

SITE NUMBER AND NAME: C035 Ditch Erosion		HIGHWAY & KM: 590:04, 20.104	PREVIOUS INSPECTION DATE: June 9, 2020	INSPECTION DATE: June 24, 2021
LEGAL DESCRIPTION: 04-28-035-21 W4M 13/14/15/16-21-035-21 W4M 01-28-035-21 W4M	NAD 83 COORDINATES: UTM Northing Easting 12 5765903 365774 12 5765738 367296		RISK ASSESSMENT: PF: 10 CF: 4 TOTAL: 40	
AVERAGE ANNUAL DAILY TRAFFIC (AADT): 680 (east) and 570 (west) (Ref No.103300 & 997156)			CONTRACT MAINTENANCE AREA (CMA): 517	

SUMMARY OF SITE INSTRUMENTATION: There is no instrumentation at the C035 site. LAST READING DATE: N/A	INSPECTED BY: Chris Gräpel (KCB) James Lyons (KCB) Roger Skirrow (AT) Tony Penney (AT) Darcy Newton (AT)
PRIMARY SITE ISSUE: Numerous erosion features located along Hwy 590, mainly in the ditches, on either side of the Red Deer River.	
APPROXIMATE DIMENSIONS: The site is approximately 2 km long.	
DATE OF ANY REMEDIAL ACTION: 2020 – The large erosion gully approximately 600 m west of the bridge was backfilled with gravel and Class 1M riprap by the Highway Maintenance Contractor (HMC) in fall 2020.	

ITEM	CONDITION EXISTS		DESCRIPTION AND LOCATION	NOTICABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Pavement Distress	X		Various locations, but unrelated to erosion or drainage.		X
Slope Movement	X		Backslope instability on east side of river causing partial blockage of westbound ditch.		X
Erosion	X		Numerous erosion features along highway due to presence of dispersive soils.	X	
Seepage		X	None observed.		X
Culvert Distress	X		Culverts require repair or replacement, see below.	X	

COMMENTS

West of the bridge:

- The 6 m deep erosion gully on the valley slope approximately 600 m west of the bridge was repaired by the HMC in fall 2020. The erosion gully was backfilled with gravel, and riprap was placed for erosion protection (Photo 1). The majority of the riprap appears to have poor durability and will breakdown into smaller pieces in a few years due to freeze-thaw action (waypoint 0059).
- The CSP culvert downslope of the erosion gully continues to corrode (Photo 2). The culvert was observed to be flowing and the bottom of the culvert was corroded.
- Rill erosion and voids associated with the erosion of dispersive materials were observed in the exposed bedrock along the backslopes. The backslopes are sporadically vegetated.
- Both ditches are gullied to a depth of 1 m with near-vertical slopes. The ditch channels outside of the gullies are well vegetated with grass.
- The 1200 mm diameter CSP culvert just west of the bridge is corroded (corrosion holes in crown of culvert) and requires replacement or repair. The culvert outlet is undermined by ditch flow from further

upslope and culvert discharge onto unarmored soil. In the short term, the ditch downstream of the culvert outlet should be armored with riprap.

East of the bridge:

- The extent of ditch erosion east of the bridge appeared to be the same condition as during the 2020 inspection.
- The inlet of a culvert is partially buried by sediments eroded from further up the ditch (just east of the bridge).
- A wider section of the ditch appears to act as a sediment trap (upslope of 600 mm culvert).
- Riprap was placed in an erosion gully before 2016. This area looks stable, but sediment deposition from further upstream is probably contributing to the favorable performance at this site.
- Ditch flows have bypassed riprap placed in a former gully, near the east extent of the site and near the bedrock outcrop. In some areas, erosion in the ditch is causing instability of the backslope, and bentonitic materials are exposed on the backslope.
- Erosion gullies beneath the bridge have expanded and retrogressed toward the bridge abutments. The erosion gully is larger than during the 2020 inspection and should be repaired in 2021.
- Rill erosion was observed on the south side of Hwy 590. A shallow and narrow ditch was recently excavated by the landowner, near the toe of the highway embankment to direct surface water flows away from the campground. The MCI told AT and KCB that in January 2021, water flowed over the road due to higher-than-normal temperatures, which was a first for this site.

