PEACE REGION
(GRANDE PRAIRIE DISTRICT – SOUTH) GRMP
SITE INSPECTION FORM

SITE NUMBER AND NAME: **GP054 Debris Flow Corridor South of McIntyre Mine**	HIGHWAY & KM: 40:36, 8.119 to 12.262	PREVIOUS INSPECTION DATE: June 12, 2023	INSPECTION DATE: **June 10, 2024**
LEGAL DESCRIPTION:	NAD 83 COORDINATES: UTM / Northing / Easting	RISK ASSESSMENT:	
South NW 29-57-08-W6M	11 / 5981027 / 358454	**No Recent Occurrence** PF: 7 CF: 6 TOTAL: 42	
North NW 04-58-08-W6M	11 / 5984770 / 360291	**Recent Occurrence** PF: 5 CF: 2 TOTAL: 10	
AVERAGE ANNUAL DAILY TRAFFIC (AADT): 760 (north) & 960 (south) (Reference No. 25592, 2023)		CONTRACT MAINTENANCE AREA (CMA): 504	

SUMMARY OF SITE INSTRUMENTATION:	INSPECTED BY:
There is no instrumentation at the GP054 site. LAST READING DATE: N/A	Chris Gräpel (KCB) Courtney Mulhall (KCB) Robert Senior (TEC) Rishi Adhikari (TEC) Babatunde Awokunle (TEC)

PRIMARY SITE ISSUE: Series of debris flow locations along backslope on west side of Hwy 40:36, which have/could deposit debris onto highway causing a traffic hazard or into ditches impeding flow. Debris flow locations generally correspond to or are adjacent to water courses or smaller gullies/drainage paths down mountain side. Site is located along west valley slope of the Smoky River. This site includes former debris flow components of GP036 and GP049 sites. Since 2022, GP036 and GP049 sites are for rockfalls only.

APPROXIMATE DIMENSIONS: Corridor is approximately 4.5 km long.

DATE OF ANY REMEDIAL ACTION: Ongoing cleaning of debris flow material from highway ditch and pavement surface.

ITEM	CONDITION EXISTS		DESCRIPTION AND LOCATION	NOTICABLE CHANGE FROM LAST INSPECTION	
	YES	NO		YES	NO
Pavement Distress		X	None observed at time of 2024 inspection.		X
Slope Movement	X		Debris flow material continues to slump towards highway at some locations. Slope failure along backslope at some debris flow locations expanding laterally, parallel to highway likely due to saturation and softening of materials (e.g., at km 11.1 and 11.2).	X	
Erosion	X		Erosion along debris flow path, and gullies being eroded in some debris flow fans (e.g., at km 12.1).		X
Seepage		X	None observed at time of 2024 inspection.		X
Culvert Distress		X	No culverts observed by KCB.		X

COMMENTS

Five event sites were visited during the 2024 inspection, one at km 8.1, km 10.9, km 11.1, km 11.2, and km 12.1. Several other event sites previously observed/inspected by KCB and others along corridor, e.g., at km 8.8 and 11.6.

Last known date of debris flow occurrence (if known):

Km	8.1	8.8	10.9	11.2	11.6	12.1
Year	2017	2017	2020	2019 & 2020	2017	2017

Debris flow locations generally correspond to or are adjacent to water courses or smaller gullies/drainage paths down the mountain side. Water courses that have not generated debris flows yet will eventually generate a debris flow. Depending on the severity of rainfall and timing of the last debris flow, higher rainfall amounts could generate another debris flow from a water course that has already generated a debris flow. Additionally, with time, debris will build up in the water course that will eventually get mobilized by a runoff event, possibly smaller or larger than the last triggering event, creating another debris flow.

