erosion and the erosion gully downslope of the unarmoured fill stockpile continues to expand off highway right-of-way (Photo 6).
- The ditch erosion is causing slope failures that are enlarging slowly and extending uphill towards the highway. Continued erosion and slide mass removal will eventually cause sliding that is large enough to impact the highway.
- In 2022, ten (10) new waypoints (WP) were taken (WPs 152 to 162, excluding WP 160) across the site. All WPs are referencing new or existing sinkholes, excluding:
 - WP 158 (Photo 5) which is a new pavement patch that was completed between the 2021 and 2022 inspections;
 - WP 159, which is a dip in the road between the upslope ditch and the general area of the line of sinkholes observed on the east (downslope) slope; and
 - WP 162, which is the inlet of a 600 mm diameter CSP culvert.
- The sinkholes at WP 149, WP 150, WP 151, WP 154, WP 155, and WP 161 range from approximately 1 m to 5 m in diameter. The sinkhole observed at WP 154 appears to be in an area of exposed bedrock fill with no vegetative cover.
- WP 152 is a linear feature erosion feature approximately 5 m long by 1.5 m wide. WP 153 is also a linear erosion feature approximately 10 m long and 1.5 m wide (partially obscured by tall grass).
- WP 157 is at a sinkhole approximately 3 m wide, 3 m deep, and 20 m long, that was observed further to the east on the north side of the highway and the rate of water discharge from the sinkhole is enough to have created a small gully (Photo 7). KCB suspects this may be the location of a culvert outlet underlying the highway (oriented approximately northeast-southwest).
- The surface of the embankment slope has several sinkholes as shown in Figure 1, including a line of sinkholes extending southeast along the south edge of the erosion gully. The line between sinkholes on the east and west side of the highway indicates a preferential flow path along the sinkholes on both sides of the embankment at a shallow depth below the highway. The presence of the sinkholes indicates that dispersive soil fill is present in the embankment and foundation. AT operations crews should monitor this site for possible settlement or collapse of the pavement like they do at the C058 geohazard site on Hwy 570:02.
- Review of the drainage path from the bottom of the hill indicated that the drainage from the erosion gully to the Red Deer River was not clearly defined.

Maintenance/Repair/Monitoring Recommendations:

C011-II:

- A seamless HDPE slope drain could be used to convey flows over the eroded areas and into the sediment pond, or to a natural creek channel for discharge into the Red Deer River. An energy dissipation structure would be required at the base of the slope to reduce the flow velocity from the slope drain outlet.
- A tracer dye test could be completed to assess the connectivity of the sinkholes observed on the north and south sides of the highway.

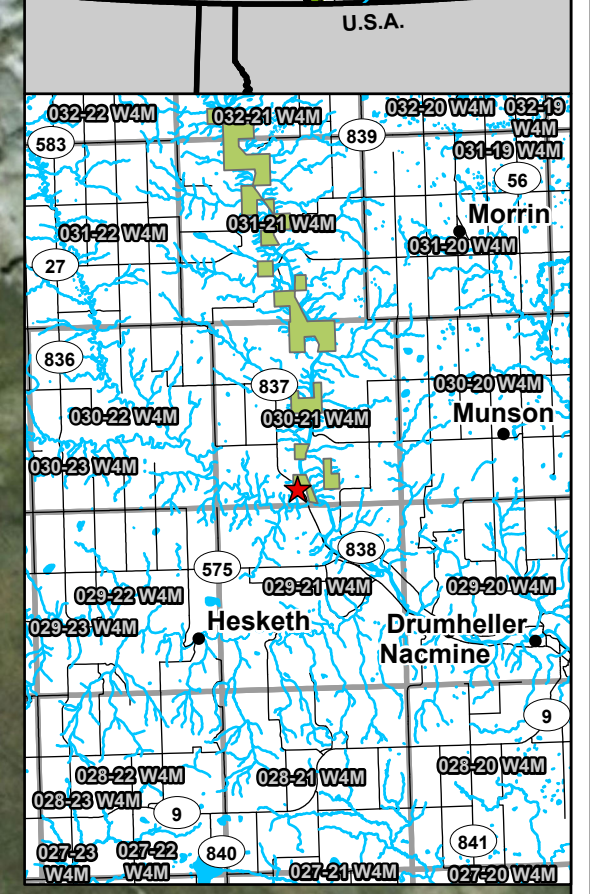
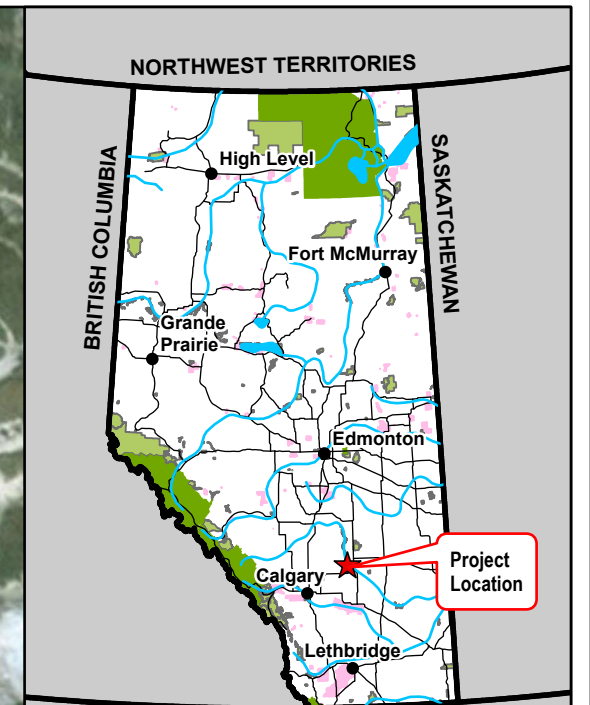
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Chris Gräpel, M.Eng., P.Eng.
Senior Civil Engineer, Associate