The colluvial soil and bedrock exposed at the C035 site (both sides of the river) are dispersive. Erosion control of dispersive soils should be approached differently than for non-dispersive soils, as per KCB's 2017 report on the C035 site. KCB proposes that AT conduct a series of field tests on the west and east sides of the river to assess erosion control measures in dispersive soils, similar to what AT conducted at the Diashowa site in the Peace River valley. Trial sections should be 100 m long and hydrologically similar (e.g., similar slope and runoff characteristics) so that the effectiveness of different erosion control measures and construction methods can be compared. Candidate repair methods for field testing could include geocell, riprap (with and without granular filter layers and cross-ditch sand filters), lime treatment, and vegetation. Some areas of the C035 site are well vegetated, while others are not. It is recommended that after repairs, the disturbed areas should be hydro-mulched with a seed mix that is suitable for the soil chemistry, as determined during KCB's soil and vegetation assessment completed in 2020 (report issued to AT in early-2021).

Repair options for the ditch erosion on the east and west side of the site:

- The ditch erosion could be repaired with geotextile and geocell armoring, similar to the repair at C011 that was completed in 2020. Other repair options could include TRM, geotextile-gravel-riprap combination, geotextile wrapped gravel, etc. Any repair option should limit disturbance due to the difficulty in growing vegetation at the badlands sites (salty and dispersive soils). KCB will schedule a virtual meeting with Layfield or Nilex to discuss possible repair options (AT will be invited to the meeting).

Repair options for the erosion gully repaired in 2020:

- The erosion gully was repaired with more riprap than original expected. However, the HMC should replace the riprap into a more "channel shaped" to allow surface water flows to pass through the channel, instead of around it. The shape of the channel cross section will result in water bypassing the armoured channel and causing erosion at the unarmoured flanks of the channel, by pass the armoring constructed by AT is 2020. Additionally, the riprap placed in 2020 has some particles that are sedimentary in origin (e.g., sandstone) and should be replaced with suitable riprap.

Repair options for the erosion gully below bridge abutment:

- In the short term, riprap should be placed in the erosion gully to minimize the potential for enlargement and continued retrogression. This should be repaired by the bridge group, as they have experience completing work around existing creosote timbers and have procedures in place.