KCB reviewed available precipitation data recorded at Kakwa weather station (located approximately 30 km northeast of site) from 1967 to 2024. Record discontinuous before 1990, but average daily precipitation data from 1990 to 2024 is shown on Figure 4.The rainfall data indicates that the debris flows tabulated in the table above each occurred around the same time as a high-than-average rainfall events on June 9, 2017 (approximately 80 mm), June 28, 2019 (approximately 70 mm), July 1, 2020 (approximately 70 mm), and June 29, 2022 (approximately 70 mm). The last time a similar rainfall event occurred was 2009 and before that 2001. It is noted that despite a higher-than-average rainfall event on June 19, 2023 (approximately 110 mm) no debris flows were reported, except north of the site at km 13.8, indicating the debris flow channels within the current extents of the corridor are likely in the process of recharging following the debris flow events that occurred between 2017 and 2020.

Debris flow at approximately km 8.1 (Photos 1 and 2):

- Last documented debris flow occurred at this location in 2017, but there is evidence of more recent events.
- Debris fan extends from an erosion gully approximately 4 m high into the west highway ditch. Debris fan material mostly consists of sand and gravel with some cobbles.

Debris flow at approximately km 10.9 (Photos 3 and 4):

- Ponded water in north highway ditch at toe of debris flow.
- Fan is fairly well vegetated, indicating no recent debris flow activity.
- Debris flow material continues to slump slowly towards highway and is approximately 2.5 m from edge of pavement. Backslope failure is approximately 25 m wide. Slope is approximately 5 m to 8 m high.

Possible debris flow at approximately km 11.1 (Photo 5):

- Ponded water and cattails in north highway ditch at toe of debris flow.
- Fan is partially vegetated, especially the lower half, indicating no recent debris flow activity.
- Debris flow material continues to slump slowly towards highway with slope failure along backslope likely due to saturation and softening of materials. Backslope failure is approximately 50 m wide. Slope is approximately 5 m to 8 m high.

Possible debris flow at approximately km 11.2 (Photos 6 and 7):

- North highway ditch at toe of debris flow dry.
- Fan is partially vegetated, especially the lower half, indicating no recent debris flow activity.
- Debris flow material continues to slump slowly towards highway with slope failure along backslope likely due to saturation and softening of materials. Debris flow material approximately 2.5 m from edge of pavement. Backslope failure is approximately 50 m wide. Slope is approximately 5 m to 8 m high.

Debris flow at approximately km 12.1 (Photo 8):

- Debris fan is poorly vegetated with erosion gully eroded down center, indicating higher water flows at this site are possibly hindering vegetation growth.
- Debris flow deposit appears wet, and ponded water in west highway ditch at toe of debris flow.

Maintenance/Repair/Monitoring Recommendations:

- Clean ditch regularly to maintain debris flow storage volume (i.e., keep ditch as wide and deep as possible to retain material within the ditch) and reduce the potential for material reaching the highway.

- There is no debris flow related signage along corridor. Only “watch for fallen rock” signs on either side of GP036 site. Additional signage should be installed along corridor warning motorist of the debris flow risk, especially during rainfall events.
- TEC could consider a placing a net over the debris flow channel at the km 8.1 site.
- Debris flow reporting could be improved by maintaining a record of debris flows that reach the highway, including the date of event, approximate location, volume of particles, and maximum particle size. It appears that TEC may already be doing this, but a formal record could be prepared by the HMC or MCI based on e-mails to TEC and the regional geotechnical consultant.
- TEC should consider completing a study to identify, characterize, and prioritize debris flow hazards along the corridor. In July 2024, KCB submitted a proposal to TEC for phase 1 of a study to compile existing data, set up the corridor in the Geohazard Risk Prioritization System (GRiPS) platform, carry out desktop mapping and analysis to assign hazard likelihood and impact likelihood ratings to each site, and provide TEC with viewer access to GRiPS along with a summary report of findings. Estimated cost: approximately $67,000.
    - Future phases could consist of incorporating vulnerability and consequence factors, carrying out site visits to ground truth the hazard ratings, establishing extreme weather thresholds, and implementing real-time weather monitoring and alerts in GRiPS. GRiPS is an online Geographical Information System (GIS)-based tool, which KCB has developed in-house using ESRI ArcGIS Pro, to provide clients a comprehensive geohazard risk inventory.
    - Based on the available data the intensity and frequency of heavy precipitation events appears to be increasing in recent years. The study should assess the potential impacts of increased precipitation on debris flow.