Legend

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| <ul style="list-style-type: none"> Observed 2017 Observed 2019 Observed 2020 Observed 2021 | <ul style="list-style-type: none"> GPS Track (May 30, 2022) Scarp Top of Slope Culvert | <ul style="list-style-type: none"> Fill Gabion Basket Geocell Erosion |
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NOTES:
 1. HORIZONTAL DATUM: NAD83
 2. GRID ZONE: UTM ZONE 12N
 3. IMAGE SOURCE: 2022 MICROSOFT CORPORATION, 2022 MAXAR CNES, DISTRIBUTION AIRBUS DS
 4. LOCATION OF 2020 SINKHOLE IS APPROXIMATE AND WAS DETERMINED BASED ON PHOTOS.

CLIENT

PROJECT
CENTRAL REGION GEOHAZARD RISK MANAGEMENT PROGRAM

TITLE
Site Plan
C011 - Ditch Erosion
Hwy 837:02, km 5.637

SCALE 1:1,500 PROJECT No. A05116A02 FIG No. 1

File: Z:\A\EDM\A05116\A02\ABT Central Region.GRIMP\400 Drawings\GIS\MXD\2022\C011_220614.aprx Date: Time: Creator: aharrison

Inspection Photographs

Photo 1 The gabion basket drop structure that was previous being undermined (near the unarmoured fill stockpile) was repaired in fall 2020. Photo taken May 30, 2022, facing northwest.



Photo 2 Gully erosion downstream of the gabion baskets (indicated by red arrow) is in similar condition since the 2021 inspection. Photo taken May 30, 2022, facing southeast.



Photo 3 Geocell armouring in the westbound ditch was replaced in fall 2020 and vegetation has begun to grow on the ditch side slopes. A portion of the granular material in the geocell armouring, near the centre of the reinforcement, has been eroded between the 2021 and 2022 inspections. Photo taken May 30, 2022, facing northwest.



Photo 4 The CSP culvert underlying Hwy 837 (oriented east to west) is corroding and appears to be in similar condition as during the 2021 inspection. Photo taken May 30, 2022, facing northwest.



Photo 5 A pavement patch was completed in the southbound lane between the 2021 and 2022 inspections (Waypoint 158). Photo May 30, 2022, looking northwest.



Photo 6 Slope failure triggered by gully erosion at the toe of the slope north of Hwy 837 doesn't appear to have changed since the 2021 inspection. Photo taken May 30, 2022, facing northwest.



Photo 7 Aerial photo of the C011 site, showing the erosion gully at the toe of the highway embankment, new pavement patch (black circle, WP 158), and sinkholes on the downhill slope (red circle, WP 152 to WP 155), sinkholes in the upslope ditch (yellow circle, WP 161 and WP 162) and erosion gully at the outlet of a sinkhole (or buried culvert, green circle, WP 156 and WP 157) on the east embankment slope. Photo taken May 30, 2022, facing northwest.