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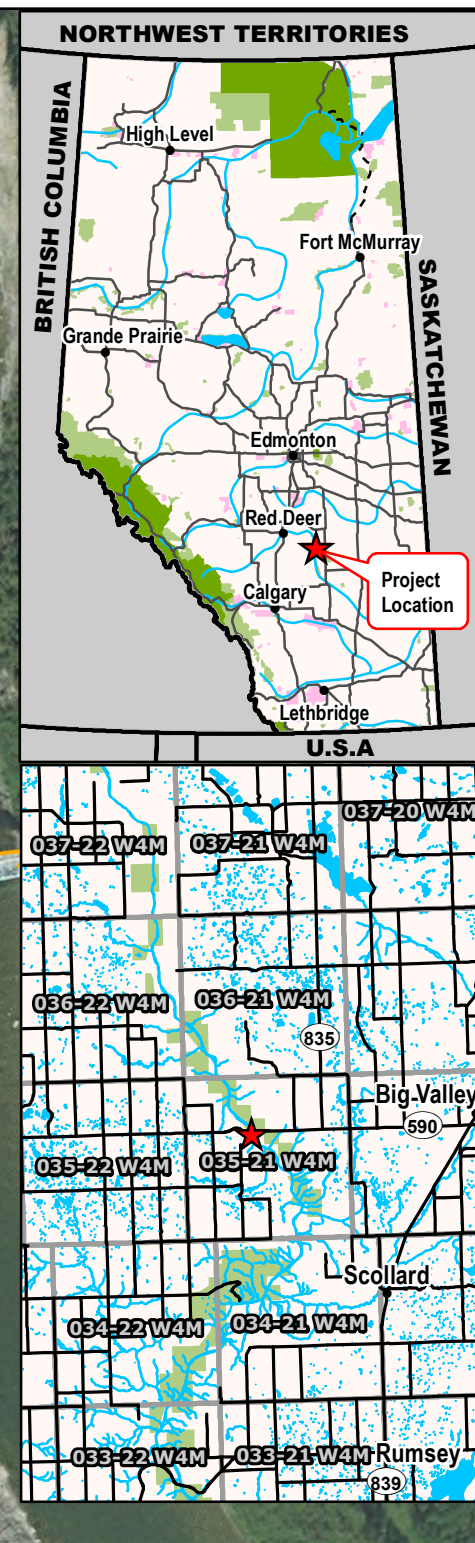
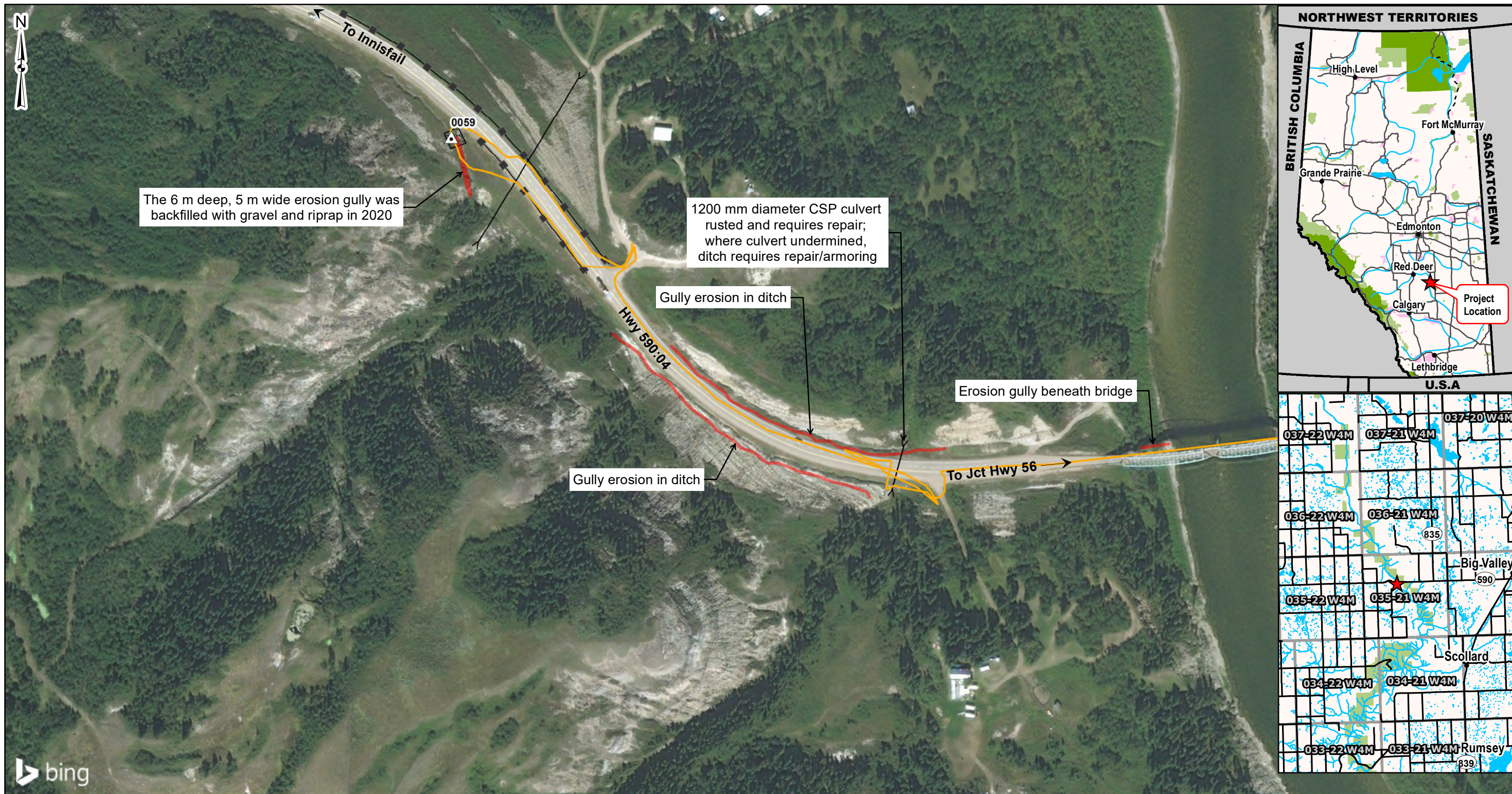
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- (ii) The observations, findings, and conclusions in this report are based on observed factual data and conditions that existed at the time of the work, and should not be relied upon to precisely represent conditions at any other time.
- (iii) KCB should be consulted regarding the interpretation or application of the findings and recommendations in the report.