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

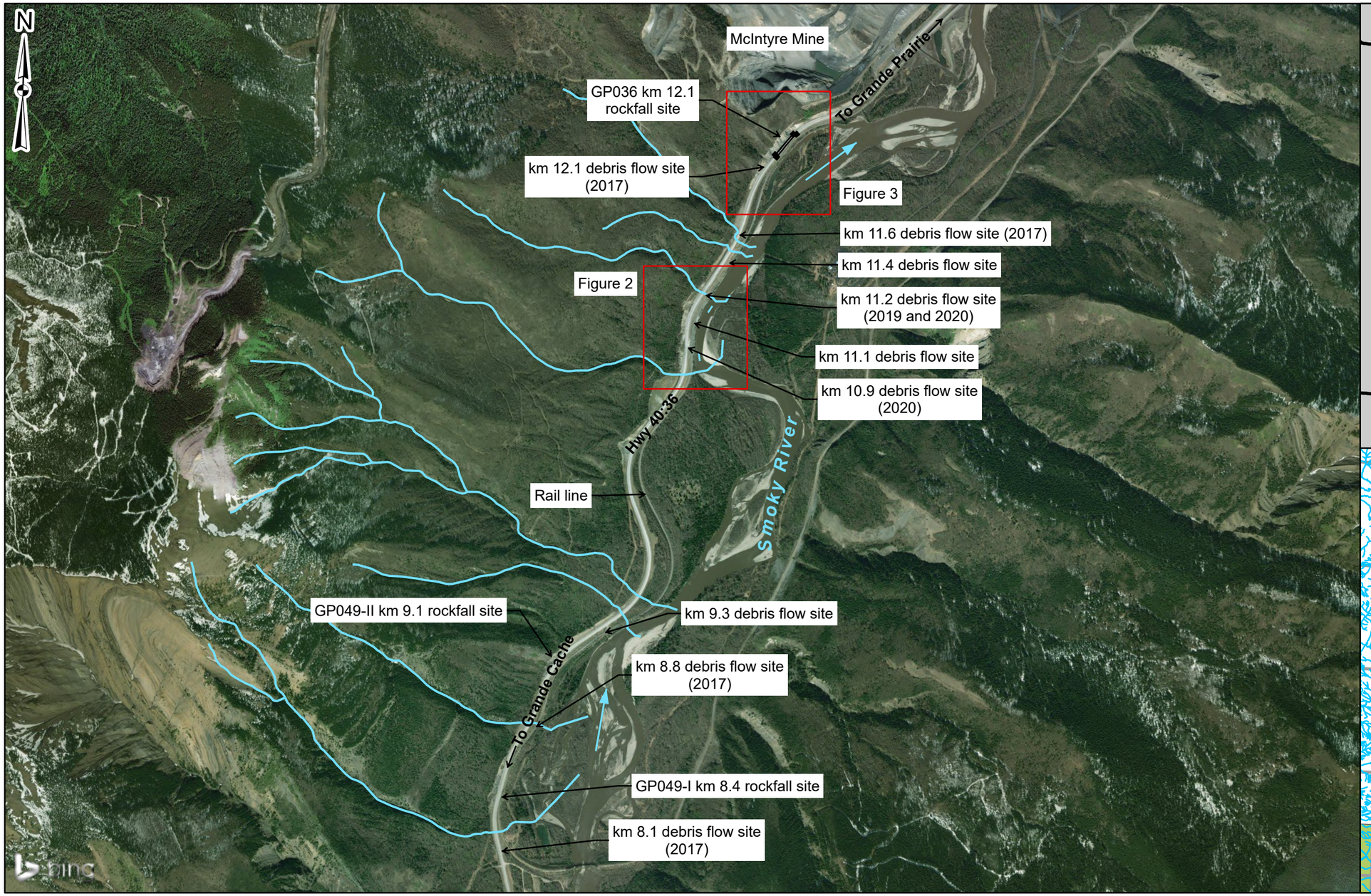
PERMIT TO PRACTICE
KLOHN CRIPPEN BERGER LTD.

