



**PEACE REGION  
(GRANDE PRAIRIE DISTRICT – SOUTH) GRMP**



**SITE INSPECTION FORM**

<b>SITE NUMBER AND NAME:</b> GP007 Wanyandie Road Slide		<b>HIGHWAY &amp; KM:</b> 40:36, 29.339	<b>PREVIOUS INSPECTION DATE:</b> June 14, 2023	<b>INSPECTION DATE:</b> <b>June 12, 2023</b>
<b>LEGAL DESCRIPTION:</b> NW 02-59-07-W6M NE 02-59-07-W6M	<b>NAD 83 COORDINATES:</b> UTM Northing Easting 11 5993890 372875		<b>RISK ASSESSMENT:</b> PF: 9 CF: 8 TOTAL: 72	
<b>AVERAGE ANNUAL DAILY TRAFFIC (AADT):</b> 421 (north) & 424 (south) (Reference No. 60403650, 2022)			<b>CONTRACT MAINTENANCE AREA (CMA):</b> 504	

<b>SUMMARY OF SITE INSTRUMENTATION:</b>  Operable: Ten slope inclinometer (SIs), nine pneumatic piezometers (PNs), nineteen vibrating wire piezometers (VWPs), and three standpipe piezometers (SPs) installed between 1998 and 2022. All VWPs and two SPs connected to data loggers.  Inoperable: Eight SIs and two PNs installed between 1998 and 2020.  LAST READING DATE: June 07, 2023	<b>INSPECTED BY:</b> Chris Gräpel (KCB) Courtney Mulhall (KCB) Roger Skirrow (TEC) Max Shannon (TEC) Renato Macciotta (UofA)
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**PRIMARY SITE ISSUE:** Deep-seated landslide (or nested slides) along north valley slope of the Smoky River. Hwy 40:36 fill placed in a cut and side-hill arrangement across slide area. Slide movement affecting both lanes of highway.

**APPROXIMATE DIMENSIONS:** Entire site is approximately 600 m long. An approximate 200-m and 150-m length of highway primarily being affected at western and eastern site limits, respectively.

**DATE OF ANY REMEDIAL ACTION:** 2018 and 2019 – asphalt overlay. Summer/Fall/Winter 2020 and 2021 – highway surface returned to gravel in summer/fall then paved for winter. Ongoing pavement patching, and sub-excavation and backfilling of voids with granular fill. Site last patched in late 2022.

ITEM	CONDITION EXISTS		DESCRIPTION AND LOCATION	NOTICABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Pavement Distress	X		Cracking and settlement in pavement surface, including recent pavement patches, as described below.	X	
Slope Movement	X		Cracking and settlement in recent pavement patches and SI data indicates ongoing slide movements.	X	
Erosion		X	None observed at time of 2023 inspection.		X
Seepage	X		At western site limit: upslope/north ditch is poorly drained and sometimes wet. Area downslope/south of Hwy 40:36 not visited during 2023 inspection, but ponded water and seepage previously observed in 2022 as described below. At eastern site limit: none observed during 2023 inspection.		X
Culvert Distress		X	Boulder-sized rock particle (approximate diameter 0.3 m) in culvert inlet at western site limit, which could block flow and prolong ponding in highway ditch. Otherwise, culverts not inspected, but no previous distress observed by KCB.	X	

