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27 November 2017

GeoWest File: GA17-1083-00

Freedom Construction c/o OTG Development Concepts
520 – 45715 Hocking Avenue
Chilliwack, BC V2P 6Z6

Attn.: Ms. Cassidy Silbernagel
e-mail: cassidy.silbernagel@otgdevelopments.com

Project: Single Family Residential Subdivision, 43730 Chilliwack Mt. Road, Chilliwack, BC
Subject: Geohazard Site Assessment Report

Dear Madam;

1. INTRODUCTION

GeoWest Engineering Ltd. (GeoWest) was retained by Freedom Construction c/o OTG Development Concepts (the Client) to conduct a geohazard site assessment in support of a proposed single family residential subdivision of a property located at the above-referenced address (the site). The site location is illustrated on the attached Figure 1.

It is understood that it is proposed to subdivide the existing property into 8 to 10 residential lots for construction of single-family residences. Access to the new lots will be provided from Old Orchard Road. A preliminary plan with the 8-lot layout is illustrated on Figure 2.

A site grading plan was not available at the time of preparation of this report; however, we understand that a grade increase is considered along the south property line. This would involve construction of a fill slope along the south property line and road improvement along the westbound lane of Old Orchard Road. It is understood that the fill slope would extend down from Old Orchard Road at an inclination of 2H: 1V (horizontal: vertical). It is not known whether retaining walls are needed at this stage. A geotechnical assessment report for the building foundations and roads is not part of the scope of work, nor is design of any retaining walls that may be required.

The purpose of this assessment was to:

- Identify the nature and frequency of potential geohazards on site;
- Provide recommendations for hazard avoidance and mitigative measures, as needed; and
- Provide our opinion if the site is safe for the use intended.

The geohazard assessment was conducted in general conformance with the guidelines presented in the following documents:

1. "Hazard Acceptability Thresholds for Development Approvals by Local Government", revised November 1993, by Dr. Peter Cave (1993 Cave Paper); and
2. "Guidelines for Legislated Landslide Assessments for Proposed Residential Developments in BC", revised May 2010 by the Association of Professional Engineers and Geoscientists of BC (APEGBC).

GeoWest scope of work for this assessment was provided in an e-mail to Client on 11 August 2017. Authorization to proceed with the proposed scope of work was received from the Client on 21 August 2017.

2. SITE DESCRIPTION

The site is located on the north side of Chilliwack Mountain, approximately 150 m west of the intersection of Old Orchard Road and Copper Ridge Drive. The site is also bordered by Old Orchard Road to the south and private properties to the east and west. A residential development was under construction on the property bordering the west side of the site.

According to the City of Chilliwack webmap, the site occupies an area of approximately 1.02 acres. The site slopes down from south to north with elevations ranging from approximately El. 96 m in the southwest corner to El. 84 m in the northeast corner of the site.

At the time of our field work, the site was occupied by a single-family residence located in the central portion of the site. A workshop/garage was located in the southwest corner of the site. The City of Chilliwack aerial photo, including topographic contours illustrating the topography of the general site area is attached as Figure 3.

3. METHODOLOGY

GeoWest conducted the following tasks for this assessment:

1. Review of surficial geology map and guideline documents listed in Section 1 of this report;
2. Review of previous relevant geotechnical reports provided by the City of Chilliwack;
3. Review of stereo pairs of historical aerial photographs obtained from the Geographic Information Centre of the University of British Columbia;
4. A site reconnaissance conducted by a GeoWest Senior Geotechnical Engineer on 13 September 2017. Slope angles were measured from the horizontal using a hand-held clinometer and relevant site conditions were documented with photographs. Select photographs are enclosed in Appendix A of this report; and
5. Analysis and preparation of this report.

4. FINDINGS

4.1. Surficial Geology Map

According to the Geological Survey of Canada Surficial Geology Map (Mission, Map 1485A), the site is underlain by Mesozoic and Upper Paleozoic bedrock that includes sedimentary, volcanic, granitic and metamorphic rocks, mantled in 90 per cent of the area by deposits, 1 to 5 m thick of glacial, colluvial, and eolian sediments.

4.2. Review of Previous Relevant Reports

A report titled “Surficial Geology, Chilliwack Mountain, BC” prepared by Bayrock and Reimchen Surficial Geology Ltd. (dated May 6, 1977) concluded that the Chilliwack Mountain is made almost entirely of bedrock with very thin surficial deposits. The bedrock was identified as highly folded and faulted sedimentary rocks with numerous ingenious intrusives. Bedrock weakness zones such as faults, shear zones and fractures transect the mountain. The surficial deposits are described as 2 to 10 feet thick till and loess (eolian silt) generally 2 to 5 feet thick.

