



THURBER ENGINEERING LTD.

MEMORANDUM

To: Kevin Healy, P.Eng.
Fine Peace Holdings (Canada) Ltd.
c/o CREUS Engineering Ltd.

Date: November 17, 2021

From: Jason Pellett, P.Eng. / P.Geo.
(Reviewed by David Regehr, P.Eng.)

File: 21452.110

OVERVIEW GEOHAZARD ASSESSMENT - FURRY CREEK LANDS PRELIMINARY GEOTECHNICAL REVIEW OF PROPOSED SCHOOL SITES

Per your request, this memorandum presents our preliminary geotechnical comments and recommendations regarding the two proposed school sites at Furry Creek based on the results of a recent site reconnaissance and desktop geohazard assessment.

It is a condition of this memo that Thurber's performance of its professional services is subject to the attached Statement of Limitations and Conditions.

1. BACKGROUND

We understand from CREUS that two potential locations for a school have been identified at Furry Creek; these are referred to herein as the north site and the south site. The locations of these sites are shown on Figures 1 and 2. Both sites are located outside of the Furry Creek lands presently owned by Fine Peace.

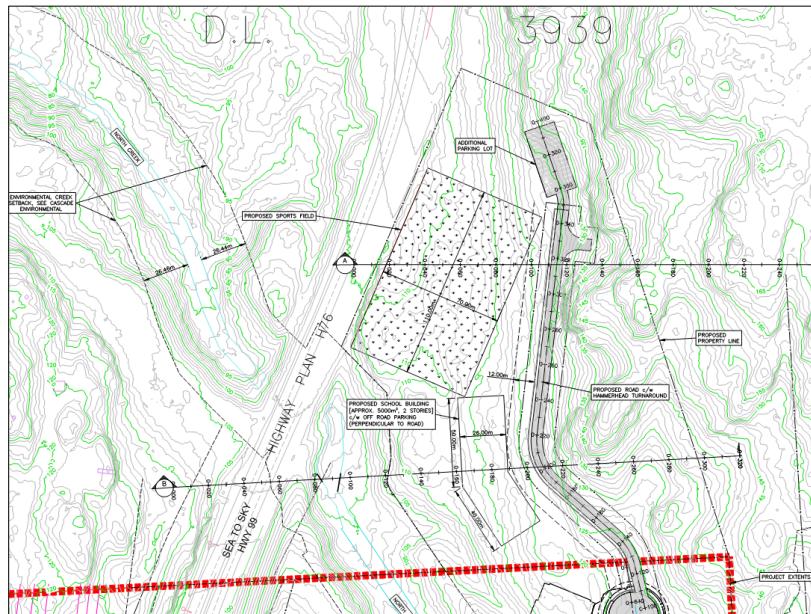


Figure 1. North Site (modified from SCH-KEY-1 File No. 14305 Rev 2, provided by CREUS). Boundary of Furry Creek Lands indicated by red dashed line.

