

To: CAO for the Electoral Area Services Committee

Date: 2019-03-12

From: Andrea Antifaeff, Planner I

File No: 9600-25-2019-02

Subject: Site-Specific Exemption Application 2019-02 for the construction of two cabins at Camp Luther Retreat Centre, 9311 Shook Road, Area "G"

RECOMMENDATION

THAT the Fraser Valley Regional District Board refuse the Site Specific Exemption application to allow the construction of two cabins at an elevation 1.95 m (6.4 feet) lower than the 9.3m flood construction level (FCL) required at Camp Luther Retreat Centre, 9311 Shook Road.

STRATEGIC AREA(S) OF FOCUS

Support Healthy & Sustainable Community
Provide Responsive & Effective Public Services

PRIORITIES

Priority #3 Flood Protection & Management

BACKGROUND

Proposal Details

The owners of the subject property have applied for a site specific exemption under Section 9(a)(ii) of the *Fraser Valley Regional District Floodplain Management Bylaw 0681, 2005* to allow for two new cabins to be constructed at an elevation of 7.35 m GSC which is 1.95 m GSC (6.4 feet) lower than the 9.3m flood construction level (FCL) required under Section 6(a) of Bylaw 0681.

The applicant has submitted two building permit applications to construct two new cabins – Cabin 12 (BP014362) and Cabin 13 (BP014363) at Camp Luther Retreat Centre, 9311 Shook Road. The cabins will be used for overnight accommodations available year-round. The applicant advises that the reasons for the exemption is to allow for the replacement of two old cabins at the same flood construction level as other cabins to maintain continuity with the other cabins and buildings located nearby on the subject property. Site plan attached as Schedule "A".

PROPERTY DETAILS	
Electoral Area	G
Address	9311 Shook Road
PID	000-826-936

Folio	775.02143.100		
Lot Size	6.74 acres		
Owner	Camp Luther Association	Agent	n/a
Current Zoning	Civic Assembly (P-1)	Proposed Zoning	No Change
Current OCP	Institutional (I)	Proposed OCP	No Change
Current Use	Camp and Retreat Centre	Proposed Use	No Change (2 new cabins)
Development Permit Areas	DPA 2-G (RAR)		
Hazards	Floodplain		
Agricultural Land Reserve	No		

ADJACENT ZONING & LAND USES

North	^	Tourist Campsite (TC), Swans Point Resort (RV)
East	>	Rural 3 (R-3), Single Family Homes
West	<	Rural 4 (R-4), Foreshore / Hatzic Lake
South	v	Rural 3 (R-3), Green Acres Mobile Home Park

NEIGHBOURHOOD MAP



PROPERTY MAP



DISCUSSION

Land Use

The subject property is located at 9311 Shook Road and is approximately 6.74 acres in size. The property is zoned Civic Assembly (P-1) under "*Dewdney-Alouette Regional District Land Use and Subdivision Regulation Bylaw No. 559, 1992*". The property since the 1960's has been used as a camp and retreat centre and surrounding lots contain residential uses.

Fraser River Floodplain

Dewdney Dike System

The property is located on Hatzic Island which is within the 1:200 year floodplain of the Fraser River. The Dewdney Dike protects Hatzic Island from flooding from the Fraser River. Since the 1948 flood there have been no Fraser River floods; however, parts of Hatzic Island still experience flooding due to the volume of water coming off the surrounding watersheds, overwhelming the drainage capacity of the system. The last noteworthy flood event occurred on Hatzic Island in 1990. Drainage from Hatzic Lake flows into the Fraser River through the Lower Hatzic Slough. However, high Fraser River levels can prevent this drainage and during rain events the lack of drainage causes flood and necessitates the use of a pump station. In 2013, a second pump station was installed to enhance drainage during high Fraser River levels. The dike and associated infrastructure is administered by the Dewdney Area Improvement District. The Dewdney dike is considered "standard" because it: 1) was built to a minimum crest elevation equal to the Flood Construction Level (as designated in Bylaw 681); 2.) met the standards of

design and construction approved by the Ministry of Water, Land and Air Protection; and, 3) is maintained by public authority, an improvement district.

Hatzic Island

Recognizing Hatzic Island is located within the floodplain, the FVRD has included the Island within the *Fraser Valley Regional District Floodplain Management Bylaw 0681, 2005*. Bylaw 0681 states the Flood Construction Level (FCL) for Hatzic Island is 9.3 metres Geodetic Survey of Canada (GSC) datum. The minimum ponding elevation, which addresses flooding from within the Hatzic watershed, is 5.2 metres GSC datum.

The mapping provided in Schedule “B” illustrates the low elevation of Hatzic Island. This mapping is showing GSC datum elevation levels and is therefore measuring elevation from sea level, but it still is illustrative of the low elevation levels of Hatzic Island. Camp Luther Retreat Centre (9311 Shook Road) is shown as having a GSC datum elevation level between 6.1 and 8.0 metres.

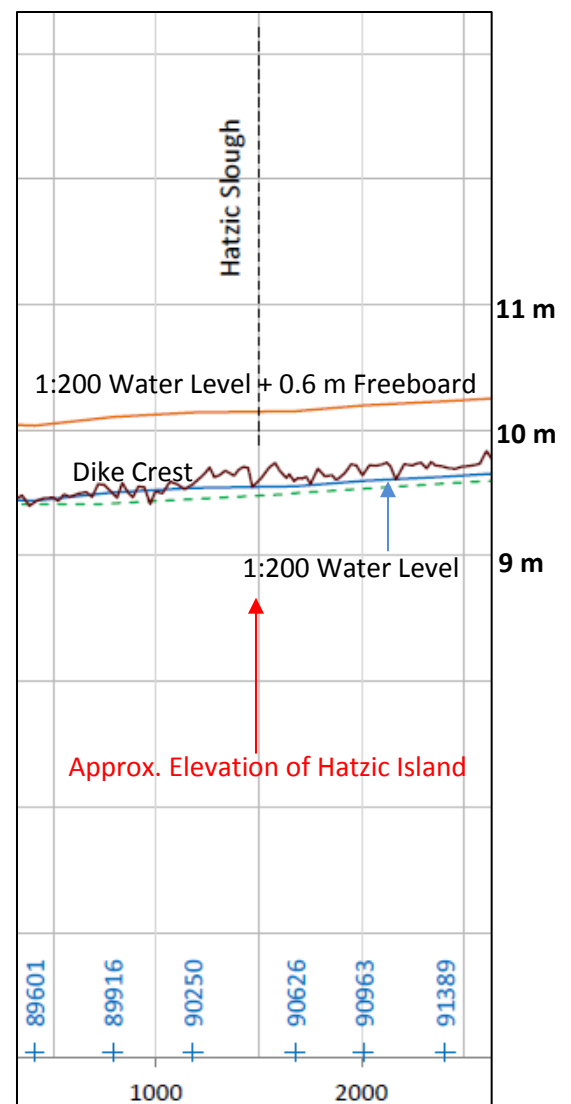
To meet the required FCL either fill has to be brought in to elevate the structure or construction has to be designed to have the non-habitable space (i.e. garage) locate below the FCL and the habitable floor located above the FCL or a combination of fill and construction. The elevation levels highlight the risk of flooding and the challenges of developing low lying areas such as Hatzic Island.

2014 Fraser River Design Flood Level Update

From 2006 to 2014, Northwest Hydraulic Consultants (NHC) and the Ministry of Forests, Lands and Natural Resource Operations (FLNRO) completed a program of hydraulic modelling to update the 1:200 year flood profile of the lower Fraser River.