Dames & More conducted a preliminary geotechnical assessment for a proposed 300-acres residential subdivision on Chilliwack Mountain and summarized the findings in a report dated May 11, 1977. The findings with regard to surficial geology and bedrock were similar to the geological setting discussed in the report referenced above. The Dames and Moore report concluded that slope stability conditions are not critical and that the seepage and erosion of surficial deposits can be controlled. Recommendations for slope cuts in soil and rock ranged from 1.5H:1V (horizontal: vertical) to 1.3H:1V in soil and 1H:2V for up to 30 feet high cuts in rock. The report concluded that a significant percentage of rainfall will result in direct runoff due to the relatively low permeability of the soil and rock at the site.

A report titled “Chilliwack Mountain Comprehensive Development Plan Background Report – Engineering Geology Considerations”, prepared by Thurber Engineering Ltd. (File: 17-610-39, dated April 26, 1995) summarized the result of interpretation of air photos. No field work was undertaken by Thurber to support their findings. The report concluded that the topography of Chilliwack Mountain is relatively steep with less steep slopes overlain by a thicker overburden layer including windblown silt (eolian deposits). The windblown silt was characterized as erodible and unsuitable for use as fill. The report also commented on potential problems due to the modification of natural drainage conditions as a result of the upslope developments.

4.3. Review of Aerial Photographs

Based on review of historical aerial photographs, the site was developed to support the current single-family dwelling between 1974 and 1979. No evidence of slope instability was observed within or above the site on the reviewed photographs. Localized steeper sections of the slope along the top of the mountain above the site were identified as possible scarps of ancient slope failures, likely associated with a previous de-glaciation period; however, the slopes below are well vegetated and appear stable on reviewed photographs.

Two bench-like features extend in the general east to west direction above the site. We infer that the benches are the reflection of the shallow underlying bedrock structure. It appears that the benches were utilized for residential developments on Alameda Drive. Three roughly parallel linear features, possible faults, extend in the general northwest to southeast direction across the north side of the mountain, west of the site.

The reviewed air photos are summarized in Table 1 below.

Table 1.
Summary of Reviewed Aerial Photographs

Photo ID	Year	Scale (approx.)
SRS6064, 290 & 291	1999	1:30,000
30BCB93032, 236 & 237	1993	1:20,000
30BCC537, 141 & 142	1986	1:12,000
30BC83008, 104 & 105	1983	1:20,000
30BC79009, 036 & 037	1979	1:10,000
BC5575, 075 & 076	1974	1:12,500
BC5319, 274 & 275	1969	1:12,000
BC5064, 24 & 25	1963	1:12,000
BC721, 69 & 70	1949	1:10,500

4.4. Site Reconnaissance Observations

The south portion of the site, occupied by the existing single-family residence and the workshop/garage was relatively flat. An approximately 10 m high slope, inclined at about 30° extended down to the north below the existing residence. The slope is illustrated on Photograph 1. We did not observe evidence of instability on the slope. The existing residence, located along the top of the slope appeared in good condition without visible evidence of settlement. A relatively flat bench extended from the toe of the slope to the north property line along Chilliwack Mountain Road.

A test pit was excavated by hand on the bench at the toe of the slope to review the near-surface soil conditions. The test pit encountered approximately 150 mm of topsoil, underlain by 0.3 m of soft brown silt (eolian deposits) which was in turn underlain by firm brown-grey silt with trace to some sand. No landslide debris was encountered in the test pit. The soil conditions at the test pit location are illustrated in Photograph 2.

Firm to stiff silt underlain by shallow bedrock was exposed along an existing slope cut along the west property line. The silt layer was over 2 m thick in the northwest corner of the site, becoming less than 0.5 m thick along the central portion of the property line (Photograph 3). We did not observe groundwater seepage along the slope cut at the time of our field work.

The slope supporting Orchard Road was about 4 m to 10 m high and was inclined at approximately 30° to 45°. The slope was vegetated with cedar trees and undergrowth. A number of trees had pistol butt trunks indicating possible slope creep. According to anecdotal information provided by the current owner of the property, a moderate groundwater seepage occurs near the toe of the slope below the road and lasts typically a few weeks a year during the rainy season. There was no seepage at the time of our field work; however, the area along the toe of the slope was wet and soggy.