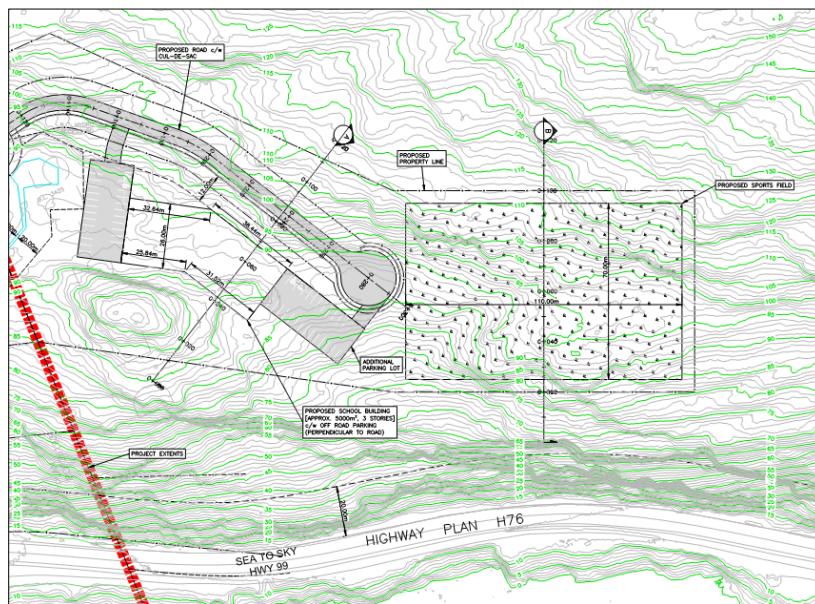


Figure 2. South Site (modified from SCH-KEY-2 File No. 14305 Rev 2, provided by CREUS). Boundary of Furry Creek lands indicated by red dashed line.

The north site is located to the north of the Furry Creek lands in a forested area bordered by Highway 99 to the west and by North Creek to the south. Sketch SCH-KEY-1 provided by CREUS shows an approx. 5,000 m² two-storey school building plus an adjacent sports field and access road.

The south site is located to the south of the Furry Creek lands in a forested area bordered by Highway 99 to the west and by the Porteau Bluff / Benchlands neighbourhoods to the north. Sketch SCH-KEY-2 provided by CREUS shows an approx. 5,000 m² three-storey school building plus an adjacent sports field and access road.

2. SITE RECONNAISSANCE

Thurber completed a reconnaissance of both proposed school sites on the morning of Wednesday, October 20, 2021. Our field work was limited to the footprint area of each site and did not include areas upslope of the proposed school infrastructure. Key observations are summarized below.

2.1 North Site

The north site was much more moderately sloping as compared to the south. Bedrock exposures were generally limited to eastern portion of the site, east of the proposed driveway, and appeared to be somewhat limited in height. The exposed bedrock appeared to be generally massive with very wide to extremely wide joint spacing. Further, the bedrock was rounded and showed evidence of being glacially scoured on the surface. Most of the site appeared to have been previously logged and there was very little undergrowth below the tree canopy. Some surface water was noted flowing along a minor topographic low near the north/south midpoint of the site.



2.2 South Site

The south site had steep, bedrock-controlled topography with many exposed bedrock faces and in general has much more rugged terrain compared to the North Site. The bedrock has a wide to very wide jointed structure with prominent joint sets comprising near vertical joints as well as joints dipping toward the west (i.e., daylighting out of the slope). This is similar to the sheet jointing pattern seen in the bluffs along Highway 99 below the site. There were very large boulders covering much of the ground surface below the bedrock faces. Vegetation comprised very mature trees, particularly on the southern portion of the site.

3. GEOHAZARD ASSESSMENT

A preliminary desktop assessment of upslope debris flow and rock fall hazards was also completed for the north site based on the results of the site reconnaissance, Thurber's recent aerial reconnaissance of the Furry Creek area in September 2021, and our previous geohazard studies of the Furry Creek lands. The intent of this assessment was to assess potential geohazard risks to the north site in terms of the overall suitability / feasibility of the site from a geotechnical perspective and the anticipated scope of mitigation measures required for development.

A similar desktop assessment was not completed for the south site as our site observations indicate that it is less favourable for a school than the north site from a geotechnical perspective.

3.1 Debris Flow Runout Analysis

As noted in previous studies by Thurber for the Furry Creek area, North Creek may be susceptible to debris flow hazards. A major study completed by Thurber for the Ministry of Transportation and Infrastructure (MoTI) in the early 1980s recommended a design debris flow volume of 5,000 m³ for North Creek based on a detailed aerial and ground reconnaissance of the creek completed at that time. Based on the size and general topography of the North Creek watershed visible from the available LiDAR imagery, and our recent observations of this area via helicopter, the 5,000 m³ design volume estimate appears reasonable for the purposes of this study.

The runout path of a hypothetical 5,000 m³ debris flow on North Creek was analysed using the computer program RAMMS based on the 2020 LiDAR data provided by CREUS; the results of the analysis are shown on Figure 3. The analysis was completed using typical material properties (i.e., rheological parameters) for debris flows in coastal BC based on the Voellmy rheology. Further details of the analysis, including the assigned material properties and input parameters, are available upon request.