The 1:200 flood is the “design” flood that serves as the basis for provincial floodplain management strategies. The flood profiles developed by NHC and FLNRO have been adopted as the provincial standard. They replaced the previous estimate of the 1:200 flood profile created in 1969, prior to modern computer modelling methods.

The 2014 flood profile maps indicated that the elevation of the water during a 1:200 year flood in the area of the subject property would be about 9.6 metres GSC at Hatzic Slough or Island. The flood construction level, which includes 0.6 m ‘freeboard’, would be 10.2 metres (freeboard accounts for



wave action). The dike crest elevation in this location is about 9.6 metres GSC (at approximately the 1:200 year flood level).

The ground elevation at the proposed building site is 6.93 to 7.18 metres GSC. Accordingly, a 1:200 year Fraser River flood would result in floodwaters about 2.42 – 2.67 metres (7.9 – 8.8 feet) deep at the subject property.

The 2014 flood profile is not reflected in flood construction levels established in the *FVRD Floodplain Management Bylaw No. 0681* which utilized the previous 1969 flood profile data.

FVRD Floodplain Management Bylaw 0681

Bylaw 0681 establishes a flood construction level of 9.3 m GSC for the subject property. It is this elevation that the applicant has applied through the site specific exemption process to reduce by 1.95 m (6.4 feet) down to 7.35 m GSC to support the construction of two cabins.

Bylaw 0681 allows the FVRD Board to grant site-specific exemptions if the Board considers it advisable and provided that:

- the exemption is consistent with the Provincial Guidelines or a report prepared by a Professional Engineer certifying that the land may be used safely for the use intended is provided; and,
- the owner enters into a Restrictive Covenant.

Engineering Report

In support of the request to reduce the flood construction level, the applicant has provided a report dated January 11, 2019 by a Professional Engineer from Cornerstone Geo-Structural Engineering Ltd. which includes a Geohazard Assurance Statement as prescribed by the FVRD and Engineers and Geoscientists of BC (EGBC). The report is attached hereto as Schedule "C". A preliminary review of the report shows that Fraser River and Tributaries Flooding (Inundation by Flood Waters) has an annual return frequency of 1:40 – 1:200 affecting the subject property. The report in its current form, does not meet the minimum standards for geohazard reports as required in the FVRD Geohazard Assurance Statement. If this proposal is supported and is to proceed, prior to proceeding to a Board meeting, staff will need to work with the Professional Engineer to ensure that the report is amended to meet FVRD standards.

FVRD Policies

Flood protection and management is a current priority of the FVRD Board and the Board has adopted a body of policy around it.

Official Community Plan

Fraser River flood protection is addressed in the *Official Community Plan for Electoral Area G Bylaw No. 0866, 2008*. The policies of the Plan aim to:

- minimize exposure to flood risk and consequences of Fraser River flood events will be central concerns in land use planning decisions (11.2.1);
- utilize floodplain management and zoning bylaws, official community plan policies and covenants to limit development within the floodplain and minimize exposure to risk (11.2.2);
- reinforce the 1:200 year design flood as the basis for flood-proofing measures (11.2.3);
- continue reliance on dykes combined with on-site flood-proofing measures including the implementation of flood construction levels, siting, and floodplain setbacks to minimize exposure to flood hazards (11.2.4);
- consider the Ministry of Environment *Flood Hazard Area Land Use Management Guidelines* when amending the floodplain bylaw and generally when developing land use policy and regulation for the Fraser River floodplain within the Plan area (11.2.5); and,
- support an update to the Floodplain Management Bylaw to reflect the most current Fraser River flood profile modelling (11.2.6).

FVRD Hazard Acceptability Thresholds Policy

FVRD's Hazard Acceptability Thresholds Policy identifies acceptable levels of risk based on the type of hazard and the form of development proposed. The likelihood that the subject property will be flooded by the Fraser River and tributaries is identified in the submitted Engineering Report as having an annual return frequency of 1:40–1:200. As shown below, the policy supports construction of new buildings where the flood risk is between 1:40–1:200 as long as there are protective works to mitigate the hazard.



Inundation¹ by Flood Waters

Flood inundation involves the submersion of land or property by flood waters. This includes areas located on the flood-plain of the Fraser River and its tributaries, which may be susceptible to inundation by flood waters, particularly during spring thaw or periods of heavy rainfall.

Table 1

	1:40	1:40 - 1:200	<1:200
Minor Repair (< 25%)	2	1	1
Major Repair (> 25%)	4	3	1
Reconstruction	4	3	1
Extension	4	3	1
New Building	4	3	1
Subdivision (Infill/extend)	5	4	1
Rezoning (for new community)	5	5	1

¹ Flooding Hazard involves both inundation and erosion at a given site.

Figure 2. Hazard-Related Responses to Development Approval Applications

1	Approval without conditions relating to hazards.
2	Approval, without siting conditions or protective works conditions, but with a covenant including "save harmless" conditions.
3	Approval, but with siting requirements to avoid the hazard, or with requirements for protective works to mitigate the hazard.
4	Approval as (3) above, but with a covenant including "save harmless" conditions as well as siting conditions, protective works or both.
5	Not approvable.

The Dewdney Dike mitigates much of the flood risk, but (as described above) however it has inadequate freeboard and is at a high risk of overtopping during a design flood event. Elevating the buildings to meet the flood construction elevation would deal with this residual risk.

Provincial Policy

The Province of BC adopted the Flood Hazard Area Land Use Management Guidelines in May 2004 and subsequently updated them in 2011 and 2018.

The goals of the provincial guidelines are to:

- reduce or prevent injury, human trauma and loss of life; and,
- minimize property damage during flooding events.

With respect to “requests for modification of bylaws”, such as site specific exemption requests, the guidelines state:

Subject to review by and if acceptable to the local government, a floodplain bylaw may be modified. The local government may alter any bylaw condition to best match the flood hazard provided the level of protection is not altered. This discretion extends to the reduction of elevation requirements, where floodplain mapping exists, by the freeboard, provided the subject property is in the floodplain fringe area and there are no major erosion or channel avulsion hazards in the immediate vicinity.

Prior to agreeing to a modification, other exceptions in the surrounding area should be reviewed to ensure consistency and a summary report prepared. Review by the local government may not support modification on technical grounds but the applicant may nevertheless have demonstrated a hardship.

In order to avoid setting difficult precedents these site characteristics should be unique to the subject property and environs. The economic circumstances or design and siting preferences of the owner should not be considered as grounds for hardship. Before agreeing to modification, consideration should be given to other options such as the use of alternate building sites, construction techniques and designs (e.g. construction and additional storey and thereby reducing the size of the 'building footprint').

The proposal does not meet the above guidelines.

Previous Site Specific Exemptions on Hatzic Island

The FVRD Board considers all applications on their own merits based on the facts and issues specific to the application. Support or denial of this application does not hinder the FVRD Board in considering other applications. However, successful requests for site specific exemptions inform broader community expectation and may be seen as standard-setting by the community.

Address	Year	Description	FCL Reduction
#4-9201 Shook Road (Aqua Vista)	2009	The Regional Board approved a site specific exemption to allow an addition and renovation to a single family dwelling, varying the required FCL from 9.3 m GSC to 5.2 m GSC.	4.1 m
#11-8985 Shook Road (Dogpatch)	2013	The Regional Board approved a site specific exemption to convert a 32.27 m ² garage area to a habitable residential floor space, varying the required FCL from 9.3 m GSC to 6.02 m GSC.	3.28 m
9181 Shook Road	2014	The Regional Board approved a site specific exemption to allow an accessory residential storage building (133m ²), varying the required FCL from 9.3 m GSC to 6.0 m GSC.	3.3 m
8785 Miles Road	2014	The Regional Board approved a site specific exemption to convert a garage area to a habitable residential floor space, varying the required FCL from 9.3 m GSC to 7.18 m GSC.	2.12 m
#18-9201 Shook Road (Aqua Vista)	2015	The Regional Board approved a site specific exemption to allow an addition and renovation to a single family dwelling, varying the required FCL from 9.3 m GSC to 7.2 m GSC.	2.1 m

COST

The application fee of \$400.00 has been paid by the applicant.

