



THURBER ENGINEERING LTD.



July 14, 2017

File: 19037

Freedom Construction Ltd.
46492 Valleyview Road
Chilliwack, BC
V2R 5M8

Attention: Josh Hall

**7138 MARBLE HILL ROAD, CHILLIWACK, BC
GEOTECHNICAL REPORT**

Dear Josh:

Thurber Engineering Ltd. has completed a geotechnical assessment of the property at 7138 Marble Hill Road in Chilliwack, BC. We understand that Freedom Construction Ltd. plans to subdivide the property. This report describes our understanding of the project, summarizes our findings and provides a geotechnical assessment and recommendations for the proposed subdivision.

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

1. PROJECT AND SITE DESCRIPTION

The property at 7138 Marble Hill Road in Chilliwack, BC is located on the Eastern Hillside. The property comprises two separate parcels: the southern parcel is adjacent to Marble Hill Road, whereas the eastern parcel is adjacent to Ramsay Place (see Figure 1). Freedom Construction obtained Preliminary Lot Approval (PLA) for subdivision of the eastern parcel into three lots, and rezoning of the southern parcel in a May 2, 2017 letter from the City of Chilliwack (City). We understand that the eastern portion of the southern parcel is proposed to be rezoned to Suburban Residential Zone and that the western portion of the southern parcel is proposed to be rezoned to Limited Use Reserve to preserve the undevelopable area in a natural state. This proposed division largely follows the unnamed tributary that runs approximately north-south through the southern parcel. Freedom Construction requested a geotechnical assessment of the property for subdivision approval, in accordance with the geotechnical requirements stated in the PLA letter from the City.

According to topographic maps from the City, the southern parcel slopes downward to the north from a high of about El. 204 m near Marble Hill Road to about El. 188 m. The eastern parcel slopes downward to the northwest from a high of about El. 195 m to about El. 186 m. The southwestern corner of the parcel is adjacent to Marble Hill Creek and designated a riparian area. Further upstream, a separate tributary of Marble Hill Creek flows to the east of the southern parcel. Several small unnamed tributaries run through the western portion of the southern parcel, which is designated riparian area. The property is subject to Development Permit (DP) Areas Nos. 2 and 6 of the City. Riparian areas noted on Figure 1 were taken from the PLA letter.

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2. HISTORIC INFORMATION

Surficial Geology Map 1487A indicates that the subsurface soils of both parcels comprise eolian sediments of sand, silt, and silt loam up to 3 m thick, underlain by sandy loamy till and bedrock.

Thurber summarized the results of a geotechnical investigation of the property for Baker Newby LLP in our June 3, 2013 report. Three test pits were completed on the southern parcel and two test pits were completed on the eastern parcel. The pits encountered mainly compact to dense sand or sand and gravel to 4 m depth. In one test pit on the southern parcel silt units were encountered to 0.3 m depth and between 0.9 m and 2.0 m depth. Seepage was encountered in all test pits between 1.0 m and 1.7 m depth.

A review of historical air photos from 1949 to 1996 revealed some development was present in the area since at least 1949. We did not observe any indication of landslide activity around the property on the air photos.

Klohn Crippen Berger Ltd. (KCB) provided an updated landslide map in their report titled “Panorama subdivision – Marble Hill, Chilliwack BC, Updated Landslide Map” dated August 3, 2016. According to the landslide map, the property does not fall within an area subject to (potential) landslide activity.

3. SITE RECONNAISSANCE

Paul Slangen, E.I.T. of Thurber conducted a site reconnaissance on July 6, 2017. The reconnaissance concentrated on the portions of the properties proposed for residential development, that is the eastern portion of the southern parcel and the eastern parcel (see Figure 1). Reconnaissance of the private properties directly uphill of the parcels was limited to visual observations from the road.

The eastern parcel slopes gently downward to the northwest at about 8° and is largely covered by grass, shrubs and some trees (see Figure 2 and 3). A rock stack wall comprising two tiers each about 0.7 m high and separated by a 3 m wide bench accommodates the grade difference between the gravel road and the western boundary of the parcel (see Figure 4). The southwestern corner of the parcel comprises a steep river bank down to Marble Hill Creek (see Figure 5). Curved tree trunks and seepage coming from the bank were observed at way point WP#4, indicating slow ground movements (i.e. soil creep). The area uphill from the eastern parcel, east of Ramsay Place comprises a few residential developments in a densely forested area; it was not traversed by foot.

The eastern portion of the southern parcel slopes gently downward to the north at about 9° and is largely covered by grass, shrubs and trees (see Figure 6). Groundwater seepage was observed at several locations on the ground surface in the slightly steeper northern portion of the site at WP#9 and WP#10. The densely forested western portion of the southern parcel (see Figure 7) comprises a riparian area, which was not traversed due to bear sightings.

4. GEOTECHNICAL ASSESSMENT

In general, the portions of the eastern and southern parcels that do not comprise riparian area appear suitable for residential development from a geotechnical engineering perspective. Considering the observed seepage from the terrain and in the test holes, basements are not recommended with the current site grades. Comments regarding specific geotechnical engineering issues required to be addressed for DP Areas 2 and 6 are discussed in the following sections.

4.1 Geotechnical Hazards

Based on a review of historical data and our site reconnaissance, landslide activity on the subject property appears limited to local soil creep ground movements near the creek banks. We recommend that all permanent buildings are located beyond a setback line sloping 2H:1V from the toe of the creek banks. We further recommend a permanent building setback line of 2H:1V from the toe of the lower tier of the rock stack wall at the western boundary of the eastern parcel.