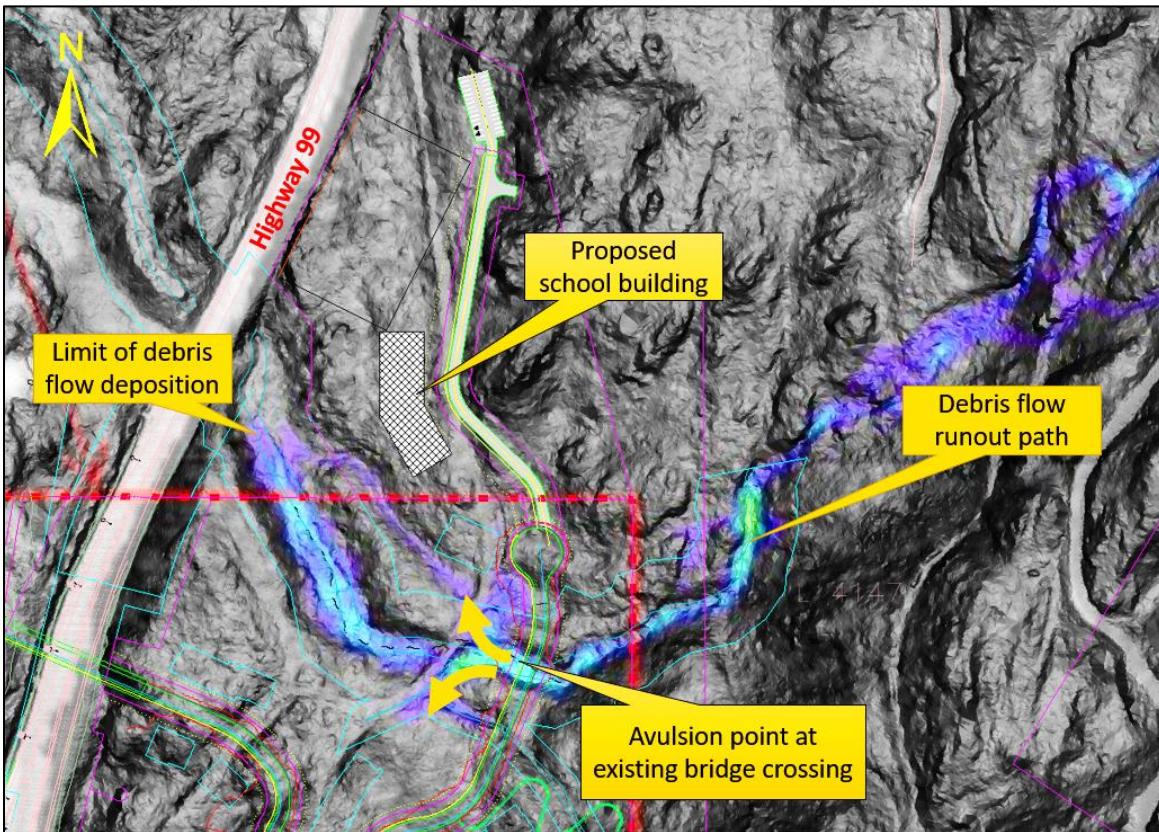


Figure 3. Plan view of the north site showing the runout path (indicated by coloured shading) of a hypothetical 5,000 m³ debris flow on North Creek.

From Figure 3, it can be seen that the north site is not impacted by the modelled 5,000 m³ debris flow, although there is some avulsion of material out of the channel at the existing bridge crossing. Implications for development of this area are discussed in Section 4.1.

3.2 Rock Fall Runout Analysis

Potential rock fall paths upslope of the north site were evaluated using the computer program RocPro3D based on the 2020 LiDAR data provided by CREUS and the rock block sizes observed from the aerial reconnaissance; the results of the analysis are shown on Figure 4. The analysis was completed using typical material properties (i.e., restitution coefficients) based on the site conditions (soil cover, vegetation, etc.) observed by Thurber. Further details of the analysis, including the assigned material properties and input parameters, are available upon request.