Tension cracks were visible in the westbound lane of Old Orchard Road above the site confirming previous creep and a low degree of stability. An existing two course high retaining wall comprised of concrete barriers extended along the edge of the road atop of the slope. Steel rods and anchor plates on the barriers indicate that the retaining structure is anchored/tied back to provide additional support to the road. The slope and the barriers are illustrated in Photograph 4.

A bedrock outcrop was present on the upslope side of Old Orchard Road, opposite to the central portion of the site. The outcrop was approximately 10 m long and up to 1.8 m high. A shallow ditch, lined with crushed rock extended upslope perpendicular to Old Orchard Road, approximately opposite to the southeast corner of the site. The ditch was dry at the time of our field work (Photograph 5). The slope immediately above Old Orchard Road and the outcrop was inclined at about 25° to 27° and forested.

An existing residential subdivision was located about 100 m upslope (south) of Old Orchard Road and the site. A possible fill slope supporting an existing roadway at the east end of the subdivision (directly upslope from the site) was inclined at about 38°. The slope above the subdivision was forested and varied in inclination from less than 15° along existing benches to about 35° to 38° in the steeper sections of the slope.

Two dump sites containing logs, wood debris and garbage were perched on top of the steep section of the slope approximately 200 m upslope from the site. The dump sites were located along a gravel road that traverses the north side of Chilliwack Mountain. A 3 to 4 m high slope cut comprised of silt, sand and angular rock was present at the gravel road switchback, approximately 250 m upslope from the site (Photograph 6). We did not observe evidence of recent slope instability on the north-facing slope of Chilliwack Mountain above the site.

5. GEOHAZARDS

The 1993 Cave Paper referenced in Section 1 lists the following geohazards that should be considered in determining the suitability of a site for proposed residential developments:

- Inundation by flood waters;
- Mountain stream erosion and avulsion;
- Debris flows and debris torrents;
- Debris floods;
- Small-scale localized landslides;
- Snow avalanche;
- Massive, catastrophic landslides; and
- Rockfall.

It is our opinion that, with the exception of small-scale localized landslide hazard, the site is not subject to above listed hazards due to the following:

- The site is not located within a floodplain;
- No active watercourses are present on site nor on the slope above the site;
- The slope above the site is forested and partially developed and as such not a source of snow avalanches;
- The slope above the site is bedrock controlled and therefore not conducive to deep seated catastrophic landslides at the current inclination. We did not observe evidence of large scale landslide during our field work or on reviewed historical aerial photographs. Therefore, the large-scale landslide hazard is considered negligible;
- No sources rock fall hazard such as rock bluffs or steep rock cuts are located above the site. The rock cut along Old Orchard Road is judged to represent a negligible rockfall hazard due to its small height. In

addition, the existing ditch and the road would act as the catchment area for rockfall originating the form the cut.

It is our opinion that the small-scale landslide hazard is present at the south end of the site. This hazard is the result of the steep marginally stable condition of the embankment/natural slope that supports the westbound lane of Old Orchard road. The recommended hazard mitigation measures are discussed in Section 6 of this report.

It is expected that the steep slope in the central portion of the site will be re-graded to allow construction of the on-site access road and lots in the central/north portions of the site. This may include construction of retaining walls, cut and fill slopes and use of house concrete foundation walls for slope support. Consequently, the geohazards associated with this slope are not a consideration in this phase of the development approval process

The estimated frequency of geohazards discussed above is provided in Table 2. Recommendations for mitigative measures for the geohazard identified within the site are provided in Section 6 of this report.

Table 2.
Estimation of Annual Return Frequencies for the Entire Site

Type of Geohazard	Estimated Annual Return Frequency
Inundation by flood waters	1<200
Mountain stream erosion and avulsion	< 1:500
Debris flows and debris torrents	< 1:10,000
Debris floods	1:500 – 1:10,000
Small-scale localized landslides	1:500 – 1:10,000
Snow avalanche	<1:10,000
Massive, catastrophic landslides	<1:10,000
Rockfall	< 1:10,000

The estimated annual return frequencies provided in Table 2 were established based on the current site conditions and our engineering judgement, using the information available when this report was prepared. Annual return frequencies can be subject to change should activities such as new construction or change in natural drainage occur on the slope above the site. Climate change could also contribute to change in the estimated geohazard frequencies.