4.2 Pavement Design

The pavement design for the half-road frontage improvements on Ramsay Place shall be completed in accordance with the City's Standard Drawing DR-6 and must comprise the following:

- Minimum 35 mm thick asphalt surface course, over
- Minimum 40 mm thick asphalt base course, over
- Minimum 100 mm thick 20 mm minus crush base, compacted to at least 95% Modified Proctor maximum dry density (MPMDD), over
- Minimum 300 mm thick 75 mm minus gravel subbase, compacted to at least 95% MPMDD

The dense sand and gravel is a suitable subgrade for the pavement structure, provided it is clear of organics and any loose or wet material is removed and replaced with compacted gravel subbase. The subgrade should be inspected by Thurber before pavement construction.

4.3 Soil Infiltration Rates

Soil infiltration rates are based on typical values for the soils encountered on the property, which range from sand and gravel to silt. For preliminary storm retention design, soil infiltration rates ranging from 10^{-9} m/s to 10^{-3} m/s should be used.

4.4 Soil Volume Estimates

We understand that Freedom Construction currently do not have any building plans for the development. As such, we are not able to provide an estimate of soil volumes transported to or from the site. Further, if soil volume estimates are required, we recommend that they are provided by the Civil Engineer who will be responsible for site grading.

5. CLOSURE

It is our opinion that the site is suitable for subdivision from a geotechnical perspective.

We trust that this letter is sufficient for your needs. Should you require clarification of any item or additional information, please contact us at your convenience.

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



Paul Slangen, E.I.T.
Project Engineer

Attachment: Statement of Limitations and Conditions
Figures 1 to 7



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.

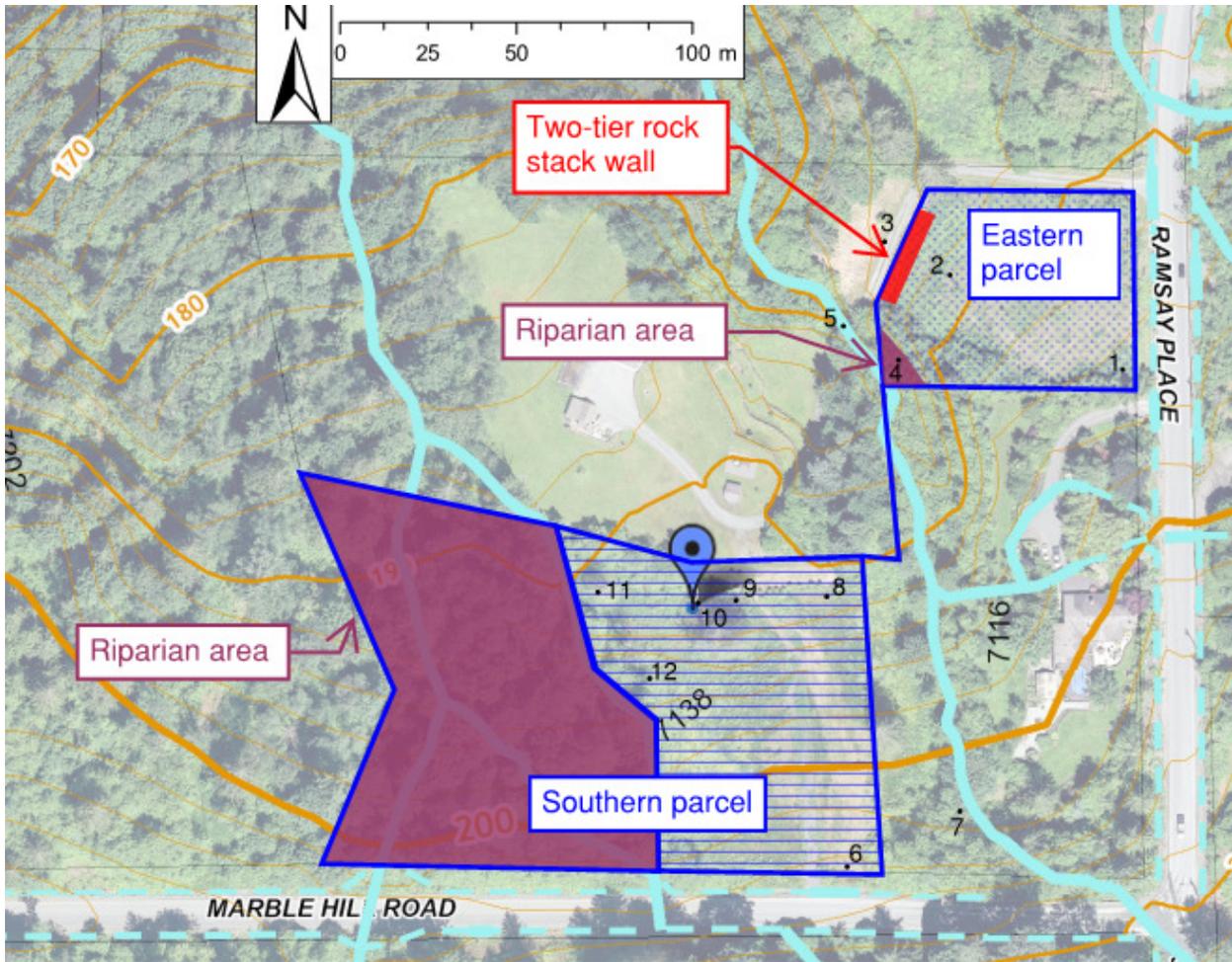


Figure 1 – Project area, including way points WP Nos. 1 to 12.



Figure 2 – WP#1 looking west (10:12AM)



Figure 3 – WP#2 looking east (10:16AM)



Figure 4 – WP#3 looking east-north-east (10:21AM)



Figure 5 – WP#5 looking east (10:35AM)



Figure 6 – WP#6 looking north (10:54AM)



Figure 7 – WP#12 looking west (11:14AM)