

October 31, 2019

Alberta Transportation
2nd Floor, 803 Manning Road NE
Calgary, Alberta
T2E 7M8

Alex Frotten, E.I.T.
Construction Engineer

Dear Mr. Frotten:

Southern Region Geohazard Risk Management Plan
Hwy 1A:02, km 12.52 to 11.91 Call-Out Report
DRAFT

1 INTRODUCTION

As part of the Geohazard Risk Management Plan (GRMP) contract for southern region, Klohn Crippen Berger Ltd. (KCB) was requested by Alberta Transportation (AT) to conduct a call-out inspection of two rock cut slopes north of Highway 1A, approximately 2 km west of Exshaw, Alberta. This location has not been previously visited under the contract.

Volker Stevin (VS) is the maintenance contractor (MC) for the site, located in Contractor Maintenance Area (CMA) 27. The sites were located using the AT Maps portal as Latitude: 51.064779 and Longitude: -115.186521 (Site A) and Latitude: 51.066749 and Longitude: -115.191075 (Site B). The Alberta Township Survey legal land descriptions are NW SEC 22 TWP 24 RGE 9 M5 (Site A) and NE SEC 21 TWP 24 RGE 9 M5 (Site B). Locations are shown on the site plan presented in Figure 1.

The site was visited on May 7, 2019 by Mr. Chris Gräpel, P.Eng., and Mr. Chris Morgan, P.Eng., of KCB. Mr. Roger Skirrow, P.Eng., Mr. Alex Frotten, E.I.T., and Mr. Nicolas Ropchan, E.I.T., of AT also attended the call-out site visit. Photographs from the site walkover are included in Appendix I.

This call-out report was prepared by KCB for AT Southern Region under Contract No. CON0017609. KCB's site observations, assessments, and recommendations for short- and long-term remediation works are presented herein.

2 BACKGROUND

The Exshaw site was identified for further review by Volker Stevin road maintenance staff due to ongoing spalling and rockfall into the ditch on the north side of the highway. The observed rockfall generally consisted of gravel to cobble sized particles, and the site was included in the 2019 GRMP tour. This location has not been previously visited.

This site consists of two adjacent rock through-cuts, excavated during highway construction. The rock slopes north of the highway are adversely oriented (bedding planes dip towards the highway), creating a rockfall risk to road users.

The rock slope south of the highway is lower in height than the north face, and bedding plane / joints are generally dipping into the face. Rockfall from the southern cut face is contained within the existing highway ditch. A rail line is located south of the southern cut slope.

At the subject site, the highway is aligned approximately southeast to northwest. Site A is located to the southeast of Site B. The two locations have been identified using the Alberta Infrastructure and Transportation Extranet AT Map portal and are referenced as:

- Site A (Hwy 1A:02, km 12.52 to km 12.34); and
- Site B (Hwy 1A:02, km 12.26 to km 11.91).

3 SITE OBSERVATIONS

The weather during the site visit was overcast and 11°C. The following observations were made during the site visit:

- Site A was estimated to be approximately 300 m long and up to 15 m high. A power line is present at the crest of the cut slope, running generally parallel to the highway. The crest of Site A cut slope was vegetated, but topsoil appeared to be thin to non-existent;
- Site B was estimated to be approximately 350 m long and up to 12 m high. The slope above the rock cut includes a soil mantle, and erosion of the soil layer was noted releasing rounded and angular boulders from the soil mass. The slope above the rock cut was vegetated;
- Bedrock at the site was evaluated as sedimentary, possibly Paleozoic middle to upper Exshaw and Banff Formation: dark grey, finely crystalline, thin-bedded limestone; dark brownish grey shale, and calcareous shale; brown argillaceous siltstone, argillaceous, and cherty skeletal calcarenitic limestone; and argillaceous dolomite. The Canmore geological map reported dip angles of between 34 and 47 degrees in bedrock north of the highway, dipping to the west and southwest (GSC, 1970a).
- Cut slopes were observed to have visible bedding planes. The rock mass was observed to contain multiple open joints, with the potential for block falls, wedge failures, and sliding

failures. Erosion of the near-surface soil mass was noted to be releasing cobbles and boulders down the cut face, particularly at Site B;