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

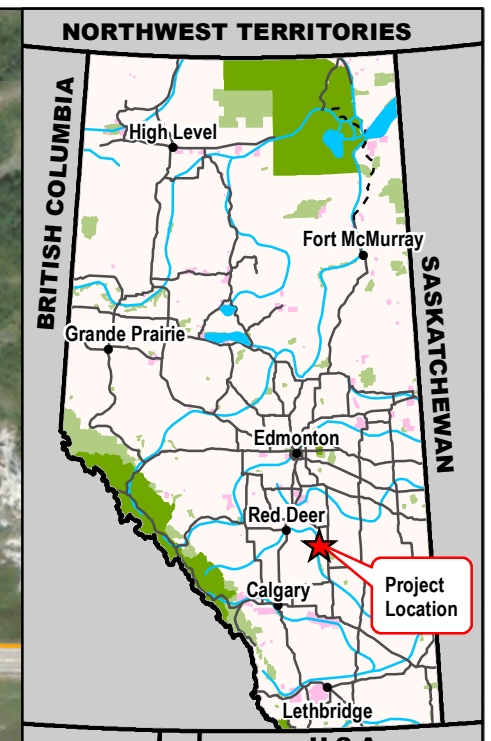
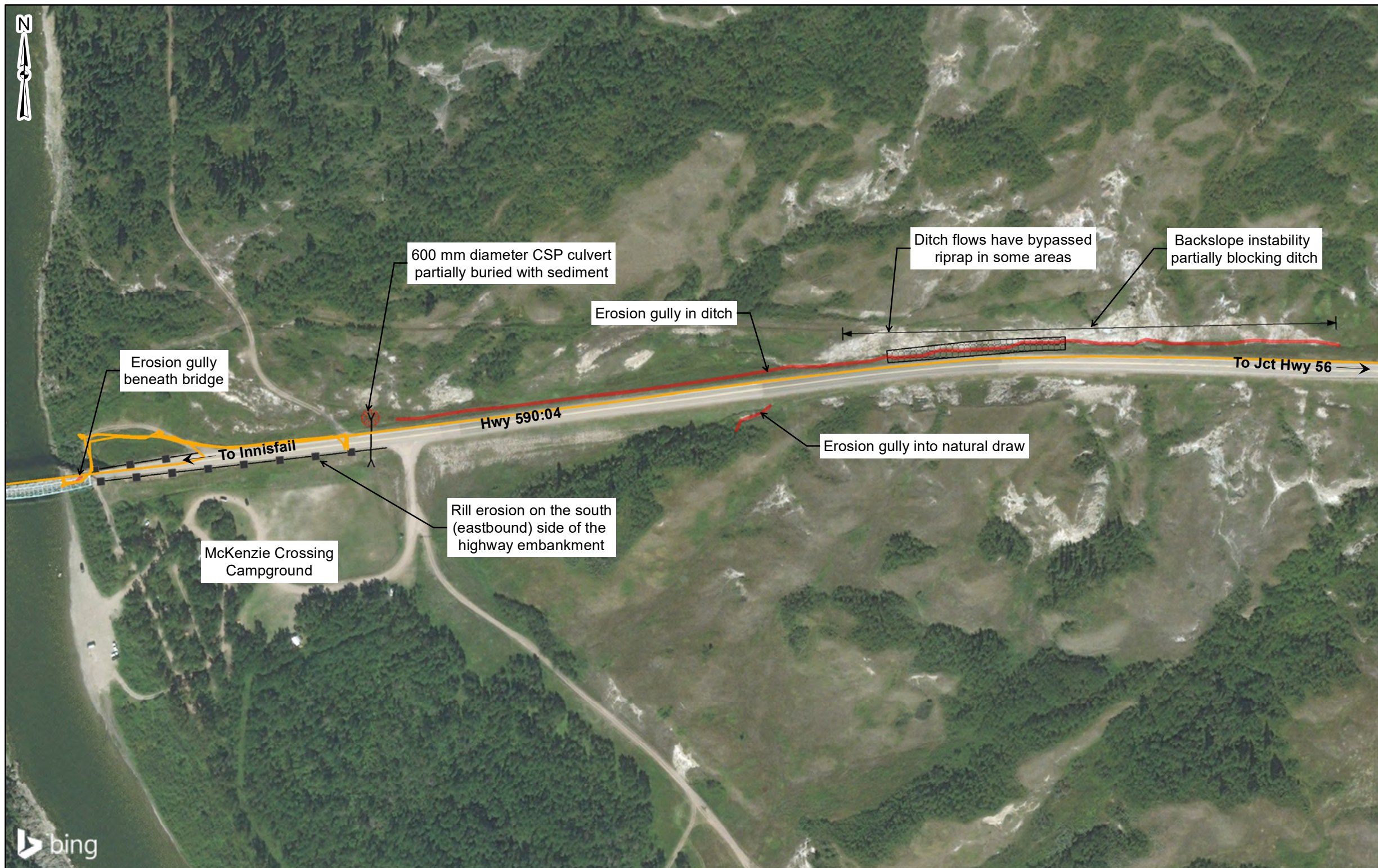