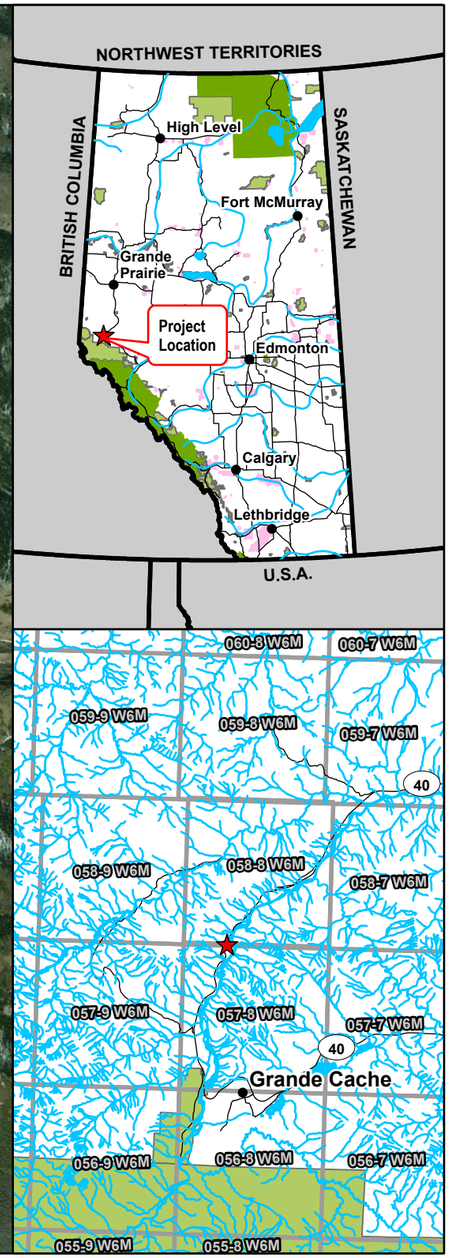
RM SIGNATURE: _____

RM APEGA ID #: 187607

DATE: 15 Oct. 2024

PERMIT NUMBER: P009196
The Association of Professional Engineers and Geoscientists of Alberta (APEGA)





Legend

- Flow Direction
- Watercourse

0 1 Kilometres

NOTES:
1. HORIZONTAL DATUM: NAD83
2. GRID ZONE: UTM ZONE 11N
3. IMAGE SOURCE: 2022 MICROSOFT CORPORATION, 2022 MAXAR CNES, DISTRIBUTION AIRBUS DS

CLIENT: Alberta

Klohn Crippen Berger

PROJECT: PEACE REGION (GRANDE PRAIRIE DISTRICT-SOUTH) GEOHAZARD RISK MANAGEMENT PROGRAM

TITLE: Site Plan
GP054- Debris Flow Corridor South of McIntyre Mine
Hwy 40:36, km 8.119 to 12.262