- Bedding planes and jointing on the north side of the highway were dipping towards the highway at approximately 40 degrees, which correlates with the geological map. The bedding plane orientation means that there is the potential for blocks to roll onto the highway, primarily due to wedge and sliding failures of rock blocks due to joint propagation perpendicular to bedding planes. Multiple areas of rockfall were noted at the toe of the slope, generally consisting of gravel sized particles (≤ 75 mm diameter), but with cobble to boulder-sized blocks (> 75 mm) noted in places;
- Rock slopes to the south of the highway are lower in height and dip away from the road, meaning that the potential for rockfalls onto the road is lower;
- Catchment ditches are present at both sites; however, they were shallow. The catchment width was estimated to vary between 3 m and 7 m;
- No evidence of existing rock bolting or slope reinforcement was observed at the site; and
- Bank swallows were observed, and mountain goats were present at the crest of the rock slope.

4 ASSESSMENT

The rock slopes at this site consist of bedded sedimentary rocks dipping towards the highway and with the potential for rockfall to reach the road.

The risk of blocks reaching the highway at Site A was considered to be low, due to the observed slope geometry and bedding plane dip. The risk of blocks reaching the highway at Site B was considered to be higher than at Site A due to the slope height, geometry, and weathering of the soil horizon at the slope crest.

5 RISK LEVEL

Risk levels of 11 (Site A) and 33 (Site B) were assigned in May 2019 according to the following:

$$\text{Risk Level} = \text{Probability Factor} \times \text{Consequence Factor}$$

Where the AT risk level is defined as follows:

- Probability Factor varies from 1 (inactive, very low probability of slide occurrence) to 20 (catastrophic slide occurring).
- Consequence Factor varies from 1 (minor consequence, no impact to driver safety, maintenance issue) to 10 (safety of public at risk, loss of infrastructure, rapid mobilization of large slides).

The 2019 risk level was determined using AT's risk level system for rock falls, and is presented as follows:

Site A

- Probability Factor – A rating of 11 was selected because the slope was active, with ongoing periodic rockfalls, possibly triggered by annually recurring weather conditions. The fallen rocks were generally small-sized, but there was the potential for larger-sized wedge failures, and the geometry of the slopes were such that rocks could possibly bounce onto the road.
- Consequence Factor – A rating of 1 was selected, because rockfall would probably be contained by the existing shallow ditch, if the ditch was cleaned as required to maintain capacity.

Site B

- Probability Factor – As for Site A, a rating of 11 was selected because the slope was active, with ongoing periodic rockfalls.
- Consequence Factor – A rating of 3 was selected because rockfall could damage a vehicle (e.g., flat tire, dent of body of vehicle). Rocks could bounce or roll onto the road surface but likely not with a trajectory that would pass through the windows or windshield of a passing vehicle.

The 2019 risk level was based on KCB and AT site observations, together with comments from the VS road maintenance crew for the area. This site will be revisited during the 2020 southern region GRMP spring tour, and the risk ranking reevaluated.

6 RECOMMENDATIONS

The following subsections discuss the recommended short and long-term remediation works for the subject site.

6.1 Short-Term

Recommended management options include routine inspection of the cut slopes and ongoing clearance of rockfall debris in the existing shallow to non-existent catchment ditches.

6.2 Long-Term

A photogrammetry assessment of the slopes is recommended to identify source zones, risk areas, and potential areas for anchors. Spot bolting of blocks which appear unstable or pose a wedge failure risk is recommended.

7 CLOSING

This report is an instrument of service of Klohn Crippen Berger Ltd. (KCB). The report has been prepared for the exclusive use of Alberta Transportation (Client) for the specific application to the Southern Region GRMP, and it may not be relied upon by any other party without KCB's written consent.

KCB has prepared this report in a manner consistent with the level of care, skill, and diligence ordinarily provided by members of the same profession for projects of a similar nature at the time and place the services were rendered. KCB makes no warranty, express or implied.

This is a draft report only and we solicit your review and comments within four weeks of submission. Upon issue of the final report, we request that all draft reports be destroyed or returned to Klohn Crippen Berger Ltd. This draft report should not be relied upon as a final document for design and/or construction.

We look forward to continuing a constructive and successful working partnership with Alberta Transportation. Please do not hesitate to contact the undersigned at 403.731.6859 if you have any questions, comments, or concerns regarding this report.

Yours truly,

KLOHN CRIPPEN BERGER LTD.