ALTERNATIVES

FVRD staff reviewed with the applicant the FCL requirements and options to construct on the property to meet the required FCL, recognizing the existing buildings and historical use of the Camp Luther Retreat Centre. Some alternatives include:

- Revised building design where parking is located at the existing grade and the habitable area is located above. (There would be requirements for accessibility). There are also sufficient undeveloped areas on the property for construction;
- Revised building design using a combination of fill and construction. There are also sufficient undeveloped areas on the property for construction; or,
- A comprehensive property review to provide a phased approach and strategy to have all existing buildings meet the required FCL.

CONCLUSION

The property owners have applied for a Site Specific Exemption to reduce the flood construction level from 9.3 m GSC to 7.35 m GSC to facilitate the construction of two cabins. Staff recommend that the FVRD Board refuse the request and require the proposed construction conform to the 9.3m GSC flood construction level as required by the *Bylaw 0681*. New construction is the opportunity to ensure that proposals meet the requirements of *Bylaw 0681*. The proposal to build the two cabins 1.95 metres below the required FCL established in *Bylaw 0681* is:

- not consistent with Official Community Plan policies;
- not consistent with provincial guidelines; and,
- does not contain a compelling rationale.

In considering the request by the property owner to reduce the flood construction level for the construction of two cabins on the property located at 9311 Shook Road, the FVRD Board may wish to consider the following options:

Option 1 – Refuse (Staff Recommendation)

Staff recommend that the FVRD Board refuse the Site Specific Exemption application to allow the construction of two cabins at an elevation 1.95 m (6.4 feet) lower than the 9.3 m flood construction level (FCL) required at 9311 Shook Road.

Option 2 – Refer to Staff

If the Board wishes to refer the application back to staff to address outstanding issues (including the geo-hazard report submitted) or to propose other building design options to meet the required FCL, the following motion would be appropriate:

MOTION: THAT the Fraser Valley Regional District Board refer the application for Site Specific Exemption 2019-02 for the property located at 9311 Shook Road, Electoral Area G to FVRD staff.

COMMENTS BY:

Graham Daneluz, Deputy Director of Planning & Development: Reviewed and supported.

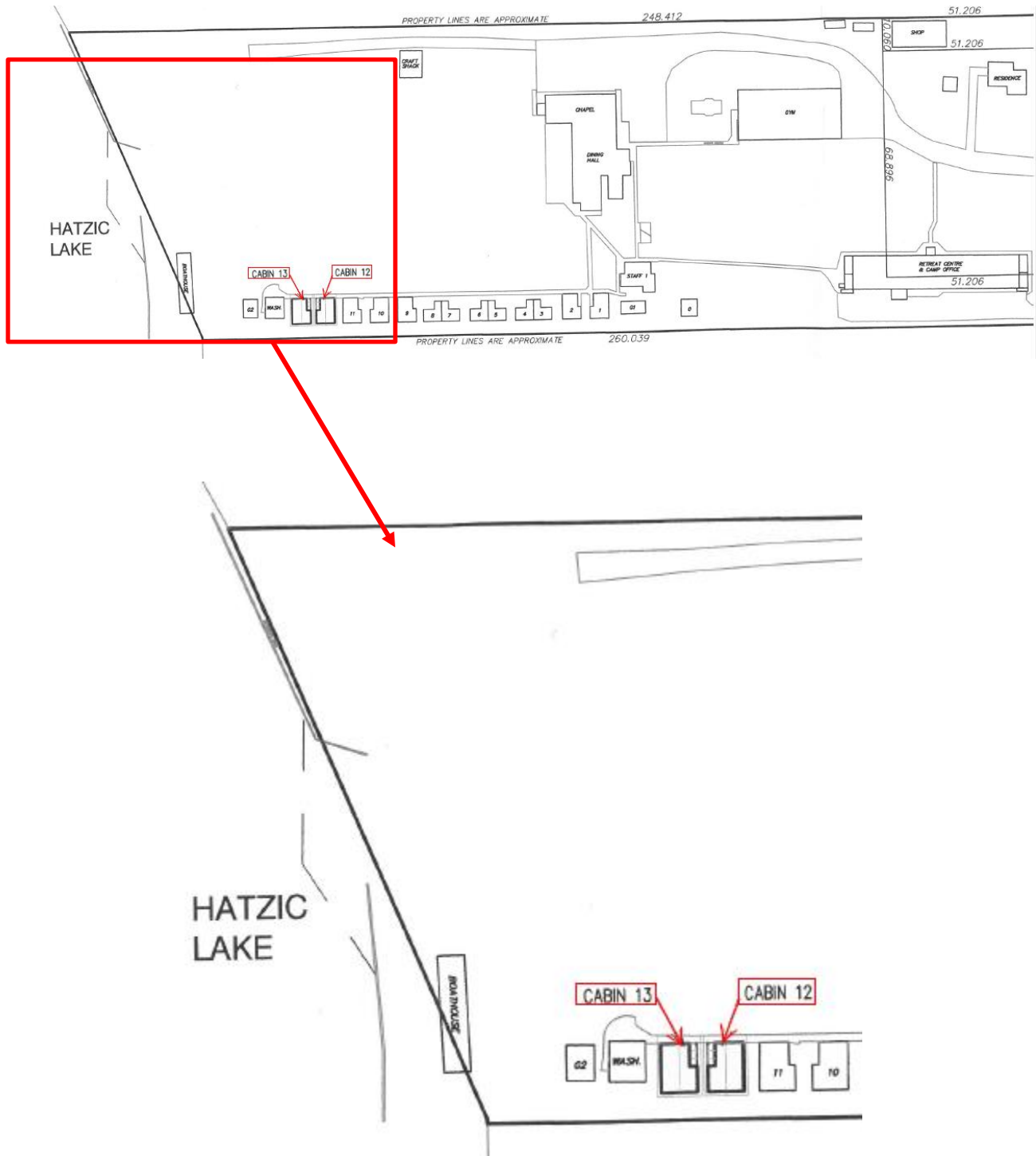
Margaret Thornton, Director of Planning & Development: Reviewed and supported.

Mike Veenbaas, Director of Financial Services: No further financial comments.

Paul Gipps, Chief Administrative Officer Not available for comment.