<b>COMMENTS</b>
Slope upslope and downslope of highway is landslide terrain.
Highway crosses deep gully/ravine and bridge-sized culvert at eastern site limit.
High fills located at western and eastern flanks of slide with lower side-hill fills in middle of slide area.
Cracking observed in pavement surface at western and eastern site extents as follows: <ul style="list-style-type: none"> <li>• At western site limit: cracking across both lanes through recent pavement patch to north shoulder. Some skid marks observed in both lanes.</li> <li>• At eastern site limit: cracking across both lanes through west end of recent pavement patch to north shoulder. SI20-02 downslope of this sheared between the fall of 2022 and spring of 2023 readings.</li> </ul>
Portions of landslide that appear most active coincide with areas of high fill (below/adjacent to Wanyandie Road intersection and deep gully at eastern site limit). Slide relatively inactive near middle of site and above highway.
Less active portions of slide above/north of highway may not be as influenced by fill placement or water infiltration into slide scarps at highway level. However, without any changes to the slide or highway geometry, continued movement of the lower portions of the slide or prolonged periods of wet weather causing groundwater levels to rise could eventually result in movements further upslope.
Sinkholes observed along upslope/north highway ditch (e.g., at WP301), which appear to correspond with the location of a fiber optics line.
The area downslope/south of Hwy 40:36 was not visited during the 2023 inspection, but the following was previously observed by KCB in 2022: <ul style="list-style-type: none"> <li>• A series of ridges and troughs on the slope, which are visible in historic air photos and the bare-earth light detection and ranging (LiDAR) data. It was discussed that the ridges and troughs could be the result of blocks sliding and eroding overtime becoming more dome shaped. Generally, no pattern to ridges and troughs.</li> <li>• A pond of water located on the mid-slope. As well as other wet spots on the slope, and ponded and flowing water in two locations on former Wanyandie Road. Note pore pressures/water levels recorded in PN-3, located along former Wanyandie Road, were above ground surface before the instrument became inoperable in 2011.</li> </ul>
Several geotechnical site investigations completed by others between 1998 and 2020, which included installing 14 SIs and 21 piezometers. <ul style="list-style-type: none"> <li>• Several of these piezometers have been dry or near dry (i.e., recording water levels below or near their tip elevations) since installation with a water level/porewater pressure above tip elevation only being recorded in the spring of 2020 and/or 2021. A sustained water level/porewater pressure has only been recorded in PN98-1, PN98-3, and the piezometers (VW20 02A/B, -03A/B, and 06A/B, and SP20-4) at the eastern site limit.</li> <li>• Several of these SIs were either not installed deep enough (e.g., SI98-4 and -6, SI02-11 and -12, and TH20-2, -3, and -6) or did not record clear movement patterns before they became inoperable (e.g., SI98-1).</li> </ul>
KCB subsequently completed a geotechnical site investigation in May 2022, which included installing 4 deep SIs and 13 deep VWPs.
To record year-round groundwater-fluctuations and improve our understanding of groundwater conditions below Hwy 40:36, KCB: <ul style="list-style-type: none"> <li>• installed data loggers on all 19 VWPs in the spring of 2022; and</li> <li>• installed small-diameter VWPs connected to data loggers in 2 SPs in the spring of 2023.</li> </ul>

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Highway re-alignment to north/upslope previously studied and designed by others. The re-alignment design involved:

- large excavations of the mountain slope and high backslopes above/north of Hwy 40:36, which was judged by KCB and TEC to have a high risk of exacerbating existing movements or triggering other movements further upslope above/north of Hwy 40:36; and
- extension of the existing 1980's bridge-sized culvert at the eastern site limit.

Subsequent discussions with TEC indicated that they would like to see additional preliminary engineering assessments from KCB for re-alignment/lowering downslope/south and drainage/dewatering.

KCB presented our preliminary engineering work to TEC on March 18 and April 21, 2022. The main conclusions of the April 21, 2022 meeting were that:

- TEC will no longer be considering realignment and lowering/unloading of Hwy 40:36 to address slides movements; and
- there was insufficient piezometric and groundwater level data to full assess the feasibility of a dewatering solution.

A subsequent drilling investigation completed in May 2022 (see above) indicated dewatering would be challenging due to the fine-grained materials (soils and bedrock) present and the depth to bedrock (30 m to 40 m versus the 10 m to 20 m expected based on previous geotechnical site investigations).

Preliminary engineering report to be issued in late 2023.

Maintenance/Repair/Monitoring Recommendations:

- Upslope/north ditch is wet and poorly drained. Tire tracks also left in bottom of ditch by drill rig in spring of 2022. Ditching improvements needed in upslope/north ditch to improve drainage to west and divert water from slide area. KCB prepared a "sketch" design package for a highway maintenance contractor (HMC) repair, which is expected to be completed in summer or fall 2023. Repair consists of ditch grading and excavation of new deeper ditch channel. Estimated cost: approximately \$100,000.
  - Rock particle in culvert inlet should be removed as part of this work to re-establish culvert flow capacity.
- Most of the slide mass is not instrumented and the available LiDAR data indicates slide terrain extends well above/north of the highway where there are no instruments. Interferometric Synthetic Aperture Radar (InSAR) monitoring could be used to further study the slide and assess how the slope is moving and over what extent, which would be useful if TEC adopts a strategy where the impact of sliding at the site is managed with road repairs. Estimated cost: approximately \$50,000 to \$100,000 per year for InSAR.



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Courtney Mulhall, M.Sc., P.Eng.  
Geotechnical Engineer



## Inspection Photographs

- Photo 1** Pavement surface of Hwy 40:36 at western site limit near Wanyandie Road intersection. Note recent pavement patch on Hwy 40:36 (circled in white). Photo taken June 12, 2023, facing east.



- Photo 2** South embankment slope of Hwy 40:36 above Wanyandie Road at western site limit. Note recent pavement patch on Hwy 40:36 (circled in white). Photo taken June 12, 2023, facing east.





**Photo 3** Cracking and settlement of recent pavement patch in eastbound (south) lane of Hwy 40:36 near western site limit. Photo taken June 12, 2023, facing east.