Chris Morgan, M.Sc., P.Eng.
Senior Geotechnical Engineer

CM:ap

Attachments

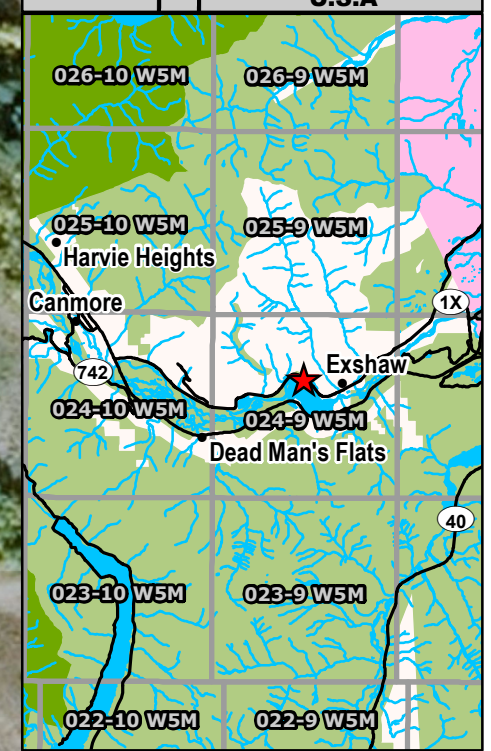
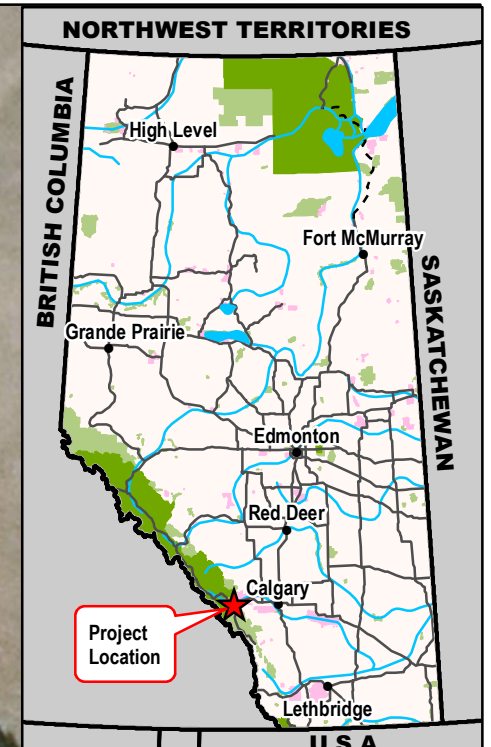
Figure
Appendix I Site Walkover Photographs

REFERENCES

GSC, 1970a: Geological Survey of Canada, 1970. "A Series Map 1265A, Geology of Canmore (east half), West of Fifth Meridian". Geological map published in 1:50,000 scale in 1970. Downloaded from Natural Resources Canada Geoscience Publications GEOSCAN portal in July 2019.

AT Maps, 2019: Government of Alberta, Alberta Transportation extranet interface portal. AT Maps web mapping solution (https://extranet.infra.gov.ab.ca/infra_portal.html#). Accessed October 2019.

FIGURE



© 2019 Microsoft Corporation © 2019 DigitalGlobe © CNES (2019) Distribution Airbus DS

Legend

— GPS Track (May 7, 2019)



Time: 15:21:09 PM
 Date: June 24, 2019
 File: Z:\A\EDMA05115A03\ABT Southern Region GRMP\400 Drawings\2019\2. Section BIMXD\Exshaw_191004.mxd

NOTES: 1. HORIZONTAL DATUM: NAD83 2. GRID ZONE: UTM Zone 11N 3. IMAGE SOURCE: Bing Maps 2019, Microsoft Corporation	CLIENT 	PROJECT SOUTHERN REGION GEOHAZARD RISK MANAGEMENT PROGRAM
		TITLE Site Plan Highway 1A, Exshaw Hwy 1A:02, km 12.24
	SCALE 1:2,000	PROJECT No. A05115A03
		FIG No. 1

APPENDIX I

Site Walkover Photographs

Photo 1 Sites A & B. The rock slopes north of the highway have adverse bedding planes and potential for rock fall onto the road. Photo taken facing northwest on May 7, 2019.



Photo 2 Southeastern section of Site A (north of the highway). Mountain goat at slope crest (red circle). Photo was taken facing northeast on May 7, 2019.