SCALE	PROJECT No.	FIG No.
1:21,000	A05116A01	1

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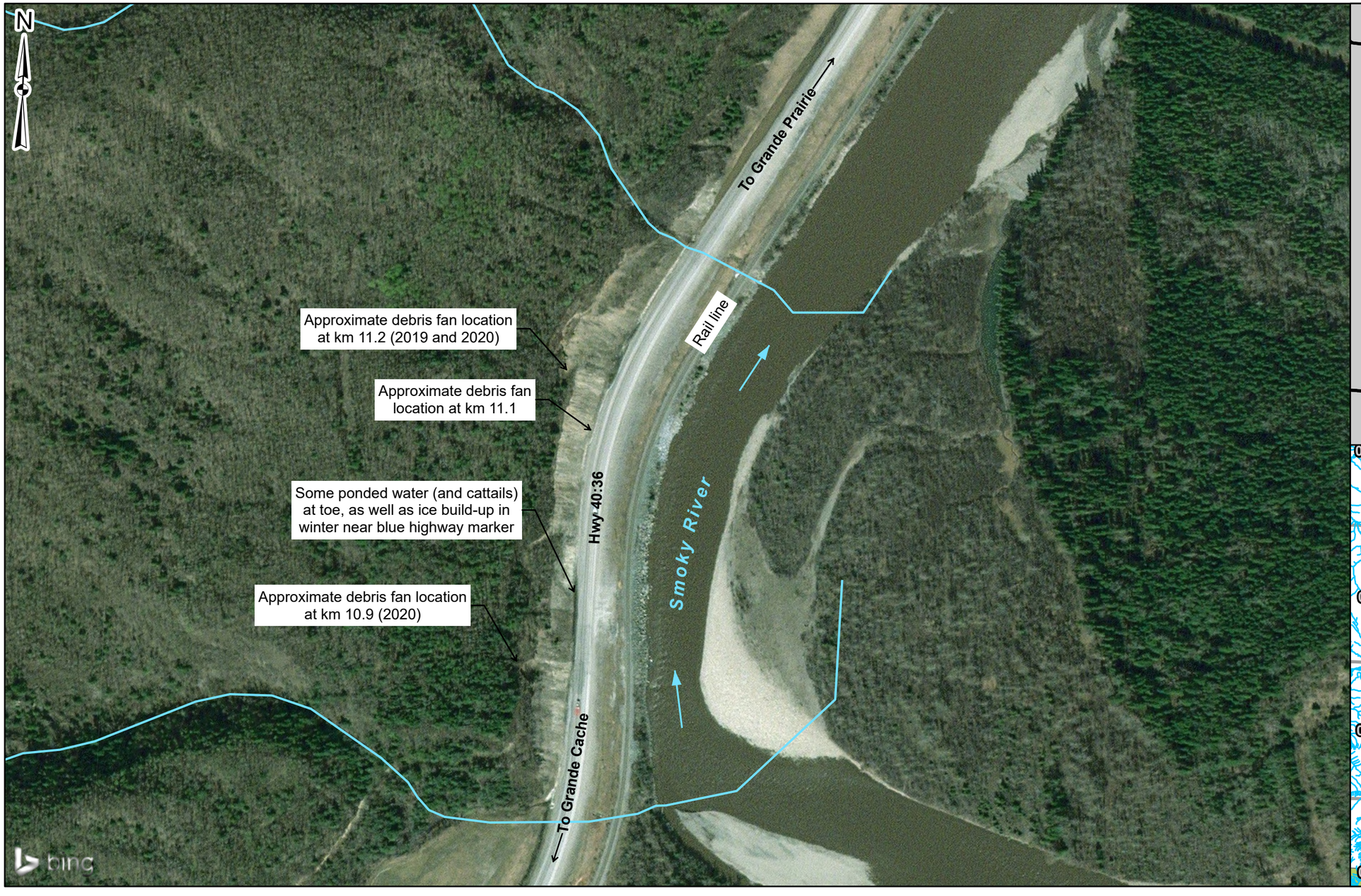