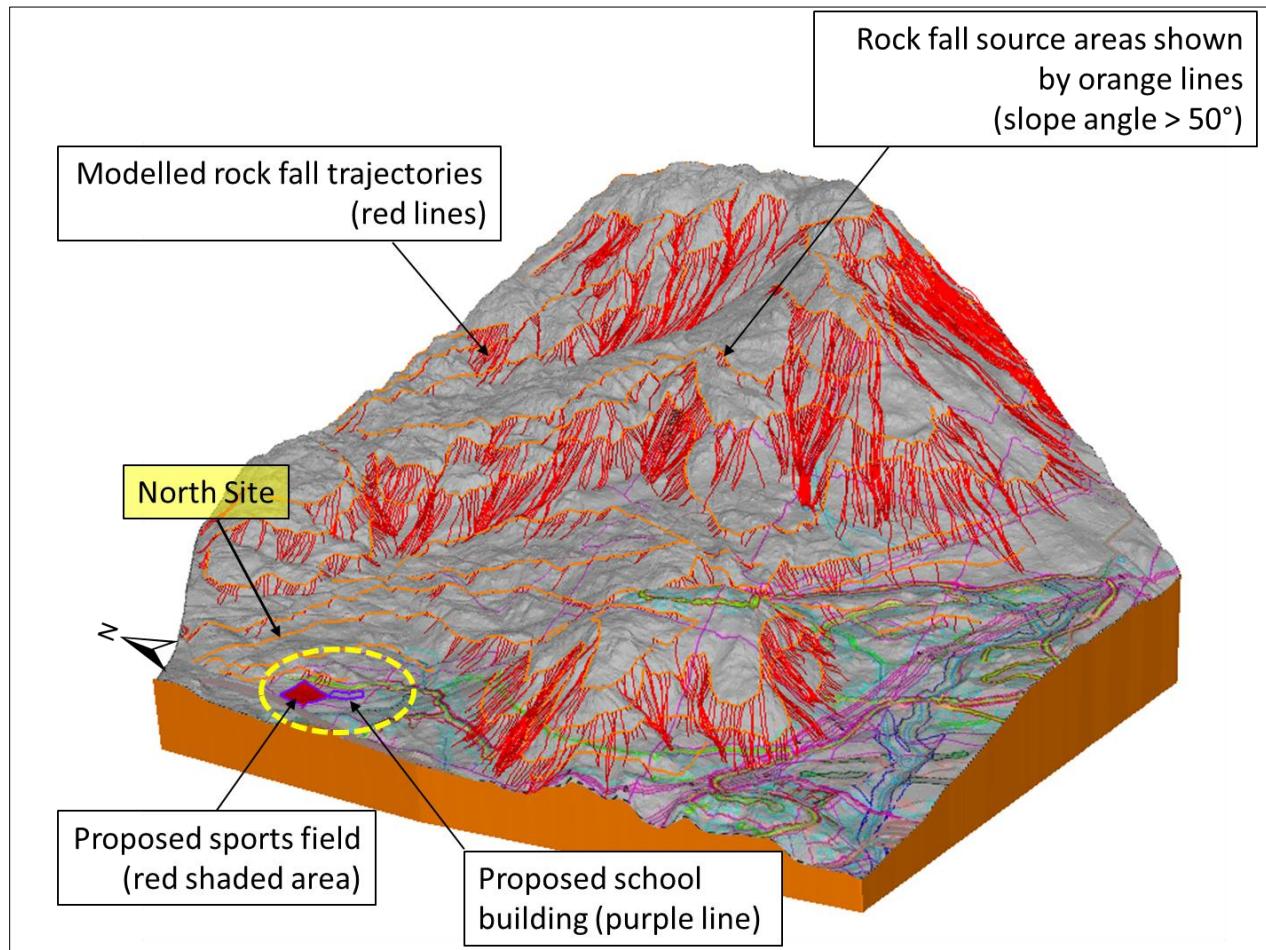


Figure 4. Isometric view of the north site showing the modelled rock fall paths (trajectories) from upslope. Red lines are rock fall paths; school site is circled in yellow.

