

SITE NUMBER AND NAME: <b>C058-I, II, &amp; III Sinkholes</b>		HIGHWAY & KM: 570:02, 8.3, 9.2, 9.8	PREVIOUS INSPECTION DATE: June 12, 2018	INSPECTION DATE: <b>July 10, 2019</b>
LEGAL DESCRIPTION: 10-08-027-17 W4M	NAD 83 COORDINATES: UTM Northing Easting		RISK ASSESSMENT:	
	<b>C058-I</b>	12 5683470 405475	PF: 8	CF: 5 TOTAL: 40
	<b>C058-II</b>	12 5683845 404934	PF: 8	CF: 5 TOTAL: 40
	<b>C058-III</b>	12 5684148 404224	PF: 8	CF: 5 TOTAL: 40
AVERAGE ANNUAL DAILY TRAFFIC (AADT): 510 (west) & 360 (east) (Ref No. 116220 & 997198)			CONTRACT MAINTENANCE AREA (CMA): 21	

SUMMARY OF SITE INSTRUMENTATION:  None	INSPECTED BY: Chris Gräpel (KCB) Ryan Gazley (KCB) Rishi Adhikari (AT) Tony Penney (AT)
LAST READING DATE: n/a	
PRIMARY SITE ISSUE: Settlement of Hwy 570 due to the presence of dispersive-soil voids beneath the highway surface.	
APPROXIMATE DIMENSIONS: Numerous soil voids along a 1.5 km stretch of Hwy 570.	
DATE OF ANY REMEDIAL ACTION: May 3, 2010 – remediated using foam injection; May 29, 2015 – excavated (deep) and reconstructed with gravel fill and a culvert; unknown – sinkholes in ditch backfilled; speed reduction signs to 50 km/h and hazard markers installed. Sinkhole at C058-I on near south edge of pavement recently patched. October 2018 – at C058-I sinkhole at culvert inlet was filled with 4 m <sup>3</sup> of grout. 2019: All sites appeared to have been recently patched (MCI later confirmed that all sites were patched in June 2019)	

ITEM	CONDITION EXISTS		DESCRIPTION AND LOCATION	NOTICABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Pavement Distress	X		C058-I: Both lanes recently patched; small sinkhole forming on north edge of pavement. C058-III: Pavement has subsided due to sinkhole on north edge of pavement.	X	
Slope Movement		X	None observed		X
Erosion	X		C058-I: Dispersive soil voids potentially forming beneath highway; erosion channel downstream of culvert at south end of site C058-I and -II: Soil voids of various sizes forming above and below highway along drainage pathways.	X	
Seepage		X	None observed		X
Culvert Distress		X	C058-I: 600 mm diameter CSP culvert open and flowing		X

<b>COMMENTS</b>
C058-I (Figure 1): <ul style="list-style-type: none"> <li>Pavement has been recently patched in both lanes. A small sinkhole (0.3 to 0.5 m in diameter) has formed on the north edge of the pavement (waypoint 21). The sinkhole is located across the highway diagonally from a dip in the pavement surface on the south side of the highway indicating the presence of a void.</li> <li>A sinkhole at the culvert inlet (north of the highway) was filled with 4 m<sup>3</sup> of grout in October 2018</li> </ul>

(waypoint 681). The grout is intact and has not subsided since 2018.

C058-II (Figure 2)

- Pavement has been recently patched in both lanes.
- A large sinkhole was discovered north of the highway at the fence line (waypoint 682) during the 2018 inspection. The sinkhole does not appear to have expanded since 2018.
- A sinkhole was discovered along the valley draw above the highway in 2018 (waypoint 683) that lines up with the sinkhole at waypoint 682 down to the road.
- Additional sinkholes (waypoint 684 and 685) were discovered during the 2018 inspection below the fence line on the south side of highway at the culvert outlet and near the toe of the slope, respectively.
- During the 2019 inspection, a series of small sinkholes (waypoint 22) were found near the fence line on the south side of the highway.

C058-III (Figure 3)

- North (westbound lane) of highway recently patched where sinkhole was observed during 2018 inspection (waypoint 686).
- A sinkhole in the ditch (waypoint 687) was filled with grout in 2018. The grout appeared to be heaving from groundwater pressure during the 2018 inspection. The grout cap and sinkhole are now buried with soil deposits and gravel fill.
- During the 2018 inspection, two sinkholes marked with 2x4 posts (waypoint 688 and 689) were full of water following filling of the sinkhole at waypoint 687 with grout, indicating that the void had been plugged.
- Two large sinkholes were found near the toe of the embankment on the south side of the highway during the 2018 inspection (waypoint 691 and 692). Sinkhole at waypoint 691 does not appear to have expanded since 2018 inspection.
- A continuous void (or voids) is believed to be present under the entire highway at this location.

The portion of Hwy 570:02 along the Red Deer River valley appear to be susceptible to dispersive-soil-void geohazards.