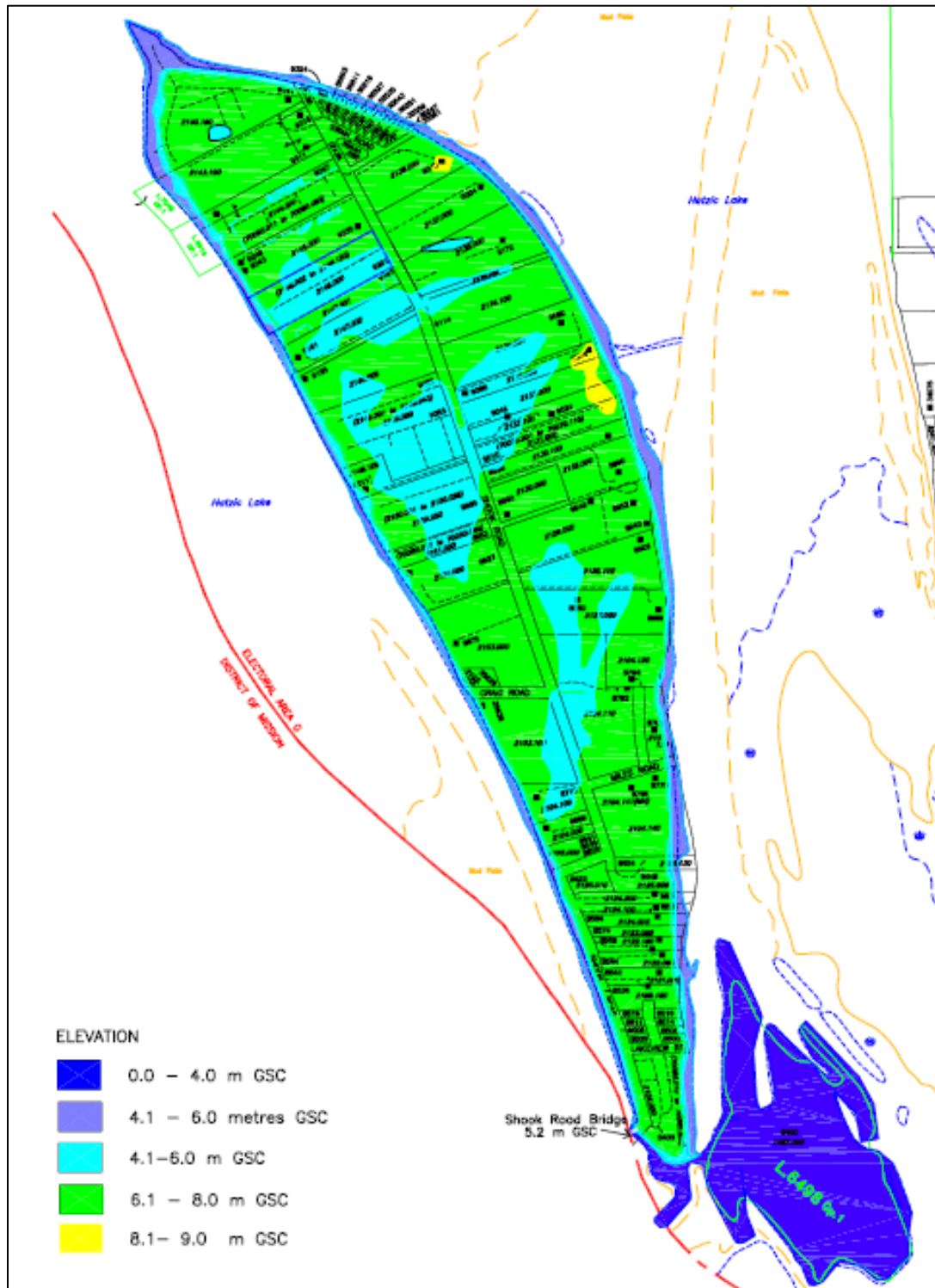
Schedule "A"

Site Plan



Schedule "B"

Hatzic Island Elevations



Schedule "C"

Geotechnical Report – Cornerstone Geo-Structural Engineering dated January 11, 2019



January 11, 2019

Camp Luther

Attn.: Mr. Nathan Janzen
Property Manager
9311 Shook Rd, Mission, BC V2V 7M2

Ref.: 9311 Shook Rd, FVRD, BC – Proposed Cabin Construction
Geotechnical Report

Dear Sirs:

As requested, Cornerstone Geo-Structural Engineering Ltd. (Cornerstone) conducted a geotechnical subsoil investigation at the above-referenced property for the proposed construction of two cabins. The purpose of the investigation was to assess the subsoil conditions and conduct a geotechnical hazard assessment of the site and provide recommendations for geotechnical and structural design.

The scope of this study comprises the geotechnical assessment of the site only. This report includes the description of the site, of the subsoil investigation conducted, summarizes the ground conditions observed the results of our hazard assessment, and provides geotechnical recommendations as stated above.

1. Site and Project Description

The site is located at 9311 Shook Rd on the Hatzic Lake Island in the Electoral Area G of the Fraser Valley Regional District as shown on Figure 1, attached. The site, with a total area of 2.63 Ha, is used as a Camp and Retreat Facility and is occupied by a number of buildings which include offices, a chapel, a gym and 13 cabins, among others.

The proposed works consist of the demolition of two existing cabins (# 12 and 13 in Figure No. 2) and their replacement with new ones. The new cabins will consist of one-storey buildings with an area of 39.3 m² (423 sq. ft.) each, to be built using conventional timber framing.

2. Subsoil Investigation

The geotechnical subsoil investigation was conducted on December 13, 2018. One Test Hole (TH-1) was excavated to a maximum depth of 2.4 m (8 ft.) using a track-mounted mini excavator supplied by the client. A Cornerstone's geotechnical engineer supervised the test hole

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excavation, logged the subsoil conditions and conducted a geotechnical reconnaissance of the site.

The approximate location of the test hole was logged using a handheld GPS and is shown in Figure 2. The soil stratigraphy observed at the test holes is described in Section 5.3 m below.

3. Background Information

Cornerstone reviewed the following information relevant to the project or the study area:

- FVRD, Official Community Plan Electoral Area G, Bylaw No. 0866, 2008
- FVRD, Floodplain Management Bylaw No. 0681, 2005, Consolidated by Bylaw 0748, 2006
- Geological Survey of Canada Map 1485a "Surficial Geology Mission"
- Topographic Survey of the property and architectural drawings A1, A2, and A3 by Richard Lowe, June, 2018, supplied by the client

4. Geology, Geomorphology and Soil Condition

4.1 Geologic Setting and Geomorphology

The GSC Map 1485a indicates that the soils in the area consist of Fraser River Sediments (Fh in Figure 3, below) including sandy loam and loamy sand.

As mentioned previously, the site is located on the Hatzic Lake Island on terrain characterized by generally flat topography underlain by fine grained soils of alluvial origin. The subject cabins are at an approximate distance of 40 m from the lake; the geodetic elevation of the ground around them varies from 6.9 m to 7.1 m and the difference in elevation with the high-water mark of the lake is of 4 m, approximately. The ground slopes gently in southwest direction towards the beach level in proximity to the water body.

No signs of erosion, avulsion or slope instability were observed at the site.

4.2 Subsoil Condition

Based on our subsoil investigation, the stratigraphy of the site is consistent with the geology described above. The soils observed in the test hole vary from silt with trace of sand to sand.

The description of the stratigraphy observed in the Test Hole (TH-01) is as follows (depths measured from existing ground elevation at TH location:

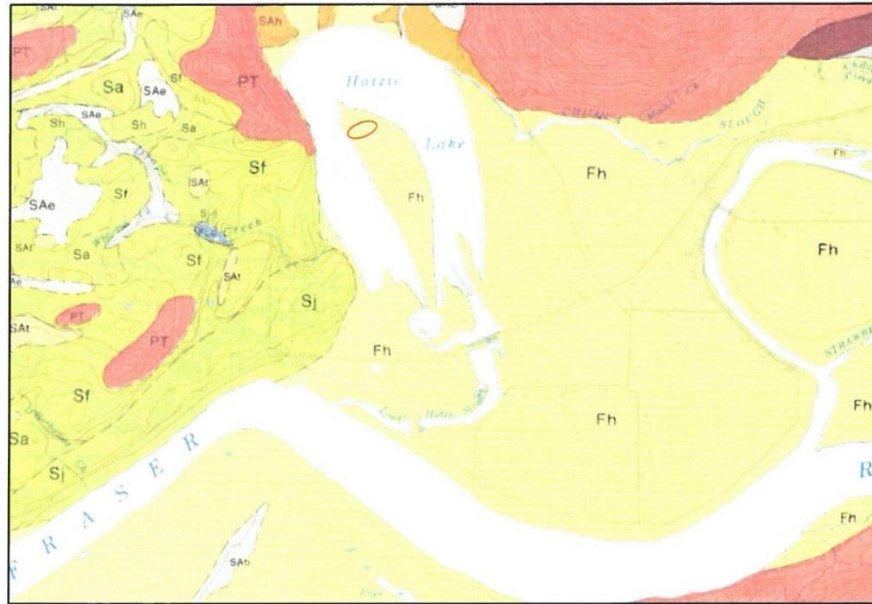


Figure 3. Geology at the Area of Study (From GSC Map 1485a)