**Photo 4** Cracking and settlement of recent pavement patch in both lanes of Hwy 40:36 near western site limit. Photo taken June 12, 2023, facing west.





**Photo 5** North ditch of Hwy 40:36 at western site limit near Wanyandie Road intersection. Photo taken June 12, 2023, facing east.



**Photo 6** North ditch of Hwy 40:36 at western site limit near Wanyandie Road intersection. Note boulder-sized rock particle (approximate diameter 0.3 m) in culvert inlet. Photo taken June 12, 2023, facing west.





**Photo 7** Sinkhole along fiber optics line (circled in white) in north ditch of Hwy 40:36 near WP301. Photo taken June 12, 2023, facing west.



**Photo 8** Start of recent pavement patch on Hwy 40:36 at eastern site limit. Photo taken June 12, 2023, facing southwest.



**Photo 9** Recent pavement patch on Hwy 40:36 at eastern site limit. Note crack in eastbound (north) lane. Photo taken June 12, 2023, facing west.



**Photo 10** Recent pavement patch on Hwy 40:36 at eastern site limit. Photo taken June 12, 2023, facing west.





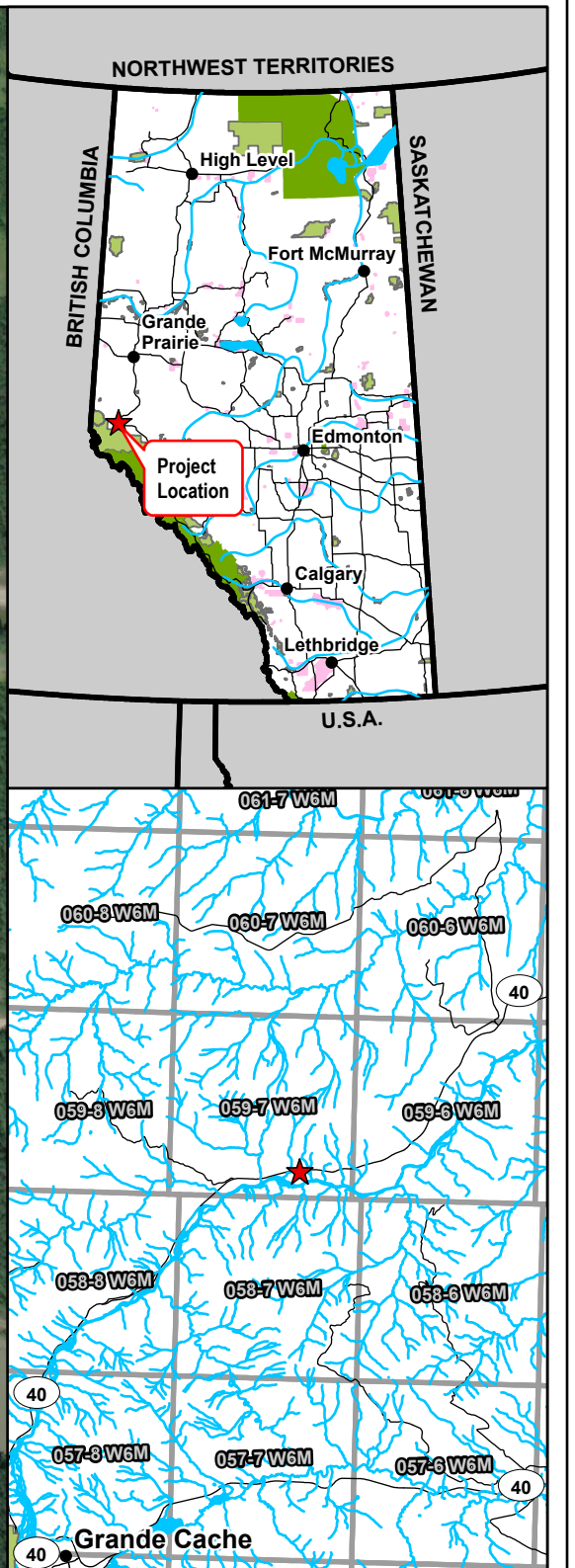
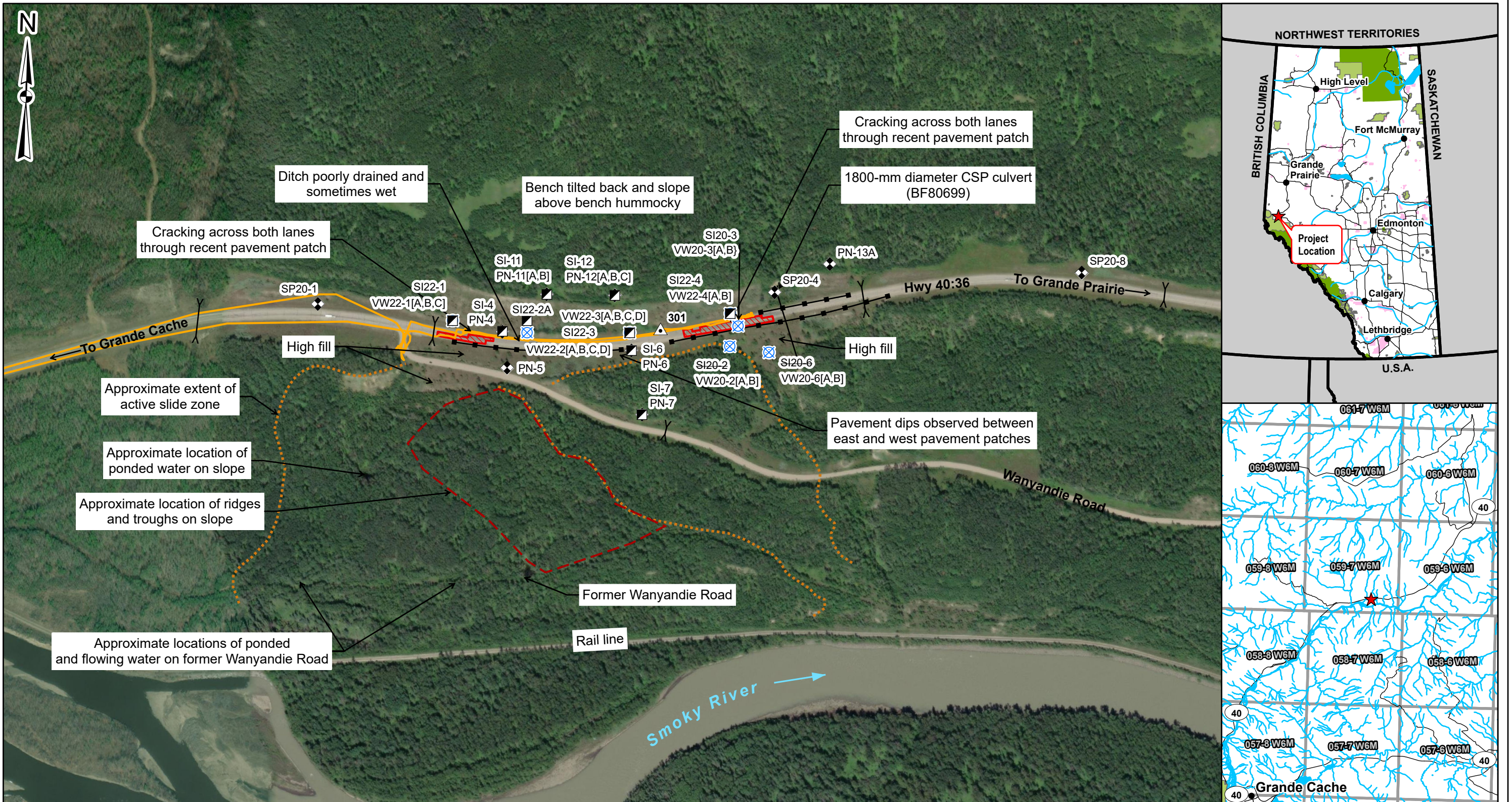
**Photo 11** Recent pavement patch on Hwy 40:36 at eastern site limit. Photo taken June 12, 2023, facing southeast.