No repairs are required at the C058 sites. However, if voids are present at depth below the highway, anywhere the highway embankment is founded on dispersive soils or constructed with dispersive soils, enlargement of a void could result in subsidence of the pavement, followed by brittle collapse of the pavement. AT's strategy to date is to backfill sinkholes and voids and patch the pavement when subsidence of the pavement occurs. The hazard markers at the C058 sites should be maintained. A speed reduction should be implemented, and repairs conducted immediately if further subsidence is noted.

A draft of geohazard-risk-level factors (e.g., probability and consequence factors) for subsurface-void geohazards was submitted to AT for review and discussion in early 2019.

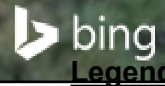
Discussed remedial actions:

C058-I and C058-II: Reinforced subgrade or asphalt to prevent collapse of roadway surface.

C058-III: Install a cut-off wall in the ephemeral creek valley upslope of the highway to force groundwater to the surface and prevent further subsurface erosion.

All sites: AT believes that heavily loaded trucks are exacerbating and hastening the collapse of subsurface voids. A weight restriction should be placed on this section of highway until a solution to void formation below the highway is developed. AT should patrol this section of highway frequently to identify areas of pavement settlement to reduce the possibility of brittle collapse of the pavement under highway traffic.

Time: 14:15:59 PM  
 Date: August 13, 2019  
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- GPS Waypoint
- Flow Direction
- GPS Track (July 10, 2019)
- Sinkhole
- Fence
- Guardrail
- Culvert
- Crack



<p><b>NOTES:</b></p> <ol style="list-style-type: none"> <li>1. HORIZONTAL DATUM: NAD83</li> <li>2. GRID ZONE: UTM Zone 12N</li> <li>3. IMAGE SOURCE: Bing Maps, Microsoft Corporation 2019</li> </ol>	<p>CLIENT</p>	<p>PROJECT</p> <p>CENTRAL REGION GEOHAZARD RISK MANAGEMENT PROGRAM</p> <hr/> <p>TITLE</p> <p style="text-align: center;">Site Plan C058-I Hwy 570:02, km 9.8</p> <hr/> <p>SCALE: 1:1,000    PROJECT No. A05115A02    FIG No. 1</p>
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Time: 14:26:57 PM  
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**Legend**

- GPS Waypoint
- GPS Track (July 10, 2019)
- Culvert
- Fence
- Sinkhole

NOTES:  
 1. HORIZONTAL DATUM: NAD83  
 2. GRID ZONE: UTM Zone 12N  
 3. IMAGE SOURCE: Bing Maps, Microsoft Corporation 2019

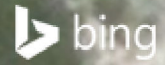
CLIENT

*Alberta*

PROJECT		
CENTRAL REGION GEOHAZARD RISK MANAGEMENT PROGRAM		
TITLE		
Site Plan C058-II Hwy 570:02, km 9.3		
SCALE	PROJECT No.	FIG No.
1:1,000	A05115A02	1

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Time: 11:26:02 AM  
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**Legend**

- GPS Waypoint
- GPS Track (July 10, 2019)
- Fence
- Sinkhole
- Grouted Sinkhole



NOTES: 1. HORIZONTAL DATUM: NAD83 2. GRID ZONE: UTM Zone 12N 3. IMAGE SOURCE: Bing Maps, Microsoft Corporation 2019	CLIENT 	PROJECT CENTRAL REGION GEOHAZARD RISK MANAGEMENT PROGRAM
		TITLE Site Plan C058-III Hwy 570:02, km 8.3
	SCALE 1:1,000	PROJECT No. A05115A02
		FIG No. 1

**Photo 1** Both lanes at C058-I have been recently patched. A small sinkhole has formed on the north edge of the pavement at waypoint 21 (red arrow; photo 2). Photo taken July 10, 2019 looking northwest.



**Photo 2** Small sinkhole (0.3 to 0.5 m diameter) along the north edge of pavement at C058-I. Sinkhole is located diagonally from dip in pavement on south side of highway (red circle). Photo taken July 10, 2019 looking southwest.



**Photo 3** Large sinkhole (red outline) on the north side of the highway at C058-II (waypoint 682). Sinkhole has not expanded since 2018 inspection. Photo taken July 10, 2019 looking north.



**Photo 4** Small sinkholes along the south side of the highway near the fence line at C055-II, west of the culvert outlet (waypoint 22). Photo taken July 10, 2019 looking southeast.



**Photo 4** Westbound lane at C058-III recently patched, covering existing sinkhole at waypoint 686. Photo taken July 10, 2019 looking southeast.



**Photo 5** Large sinkhole (red arrow) on north side of highway at the C058-III site grouted in 2018 no longer visible below soil deposits and gravel fill (waypoint 687). Photo taken July 10, 2019 looking east.





**Photo 6** Large sinkhole (red outline) at the toe of the south slope below highway at C058-III (waypoint 691) has not expanded since 2018 inspection. Photo taken July 10, 2019 looking south.