Test Hole TH-01:

From 0.0 m to 0.30 m	Top soil
From 0.30 m to 0.7 m	Fill – Soft, moist, medium plasticity, sandy SILT
From 0.7 m to 2.1 m	Firm, moist, low plasticity SILT, trace sand
From 2.1 m to 2.4 m	Compact, moist to wet, light brown, fine SAND, trace silt
2.4 m	End of Test Hole
	No ground water or water seepage observed to the depth of investigation

5. Geotechnical Hazard Assessment

5.1 Area of Interest

The primary area to be assessed corresponds to the portion of terrain within the boundaries of the parcel identified in Section 1 of this report and shown in Figures 1 and 2. The Topographic Survey of the property is included in Appendix 1.

5.2 Hazard Identification

Seismic Hazard & Seismic Site Response

Based on the soil condition assessment and geological information reviewed for the site and our knowledge of the area, the Site Classification for the structural design of the proposed development is **Class E** – Soft Soil per the BC Building Code (BCBC), 2018 and National Building Code (NBC), 2015.

The Peak Ground Acceleration and spectral values -reported for **Site Class C** by the BCBC and NBC- to be used in the structural design, where needed, for a 2% probability of exceedance in 50 years per as provided by National Resources Canada (<http://www.earthquakescanada.nrcan.gc.ca>) are:

PGA = 0.27g
Sa(0.2) = 0.617
Sa(0.5) = 0.523
Sa(1.0) = 0.314
Sa(2.0) = 0.196

Amplification factors F_a and F_v to be determined based on the above parameters and **Site Class "E"**, per the BC Building Code 2018.

Flooding

According to the Floodplain Management Bylaw, Map 8, the Flood Construction Level (FCL) at the site is 9.3 m for a return period of 200 years, while the Minimum Ponding Elevation is 5.2 m.

Since the elevation of the underside of the proposed slab-on-grade is 7.35 m, the FCL is not met. Considering that the cabins are not inhabited permanently, and that implementing other measures for achieving the FCL are not feasible technically or are cost-prohibitive to the client, it is recommended to apply for an exemption to the Flood Bylaw.

For a Flood Level of 8.7 m (FCL less the free board), the depth of flow would vary from 1.6 m to 1.8 m approximately, above the surrounding ground, and 1.35 m above the underside of the slab-on-grade.

Among the potential damages that may affect the structure as a result of the 200-yr design flood are:

- Damage to building envelope

- Damage to dry wall partitions, floors and structural and non-structural elements
- Erosion and scour of foundations
- Buoyancy
- Damage to electrical connections

Liquefaction

The phenomenon of soil liquefaction consists of the loss of strength and deformation of saturated, loose granular soils and low plasticity silts when subjected to earthquake shaking resulting in settlement of buildings.

Based on the information collected for the project and on the recommendations of the Liquefaction Task Force Report for Greater Vancouver Region it is Cornerstone's opinion that the soils in the area, have a high potential for liquefaction in the event of occurrence of the design earthquake with a probability of exceedance of 2% in 50-years (2,475-yr return period) per the National Building Code and BC Building Code, resulting in estimated differential settlements in the range of 150 mm to 300 mm, approximately, between building corners.

The structural engineer must design the foundation and other structural elements considering the above. Footings must be tied together per the National Building Code. Raft foundations, footings tied to the slab-on-grade or other structural solutions can be used to control differential settlements under the occurrence of liquefaction.

The selection of the structural solution must take in consideration the applicable seismic design objectives and expected performance as stated by the National Building Code (User's Guide – NBC 2015 Structural Commentaries [Part 4 of Division B]):

1. to protect the life and safety of building occupants and the general public as the building responds to strong ground shaking,
2. to limit building damage during low to moderate levels of ground shaking.

Other Hazards

Other potential geotechnical hazards including landslide, mountain stream erosion or avulsion, rockfall, major catastrophic landslide, were considered in our assessment and are deemed to be unlikely or inexistent on this property.

6. Discussion and Recommendations

6.1 General

Based on the geotechnical conditions of the soils at the subject site, it is our professional opinion that the construction of the proposed cabins is feasible from a geotechnical point of view and that the land may be used safely for the use intended per the probabilities described and the Hazard Acceptability Thresholds for Development Approvals by Local Government (Cave, 1993) and provided that the recommendations below are implemented.

6.2 Site Preparation

Top soil, soft silt fill and any other soft or loose soils, organic or deleterious materials must be excavated to the depth of the native silt. Over-excavated materials shall be replaced with compacted structural fill to the footing elevation.

Fills for grading purposes shall be carried out using compacted structural fill. It shall consist of sound, durable, well graded granular material, free of earth lumps, organic or deleterious materials, with a maximum size of 75 mm and fine contents (material passing sieve 0.075 mm/No. 200) less than 8% and plasticity index measured on the fraction of soil passing sieve No. 40 lower than 6 percent, to be approved by the geotechnical engineer.

The structural fill must be compacted to a minimum density of 100% Standard Proctor Maximum Dry Density (SPMDD) of the material, placed in 150 mm loose thickness lifts when compacted using light compaction equipment or 300 mm loose thickness lifts when heavy equipment is used. Structural fills must be placed at a maximum inclination of 2H:1V (H=horizontal; V=vertical). The fill must extend beyond the footing edge to a minimum distance equal to the larger of: (i) four times the footing width; (ii) the fill height, or (iii) 2.0 m

Temporary excavations into the silty fill or into the native sandy silt or sand can be carried out at a maximum inclination of 1.5H:1V (H=Horizontal; V=vertical). Excavations deeper than 1.8 m, are not anticipated, but if required, must be carried out under the direction of the geotechnical engineer.

In order to minimize the foundation scour in case of occurrence of the 200-yr design flood, it is recommended to backfill around the perimeter footings a minimum width of 1.0 m using structural fill compacted to 100% SPMDD to the slab-on-grade elevation.

6.3 Bearing Capacity

Footings founded on a layer of compacted structural fill, 150 mm min. thickness, placed on top of the native, low plasticity silt can be designed based on a factored bearing pressure (ULS condition) of 112 kPa (~2,250 psf, approx.), for a resistance factor ϕ of 0.5. Applied bearing

pressures must be limited to a serviceability bearing pressure (SLS condition) of 75 kPa (~1,500 psf, approx.).

If founded on the native silt, the footings must be designed based on a factored bearing pressure (ULS condition) of 75 kPa (~1,500 psf, approx.), for a resistance factor ϕ of 0.5. Applied bearing pressures must be limited to a serviceability bearing pressure (SLS condition) of 50 kPa (~1,000 psf, approx.).

The above bearing capacity values do not consider the effect of eccentric or inclined loads. Footings on fills must be placed at a minimum distance equal to the larger of (i) four times the footing width, or (ii) the fill thickness; otherwise the geotechnical engineer must verify the validity of those values.