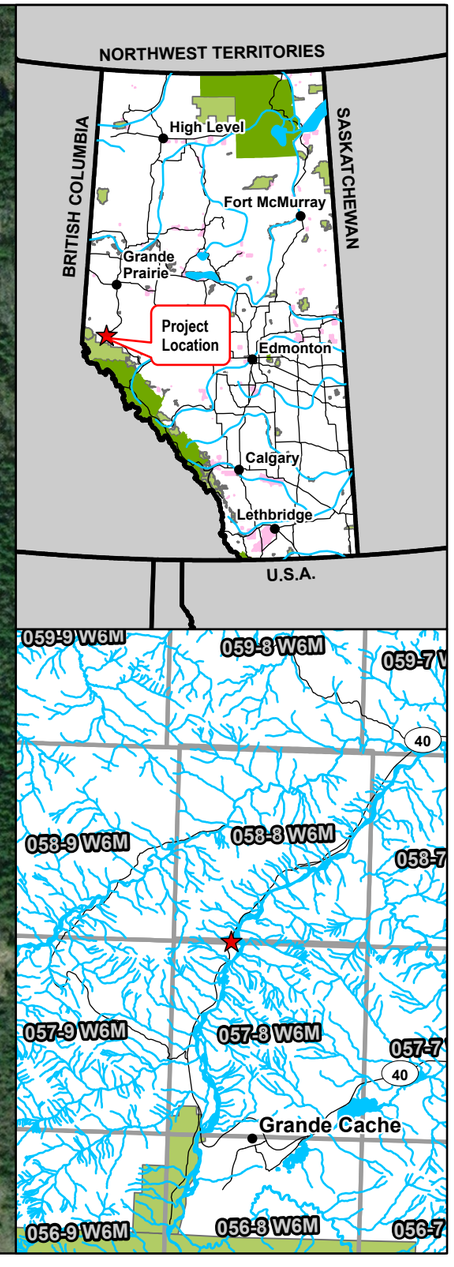

Legend

- Flow Direction
- Watercourse

0 150 Metres

NOTES:
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CLIENT: Alberta

Klohn Crippen Berger

PROJECT: PEACE REGION (GRANDE PRAIRIE DISTRICT-SOUTH) GEOHAZARD RISK MANAGEMENT PROGRAM

TITLE: Site Plan
GP054- Debris Flow Corridor South of McIntyre Mine
Hwy 40:36, km 10.9 and 11.2

SCALE	PROJECT No.	FIG No.
1:3,000	A05116A01	2

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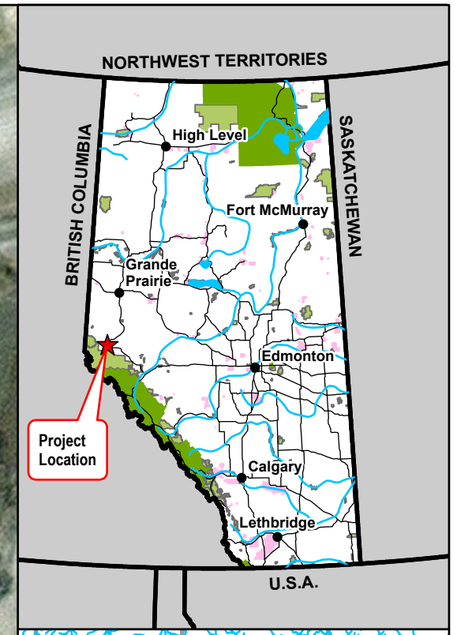

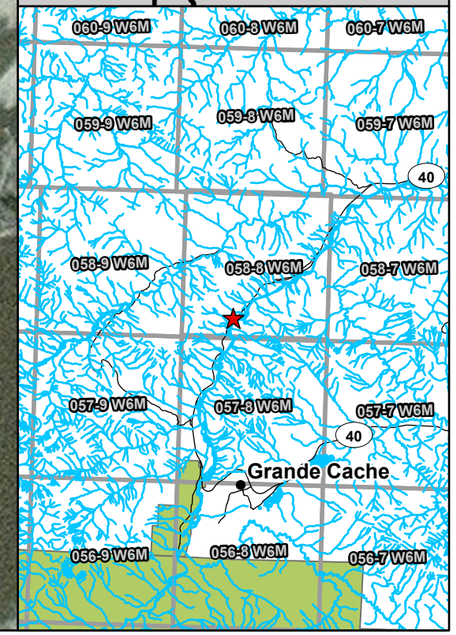

Legend

- Flow Direction
- Concrete Lock Block
- Guardrail
- Culvert

0 50 Metres

NOTES:
1. HORIZONTAL DATUM: NAD83
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CLIENT: Alberta

Klohn Crippen Berger

PROJECT: PEACE REGION (GRANDE PRAIRIE DISTRICT-SOUTH) GEOHAZARD RISK MANAGEMENT PROGRAM

TITLE: Site Plan
GP054 - Debris Flow Corridor South of McIntyre Mine
Hwy 40:36, km 12.1