- Legend**
- GPS Waypoint (June 24, 2021)
 - GPS Track (June 24, 2021)
 - Culvert
 - Guardrail
 - Erosion
 - Riprap

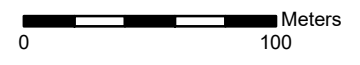


NOTES: 1. HORIZONTAL DATUM: NAD83 2. GRID ZONE: UTM Zone 12N 3. IMAGE SOURCE: World Imagery, ESRI ArcGIS Online Source date January 15, 2018 (Red Deer County 2018)	CLIENT 	PROJECT CENTRAL REGION GEOHAZARD RISK MANAGEMENT PROGRAM
		TITLE Site Plan C035 - Ditch Erosion Hwy 590.04, km 20.104
SCALE 1:3,000	PROJECT No. A05116A02	FIG No. 1

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 Date: November 08, 2021
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- Legend**
- GPS Waypoint (June 24, 2021)
 - GPS Track (June 24, 2021)
 - Guardrail
 - Culvert
 - Sinkhole
 - Erosion
 - Riprap



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		TITLE Site Plan C035 - Ditch Erosion Hwy 590:04, km 20.104
SCALE 1:3,000	PROJECT No. A05116A02	FIG No. 2

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Inspection Photographs

Photo 1 Comparison photo of the previous erosion gully on the south side (eastbound lane) of the highway, approximately 600 m west of the bridge, that was repaired by the highway maintenance contractor in late-2020. Note that the riprap channel is not well defined with minimal freeboard. Photos taken looking south.



Photo 2 Continued erosion in the ditch south of Highway 590, upstream of the 1200 mm diameter CSP culvert. Photo taken June 24, 2021 facing west.



Photo 4 Erosion gully at the east abutment is larger than during the 2020 inspection. Photo taken June 24, 2021 facing west.