Minimum footing width must be 450 mm (24 in.) for strip footings and 900 mm (3 ft.) for pad footings. Footings must be sized by the structural engineer based on the loads estimated by their analysis and on the bearing capacity values described above.

6.4 Flooding

In case of occurrence of the 200-yr design flood, damage to the building elements described above may take place. Therefore, the structural engineer must conduct an analysis of the above flood levels and provide mitigation measures to counteract the effect of buoyancy and hydrodynamic forces and debris impact on the proposed building addition.

The owner shall enter into a restrictive covenant under Section 219 of the Land Title Act.

6.5 Liquefaction

The structural engineer must implement measures to counteract the detrimental effect of differential settlements due to liquefaction as described in Section

7. Review and Inspection

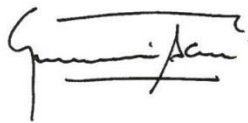
We recommend retaining Cornerstone to conduct the following activities:

- Excavation and foundation inspection
- Placement of grading fills

8. Limitations and Closure

The recommendations provided in this report are based on the analysis of the results of the subsoil investigation and geomorphological conditions of the site and our engineering judgement. Due the variable nature of the subsoil and bedrock and limitations inherent to the subsoil investigation, unexpected conditions may be found; Cornerstone Geo-Structural Engineering Ltd. must be informed by the client in this event to conduct the necessary reviews. This report has been prepared in accordance with general accepted engineering practice for the exclusive use of the client for the purposes stated. No other warranty, expressed or implied is made.

Reviewed,



German A. Cajigas Silva, M.Eng., P.Eng.
Senior Geotechnical Engineer



Jorge Silva, P.Eng.
Principal

ATTACHMENTS

- Figure 1. General Site Location
- Figure 2. Site Layout and Location of Proposed Cabins

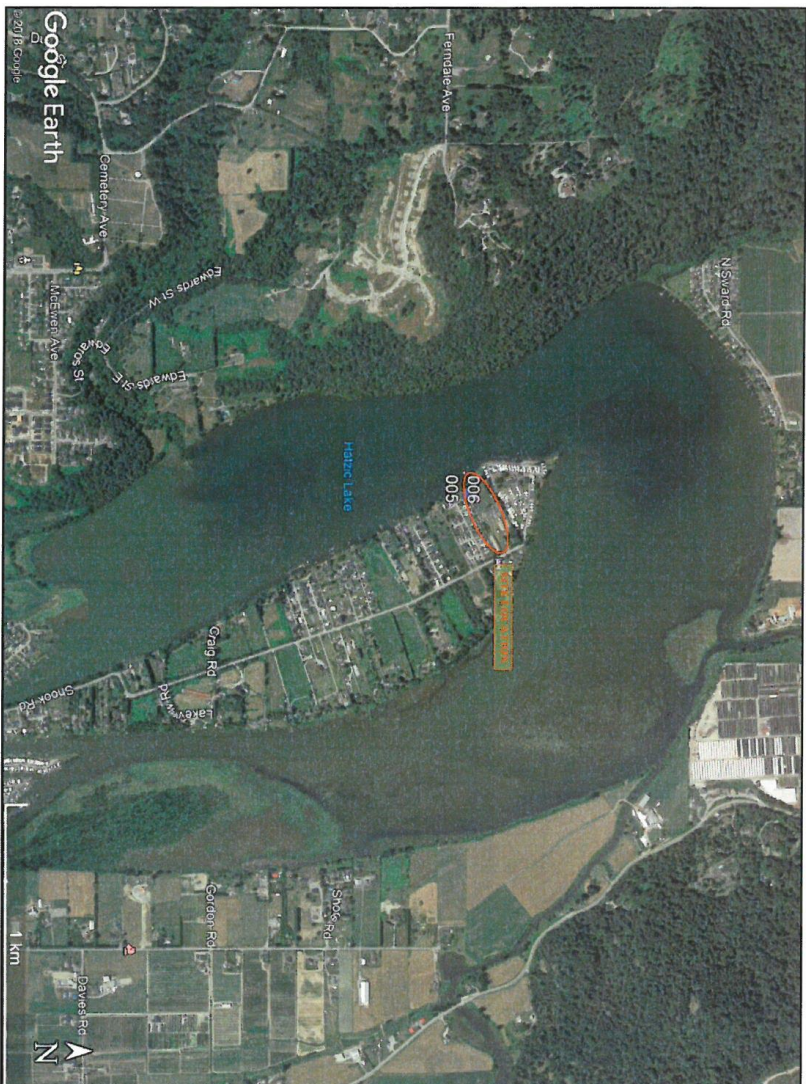
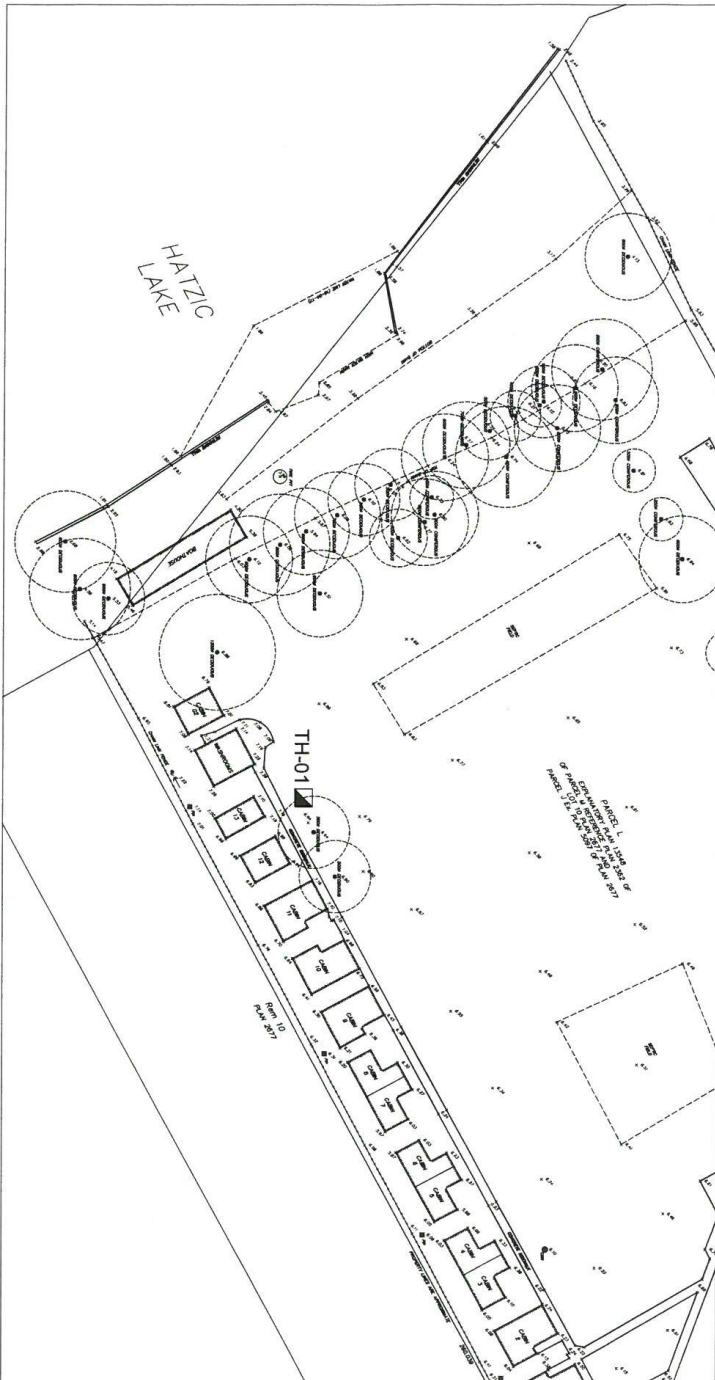