**Photo 12** South embankment slope of Hwy 40:36 at eastern site limit. Photo taken June 12, 2023, facing southwest.







**Legend**

- ◆ Approximate Pneumatic Piezometer Location
- ▣ Approximate Slope Inclinometer Location
- ⊠ Approximate Vibrating Wire Piezometer Location
- ▲ GPS Waypoint (June 12, 2023)
- GPS Track (June 12, 2023)
- Flow Direction
- > Culvert
- Guardrail
- ⋯ Active Slide Zone
- - - Ridges and Troughs
- ▨ Pavement Patch

NOTES:  
 1. HORIZONTAL DATUM: NAD83  
 2. GRID ZONE: UTM ZONE 11N  
 3. IMAGE SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY  
 4. STRIKETHROUGH INDICATES INSTRUMENT IS INOPERABLE. INSTRUMENTS INOPERABLE PRIOR TO 2021 NOT SHOWN.

CLIENT

*Alberta*

**Klohn Crippen Berger**

PROJECT	PEACE REGION (GRANDE PRAIRIE DISTRICT-SOUTH) GEOHAZARD RISK MANAGEMENT PROGRAM	
TITLE	Site Plan GP007 - Wanyandie Road Slide Hwy 40:36, km 29.339	
SCALE	PROJECT No.	FIG No.
1:6,000	A05116A01	1



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