SCALE	PROJECT No.	FIG No.
1:1,500	A05116A01	3

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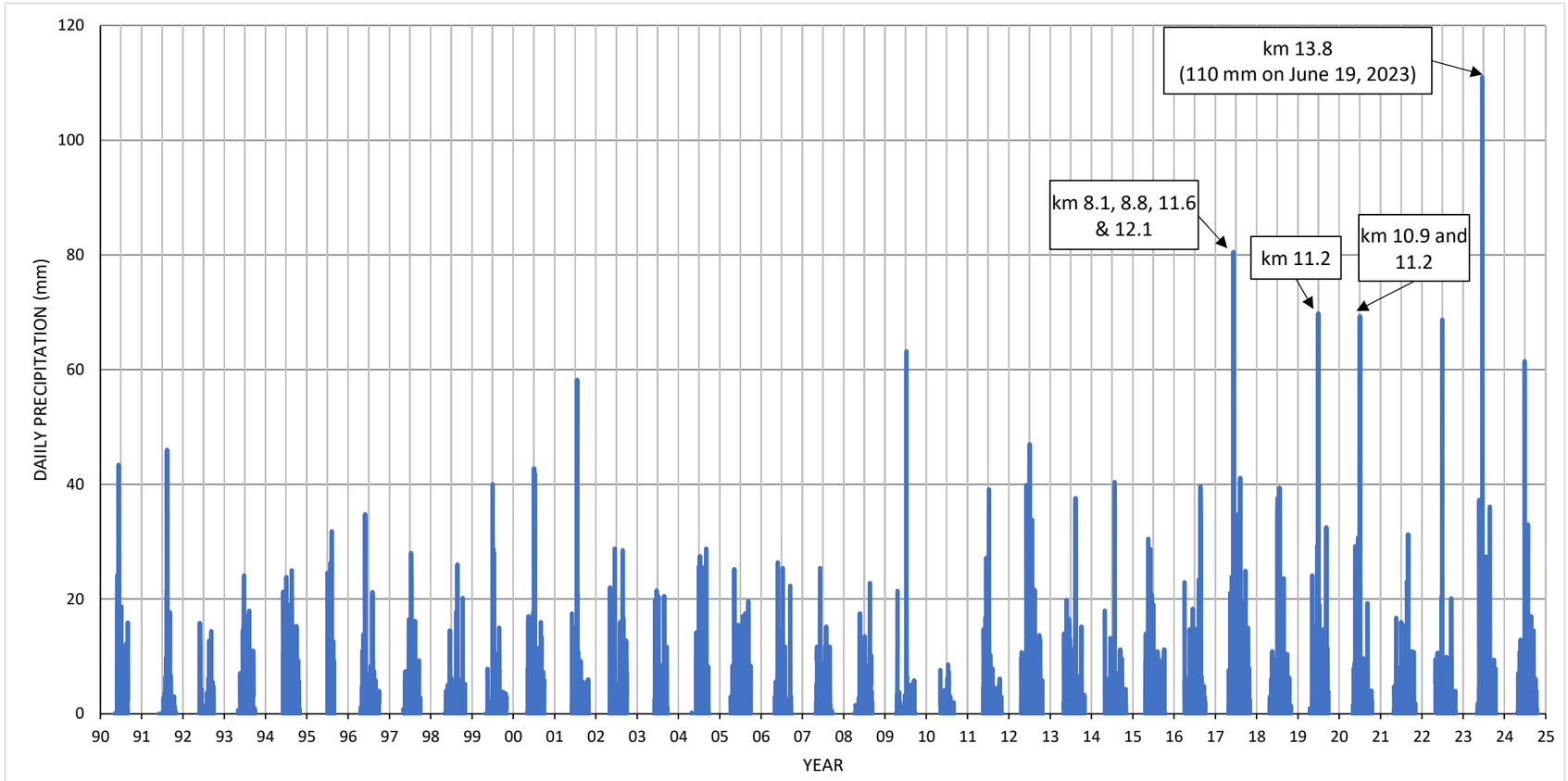