Figure 1. General Site Location (Taken from Google Earth)

Unit 1B – 30508 Great Northern Ave, Abbotsford, BC V2T 6H4 Tel. 604-746-5070



					
CORNERS + ONE GEO-STRUCTURAL ENGINEERING LTD. 18-30508 Great Northern Avenue Abbotsford, BC V1 1S4 S070 Phone : (778) 928 7589 Cell phone : (778) 928 7589 Email: cornersonegbc@shaw.ca PROFESSIONAL SERVICES ONLY, OPEN THE BOOK		FIG. 2 SITE TOPOGRAPHY, BUILDING LAYOUT AND TEST HOLE (TH) LOCATION		CLIENT: CAMPLUTHER	
9311 SHOOK RD, MISSION, BC		Drawn: German Cajigas		Date: January 11, 2019	
		Revised: Jorge Sino		SCALE: 1:500	
				1/1	
				REVISIONS	
				0 ISSUED FOR BUILDING PERMIT	

Geo-Hazard Assurance Statement for Development Approvals

A. Project Information

Date 24 JANUARY 2019 FVRD File No. _____

Property Information

Project Name & Description Camp Luther - Proposed Cabin Construction
Legal Description Parcel L (Explanatory PLan 13548) of Parcel M (Reference Plan 2362) of Lot 10 and Parcel J (Explanatory Pl
Site Address 9311 Shook Rd PID 000-811-068 / 826-936 / 826-928

Client Information

Name Camp Luther - Mr. Nathan Janzen
Role ☐ Property Owner ☐ Developer ☒ Other
Client Address _____

Qualified Professional Information

Name German A. Cajigas-Silva
APEGBC Designation ☒ P.Eng. ☐ P. Geo. ☐ Eng.L ☐ Geo.L
Company Name Cornerstone Geo-Structural Engineering Ltd.
Mailing Address Unit 1B - 30508 Great Northern Ave, Abbotsford, BC V2T 6H4
Email Address gecajigas@yahoo.com Phone # 778-918-7085

Geo-Hazard Report Reference

Title 9311 Shook Rd, FVRD, BC - Proposed Cabin Construction Date January 11, 2019

Personal information on this form is being collected in accordance with Section 27 of the Freedom of Information and Protection of Privacy Act, RSBC 1996 Ch. 165; Part 9, Division 1 [Building Regulation] and Part 14 [Planning and Land Use Management] of the Local Government Act, RSBC 2015 Ch. 1; and Section 56 of the Community Charter, SBC 2003 Ch. 26 and will only be collected, used and disclosed for the purpose of administering geo-technical hazard reviews and assurance statements related to development approvals. Questions? Contact FVRD Privacy Officer at 45950 Cheam Avenue, Chilliwack, BC V2P 1N6; 604-702-5000 or 1-800-528-0061; or FQI@fvr.ca.



Geo-Hazard Assurance Statement for Development Approvals

B. Assurance

Based on the contents of this Assurance Statement and the Report, I hereby give assurance that:
(check as applicable)

<input type="checkbox"/> Development Permit	The Report will "assist the local government in determining what conditions or requirements under it will impose in the permit", as required by the <i>Local Government Act</i> (Division 7)
<input type="checkbox"/> Building Permit	
<input checked="" type="checkbox"/> Community Charter	"The land may be used safely for the use intended", as required by the <i>Community Charter</i> (Section 56)
<input type="checkbox"/> Seismic Slope	The Report addresses the requirements of the BC Building Code 2006, 4.1.8.1.6 (8) and 9.4.4.4 (2), as detailed in the BC Building & Safety Policy Branch Information Bulletin B10-01, Jan 18, 2010
<input checked="" type="checkbox"/> Floodplain Management Bylaw Exemption	"The land may be used safely for the use intended", as required by the <i>Local Government Act</i> . (Section 524)
<input type="checkbox"/> Subdivision	"The land may be used safely for the use intended", as required by the <i>Land Title Act</i> (Section 86).
<input type="checkbox"/> Other (e.g. Zoning Bylaw Amendment, Official Community Plan Amendment, Temporary Use Permit, etc.)	<Insert statement as appropriate>

C. APEGBC Professional Practice Guidelines

The Report and this Assurance Statement should be completed in accordance with the current version of one or both of the following Professional Engineers and Geoscientists of BC (APEGBC).

- *Legislated Flood Assessments in a Changing Climate in BC*
- *Legislated Landslide Assessments for Proposed Residential Development in British Columbia, ("APEGBC Landslide Guidelines")*.

These two documents are collectively referred to as the "APEGBC Guidelines". The italicized words in this Assurance Statement are defined in the APEGBC Guidelines.

The Report has been prepared pursuant to the following APEGBC Guidelines (check one or both as applicable).

- ☒ APEGBC Flood Guidelines
☐ APEGBC Landslide Guidelines



Geo-Hazard Assurance Statement

for Development Approvals

If the Report is **not** prepared pursuant to either of the APEGBC Guidelines, please explain.

D. Background Information

Qualified Professionals **must** confirm and check that each item is included in the Report.

- ☒ 1. Property location map — 8.5 x 11 size
- ☒ 2. Development proposal site plan — 8.5 x 11 size. *If a subdivision, show the parent parcel and all lots to be created, including any remainder.*
- ☐ 3. Description of the proposed development project (including building use) to the extent this is known at the time of Report preparation.
 - ☐ residential
 - ☐ industrial
 - ☐ commercial
 - ☒ institutional
 - ☐ other _____



Geo-Hazard Assurance Statement for Development Approvals

E. Technical Requirements

Qualified Professionals **must** review, confirm and check completed items (as applicable).

Report Content

- ☒ 4. Relevant information pertaining to the Property and pertinent potential hazards from appropriate background sources, including the FVRD online library.
 - ☐ 5. Time limitation or condition statement to describe extent the FVRD may rely on the Assurance Statement and Report for development approvals, and when resubmittal is recommended.
 - ☒ 6. Maps, illustrations and diagrams to illustrate areas referred to in the Report.
 - ☒ 7. Description of field work conducted on and, if required, beyond the Property.
 - ☐ 8. Contact and consultation with the Fraser Valley Regional District. Provide name and title of contact.
-
- ☒ 9. Review of relevant FVRD bylaws and other statutory requirements.
 - ☐ 10. Restrictive covenants registered against the Property title that pertain to geo-hazards (if registered, the Report provides relevant information about the covenants).
 - ☐ 11. Notation of any visibly apparent natural hazards or other hazards identified in background reports, which are not identified and addressed in this Report. If yes, provide details in Section H: Geo-Hazard Summary Table.
 - Yes
 - ☒ No
 - ☐ 12. Does the report rely on one or more supporting reports, each of which is independently reviewed, signed and sealed. If yes, provide details in Section H: Geo-Hazard Summary Table.
 - Yes
 - ☒ No
 - ☐ 13. For subdivision approval, the Report addresses natural hazards for:
 - ☐ the parent parcel prior to subdivision
 - ☐ any lots to be created (including any remainder)