Photo 3 Central section of Site A (north of the highway). Rock catchment ditch is shallow. Photo taken facing east on May 7, 2019.



Photo 4 Northwestern section of Site A (north of the highway). Photo was taken facing north on May 7, 2019.



Photo 5 Rockfall at the toe of Site A rock slope (north of the highway). Photo was taken facing west on May 7, 2019.



Photo 6 Near vertical rock cut slope at Site A (south of the highway). Areas of historic block failure are shown by red circles. Photo taken facing west on May 7, 2019.



Photo 7 Rockfall towards the highway from adversely dipping bedrock at Site B. Photo taken facing southeast on May 7, 2019.

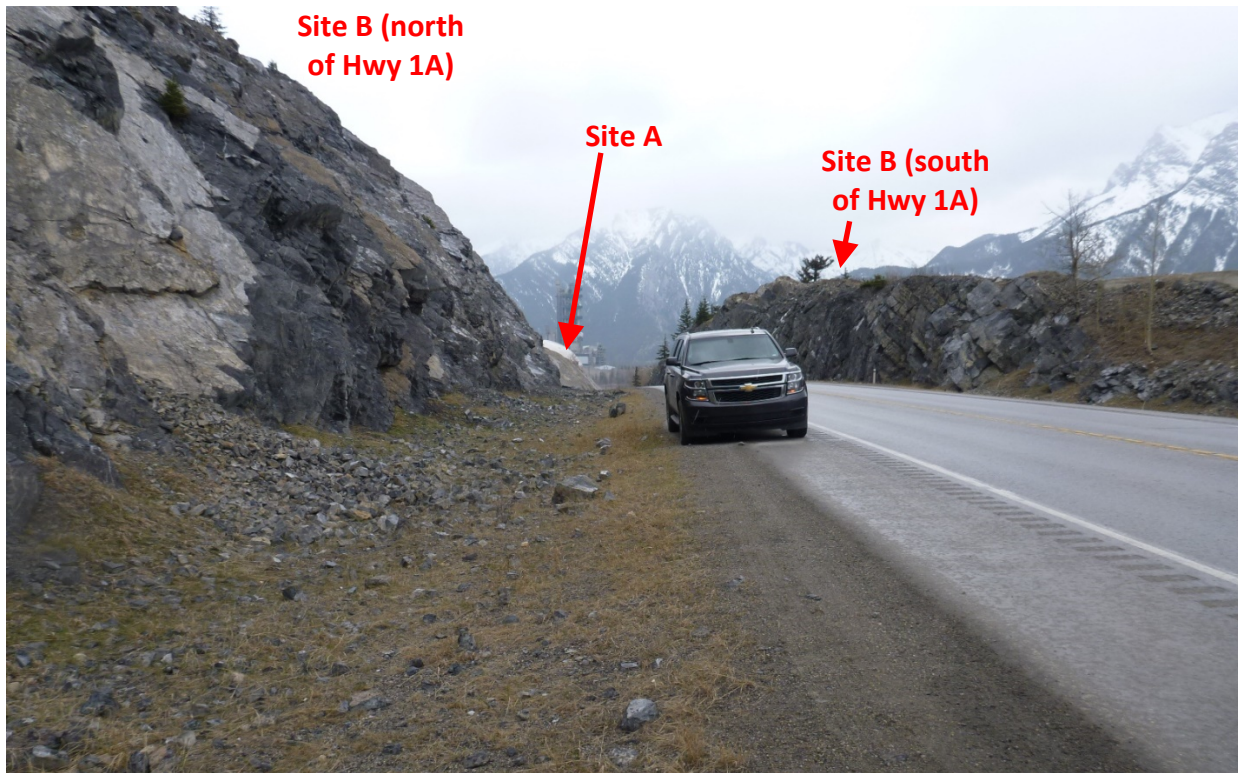


Photo 8 Rockfall in catchment ditch at Site B. Photo taken facing east on May 7, 2019.



Photo 9 Adversely dipping bedrock at Site B. Photo taken facing north on May 7, 2019.



Photo 10 Northwestern section of Site B. Note variation in bedding plane angles. Photo taken facing northwest on May 7, 2019.



Photo 11 **Rock cut south of the highway at Site B. Photo taken facing east on May 7, 2019.**