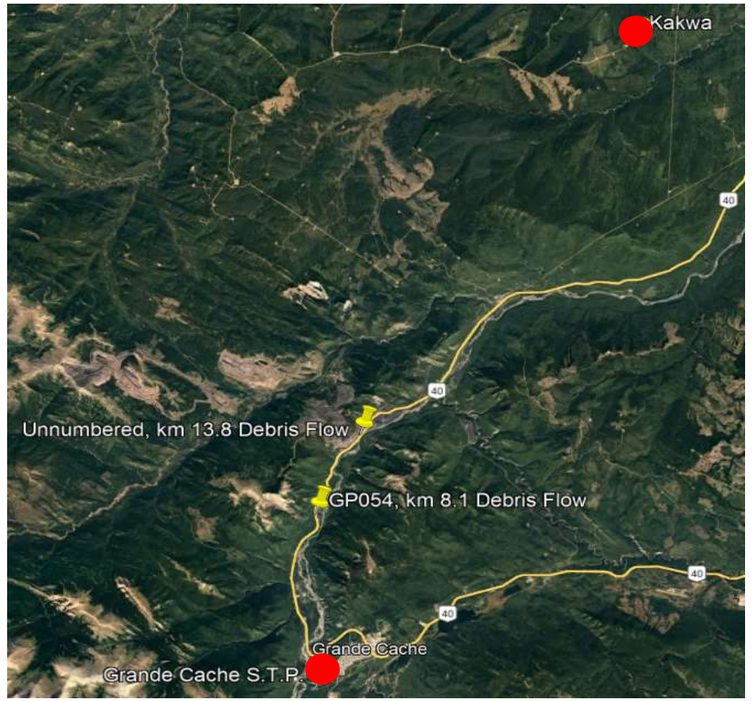

LEGEND:

- WEATHER STATION
- DEBRIS FLOW SITE
- WEATHER STATION DATA - KAKWA

NOTES:

1) DATA DOWNLOADED FROM GOVERNMENT OF CANADA (GoC) OR ALBERTA CLIMATE INFORMATION SERVICE (ACIS) WEBSITES.
2) KAKWA STATION LOCATED APPROXIMATELY 30 KM FROM SITE.
3) DATA DISCONTINIOUS BEFORE 1990 SO NOT INCLUDED. NO DATA RECORDED DURING WINTER MONTHS
5) SITE PLAN VIEW SOURCE FROM GOOGLE EARTH PRO.

CLIENT: Alberta

Klohn Crippen Berger

PROJECT: PEACE REGION (GRANDE PRAIRIE DISTRICT - SOUTH) GEOHAZARD RISK MANAGEMENT PROGRAM

TITLE: DAILY PRECIPITATION DATA GP054 DEBRIS FLOW CORRIDOR HWY 40:36

SCALE	PROJECT No.	FIG No
-	A05116A01	4

Inspection Photographs

Photo 1 **Debris flow at km 8.1 on west side of Hwy 40:36. Note debris flow fan (mostly sand and gravel with some cobbles) in highway ditch. Photo taken June 10, 2024, facing north.**

Photo 2 **Debris flow at km 8.1 on west side of Hwy 40:36. Note erosion gully is approximately 4 m high. Photo taken June 10, 2024, facing northwest.**

Photo 3 **Debris flow at km 10.9 on west side of Hwy 40:36. Photo taken June 10, 2024, facing west.**

Photo 4 **Toe of debris flow at km 10.9 on west side of Hwy 40:36. Photo taken June 10, 2024, facing southwest.**

Photo 5 **Debris flow at km 11.1 on west side of Hwy 40:36. Photo taken June 10, 2024, facing southwest.**

Photo 6 **Debris flow at km 11.2 on west side of Hwy 40:36. Photo taken June 10, 2024, facing west.**

Photo 7 **Toe of debris flow at km 11.2 on west side of Hwy 40:36. Photo taken June 10, 2024, facing south.**

Photo 8 **Debris flow at km 12.1 on west side of Hwy 40:36. Note erosion gully near middle of debris flow fan. Photo taken June 10, 2024, facing northwest.**