Geo-Hazard Assurance Statement for Development Approvals

Geo-hazard Assessment, Risk Acceptability and Risk Transfer

- ☒ 14. In considering the above-noted potential hazards that may affect the property, I have:
- ☒ reviewed and characterized the potential hazard(s)
 - ☒ estimated the potential frequency and magnitude of the potential hazard(s)
 - ☐ relied on supporting reports as noted above
 - ☒ relied on a pre-existing assessment of hazard frequency and magnitude
 - ☐ considered the potential effects of climate change in the context identified in the Report
 - ☐ considered the potential effects of changed future conditions (upstream watershed changes, forestry activity, land use changes, sea level rise, etc.) in the context identified in the Report
- ☒ 15. This Assurance Statement pertains to all geo-hazards that are assessed in the Report and any supporting reports, and accurately reflects the contents of those documents.
- ☒ 16. The FVRD has adopted "Hazard Acceptability Thresholds for Development Approvals by Local Government", which provides a specific level of hazard or risk tolerance. I have included a Hazard Summary Table which:
- ☒ lists all the potential hazards addressed by the Report and any supporting reports
 - ☒ provides an annual return frequency and acceptability threshold classification for the unmitigated condition
 - ☒ proposes mitigative measures to appropriately reduce the geo-hazard risk
 - ☒ provides an annual return frequency and acceptability threshold classification for the mitigated condition
- ☐ 17. The Report describes the potential transfer of natural hazard risk to other properties or infrastructure as a result of the proposed project (including any proposed *mitigation works*) and
- ☐ considered the potential for transfer of natural hazard risk
 - ☐ concludes that there is no significant transfer of natural hazard risk
 - ☐ identifies the potential transfer of natural hazard risk and proposes measures to offset such transfer of risk

Geo-Hazard Assurance Statement for Development Approvals

Mitigation and Design Recommendations (if recommended)

The Report contains the following items:

- ☐ 18. Implementation steps for the identified structural mitigation works (in terms of design, construction and approval).
- ☐ 19. Clearly identified safe locations for building(s), ancillary structures, and onsite utility services (as applicable, such as a septic field) out of the natural hazard area as a preferred development alternative.
- ☒ 20. Commentary on the effectiveness of proposed structural mitigation works in terms of ability to reduce the potential hazard impact, and identification of any residual risk that would remain.
- ☐ 21. Proposed Flood Construction Level (FCL) for future development and including specification of an appropriate method of achieving the FCL.
- ☐ 22. Proposed watercourse setback, which is clearly referenced from the natural boundary, top of bank or another suitable basis.
- ☐ 23. Proposed operation and maintenance actions that will be necessary in order for the level of safety to be maintained in the future, with indications of who should be responsible for those actions and when.

Riparian Area Regulation (if applicable)

- ☐ 24. QP must review RAR assessment report to avoid conflict with Geo-Hazard Report recommendations.

E FVRD Supplemental Requirements

The following points are understood by the Qualified Professional when submitting a Report:

- ☒ 25. Permission is granted to the FVRD to use the Report in considering approval of the proposed development on the property, provided that such permission is limited only to the proposed development project for which the Report was prepared.
- ☒ 26. Methodology used in the Report is described in sufficient detail to facilitate a professional review of the study by the FVRD when necessary.
- ☒ 27. Professional liability insurance coverage of at least \$1 million per claim is carried by the QP.
- ☐ 28. Third party review or supplemental information may be required by the FVRD where complex development proposals warrant.
- ☒ 29. Permission is granted to the FVRD to include the Report in the online FVRD geo-hazard report library (as background information, not for other parties to rely).



Geo-Hazard Assurance Statement for Development Approvals

G. Qualified Professional (QP)

Prepared by: (QP of Record)

Name German A. Cajigas-Silva

Designation ☒ P.Eng. ☐ P. Geo. ☐ Eng.L ☐ Geo.L

Reviewed by:

Name Jorge Silva

Designation ☒ P.Eng. ☐ P. Geo.

The Report has received appropriate technical review which is consistent with both the APEGBC Professional Practice Guidelines, and APGBC Quality Management Guidelines. The name of the reviewer is noted in the Report and below.

Professional Seal, Signature and Date:



- ☒ I am a Qualified Professional as defined in the APEGBC Guidelines, and I fulfill the education, training and experience requirements as outlined in the APEGBC Guidelines
- ☒ I have signed, sealed, dated and thereby certify, this Assurance Statement and the attached report.



Geo-Hazard Assurance Statement for Development Approvals

H. Geo-Hazard Summary Table

The geo-hazard report and/or any supporting reports addresses the following hazard types.

Geo-Hazard Type #1		Geo-Hazard Type #2	
Fraser River and tributaries flooding		Seismic Effects/Liquefaction	
Annual Return Frequency (Unmitigated) 1:40 - 1:200		Annual Return Frequency (Unmitigated) 1:2475	
Acceptability Threshold Classification	4	Acceptability Threshold Classification	5
MITIGATION (if necessary)			
Proposed Mitigation Measures	Yes <input checked="" type="radio"/> No <input type="radio"/>	Proposed Mitigation Measures	Yes <input checked="" type="radio"/> No <input type="radio"/>
Annual Return Frequency (Mitigated) 1:40 - 1:200		Annual Return Frequency (Mitigated) 1:2475	
Acceptability Threshold Classification	4	Acceptability Threshold Classification	3
Comments A Floodplain Bylaw exemption is recommended		Comments	
SUPPORTING REPORT			
Was this report prepared by others?		Was this report prepared by others?	
Yes <input type="radio"/> No <input checked="" type="radio"/>		Yes <input type="radio"/> No <input checked="" type="radio"/>	
If yes, list report name, date and author.		If yes, list report name, date and author.	
Geo-Hazard Type #3		Geo-Hazard Type #4	
Annual Return Frequency (Unmitigated)		Annual Return Frequency (Unmitigated)	
Acceptability Threshold Classification		Acceptability Threshold Classification	
MITIGATION (if necessary)			
Proposed Mitigation Measures	Yes <input type="radio"/> No <input type="radio"/>	Proposed Mitigation Measures	Yes <input type="radio"/> No <input type="radio"/>
Annual Return Frequency (Mitigated)		Annual Return Frequency (Mitigated)	
Acceptability Threshold Classification		Acceptability Threshold Classification	
Comments		Comments	
SUPPORTING REPORT			
Was this report prepared by others?		Was this report prepared by others?	
Yes <input type="radio"/> No <input type="radio"/>		Yes <input type="radio"/> No <input type="radio"/>	
If yes, list report name, date and author.		If yes, list report name, date and author.	

Geo-Hazard Assurance Statement for Development Approvals

Indicate which hazards were NOT reviewed:

- | | |
|---|--|
| <input type="checkbox"/> Chilliwack River Valley Erosion or Avulsion | <input checked="" type="checkbox"/> Seismic Effects/Liquefaction |
| <input type="checkbox"/> Debris Flow and Debris Torrent | <input type="checkbox"/> Rockfall - Small Scale Detachment |
| <input type="checkbox"/> Debris Flood | <input type="checkbox"/> Slope Stability |
| <input checked="" type="checkbox"/> Fraser River & tributaries flooding | <input type="checkbox"/> Small Scale Localized Landslide |
| <input type="checkbox"/> Mountain Stream Erosion or Avulsion | <input type="checkbox"/> Snow Avalanche |
| <input type="checkbox"/> Major Catastrophic Landslide | <input type="checkbox"/> Tsunami |

Hazard Acceptability Thresholds Classification, as per Hazard Acceptability Thresholds for Development Approvals by Local Government dated November 1993 by Dr. Peter Cave.

- 1 Approval with conditions relating to hazards.
- 2 Approval, without siting conditions or protective works conditions, but with a covenant including "save harmless" conditions.
- 3 Approval, but with siting requirements to avoid the hazard, or with requirements for protective works to mitigate the hazard.
- 4 Approval as (3) above, but with a covenant including "save harmless" conditions as well as siting conditions, protective works or both.
- 5 Not approvable.

Additional Comments