From Figure 4, it can be seen that the north site is not impacted by rock falls sourced from the steep mountain ridges high upslope, although the proposed access road could be impacted by localized rock falls from the adjacent bluffs. Implications for development of this area are discussed in Section 4.1.

4. DISCUSSION AND RECOMMENDATIONS

4.1 North Site

Based on the site reconnaissance, it is our opinion that the north site would be preferable for a school from a geotechnical perspective. It is further expected that this site could be developed using industry-standard design and construction techniques.

The debris flow and rock fall runout analyses show that the north site is unlikely to be affected by these hazards, although there could be localized impacts to the access road and bridge crossing



over North Creek. If this site is to be carried forward for development, further geotechnical studies should be completed to confirm mitigation measures for detailed design. At the present time, we expect the mitigation measures would entail the following:

1. Localized scaling, meshing and/or bolting of the rock bluffs above the access road and parking lot to secure any loose rock blocks, carried out as part of roadway construction.
2. Removal of the existing bridge crossing over North Creek and reinstatement / reshaping of the creek channel to safely convey water and debris downstream of this area.
3. Designing the new bridge crossing over North Creek with sufficient freeboard and armoring to pass the design debris flow. Localized armoring of the right (north) bank of North Creek downstream of the bridge may also be required depending on the final siting and configuration of the school building and sports field.

4.2 South Site

Further detailed geotechnical studies would be required to confirm the feasibility of the south site for a school. Based on the site conditions observed by Thurber, potentially significant rock slope stabilization measures could be required to render this area safe for school development.

5. CLOSURE

We trust the above provides the information you require at this time. If you have any questions regarding this memo, please contact either of the undersigned.

Yours truly,
Thurber Engineering Ltd.
David Regehr, M.Eng., P.Eng.
Review Principal

Thurber Engineering Ltd.
Permit to Practice #1001319

Jason Pellett, M.Eng., P.Eng./P.Geo.
Geotechnical Engineer

Attachments:

- Statement of Limitations and Conditions (1 Page)



STATEMENT OF LIMITATIONS AND CONDITIONS

1. STANDARD OF CARE

This Report has been prepared in accordance with generally accepted engineering or environmental consulting practices in the applicable jurisdiction. No other warranty, expressed or implied, is intended or made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report, which is of a summary nature and is not intended to stand alone without reference to the instructions given to Thurber by the Client, communications between Thurber and the Client, and any other reports, proposals or documents prepared by Thurber for the Client relative to the specific site described herein, all of which together constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. THURBER IS NOT RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to Thurber by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the Report, subject to the limitations provided herein, are only valid to the extent that the Report expressly addresses proposed development, design objectives and purposes, and then only to the extent that there has been no material alteration to or variation from any of the said descriptions provided to Thurber, unless Thurber is specifically requested by the Client to review and revise the Report in light of such alteration or variation.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT THURBER'S WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS THURBER MAY EXPRESSLY APPROVE. Ownership in and copyright for the contents of the Report belong to Thurber. Any use which a third party makes of the Report, is the sole responsibility of such third party. Thurber accepts no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without Thurber's express written permission.

5. INTERPRETATION OF THE REPORT

- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and the Report is delivered subject to the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. If special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to Thurber. Thurber has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, Thurber does not accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by Thurber. Thurber is entitled to rely on such representations, information and instructions and is not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.
- c) Design Services: The Report may form part of design and construction documents for information purposes even though it may have been issued prior to final design being completed. Thurber should be retained to review final design, project plans and related documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the Report's recommendations and the final design detailed in the contract documents should be reported to Thurber immediately so that Thurber can address potential conflicts.
- d) Construction Services: During construction Thurber should be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions in order to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RELEASE OF POLLUTANTS OR HAZARDOUS SUBSTANCES

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause the escape, release or dispersal of those substances. Thurber shall have no liability to the Client under any circumstances, for the escape, release or dispersal of pollutants or hazardous substances, unless such pollutants or hazardous substances have been specifically and accurately identified to Thurber by the Client prior to the commencement of Thurber's professional services.

7. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on Thurber's interpretation of conditions revealed through limited investigation conducted within a defined scope of services. Thurber does not accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.