6. CONCLUSIONS AND RECOMMENDATIONS

The acceptability of a proposed subdivision is dependant on the type of hazard, degree of hazard (expressed as the estimated annual return frequency in Table 2), and type of development being considered. Using the 1993 Cave Report as a guideline for assessing the acceptability and the above annual return frequencies, GeoWest considers the site approvable but with a covenant including “save harmless” conditions as well as siting conditions, protective works or both.

To reduce the small-scale landslide hazard identified in this study, we recommend the following:

1. The existing slope below Old Orchard Road should be built up to buttress Old Orchard Road and to improve the site accessibility. The recommended maximum inclination of an unreinforced fill slope is 2H:1V along the south end of the site. Retaining walls may also be used.
2. The above fill placement may need to be supplemented with the local stabilization of Old Orchard Road to prevent the westbound lane from failing into the site. The solution used to stabilize the westbound lane should be reviewed with the City of Chilliwack along with the Lot Grading Plan. Furthermore, the actual method used to stabilize this area will depend on the actual position of the property line and driveway entering the site.
3. The viability of Lot 1 and Lot 4 in their current configuration needs to be reviewed further by GeoWest from a geotechnical perspective. This should be conducted once a Lot Grading Plan becomes available.
4. The houses should be set back at least 3 m from the toe of the fill slope.

Provided that the Lot Grading Plan is acceptable from a geotechnical perspective and the long-term plan includes the stabilization of the westbound lane of Old Orchard Road, it is our opinion that the site of the proposed subdivision can be used safely for the use intended.

We caution that there is a natural gas line located along the edge of Old Orchard Road bordering the site. Any plan for slope stabilization works must consider the protection of its integrity.

The APEGBC Landslide Assurance Statement - Appendix D is attached to this report. It is provided on the following conditions:

1. GeoWest is retained to review the Lot Grading Plan. The findings of that review, along with the completion of site specific test holes for the subdivision design will be provided in a geotechnical report. The recommendations in that report are then followed and GeoWest is given the opportunity to review the construction of such works from a geotechnical engineering perspective.
2. Slope retaining measures must either be designed by or approved by GeoWest.

7. CLOSURE

This geotechnical desktop study report has been prepared by GeoWest Engineering Ltd. exclusively for Freedom Construction c/o OTG Development Concepts and their appointed agents. The City of Chilliwack may also rely on this report for permit review purposes. The information contained in this report reflects our judgement in light of the information provided to us at the time it was prepared.

Any use of this report by third parties, or any reliance on or decisions made based on it, are the responsibility of such third parties. GeoWest does not accept responsibility for damages suffered, if any, by a third party as a result of their use of or reliance on this report. The attached Terms of Reference form an integral part of this report.

We trust the information provided herein meets your immediate requirements. If you have any questions or require additional information, please contact the undersigned.

GeoWest Engineering Ltd.

Reviewed by:

ORIGINAL SIGNED BY:

ORIGINAL SIGNED BY:

Per: Dejan Jovanovic, P.Eng.
Senior Geotechnical Engineer

Per: Calum Buchan, P.E., P.Eng.
Principal

Attachments: Terms of Reference
Figures 1 to 3
Appendix A – Site Photographs
Appendix B – Landslide Assurance Statement (Appendix D)

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- a. **Nature and Exactness of Descriptions:** The classification and identification of soils, rocks and geological units, as well as engineering assessments and estimates have been based on investigations performed in accordance with the standards set out in Paragraph 1 above. The classification and identification of these items are judgmental in nature and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations or assessments utilizing the standards of Paragraph 1 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 all persons making use of such documents or records should be aware of, and accept, this risk. Some conditions are subject to changes over time and the parties 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. Where special concerns exist, or when the Client has special considerations or requirements, the Client must disclose them to GeoWest so that additional or special investigations may be undertaken, which would not otherwise be within the scope of investigations made by GeoWest or the purposes of the Report.
- b. **Reliance on Information:** The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site investigation and field review and on the basis of information provided by GeoWest. GeoWest has relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, GeoWest cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the report as a result of misstatements, omissions, misrepresentations or fraudulent acts of persons providing information.
- c. **Additional Involvement by GeoWest:** To avoid misunderstandings, GeoWest should be retained to assist other professionals to explain relevant engineering findings and to review the geotechnical aspects of the plans, drawings and specifications of other professionals relative to the engineering issues pertaining to the geotechnical consulting services provided by GeoWest. To ensure compliance and consistency with the applicable building codes, legislation, regulations, guidelines and generally-accepted practices, GeoWest should also be retained to provide field review services during the performance of any related work. Where applicable, it is understood that such field review services must meet or exceed the minimum necessary requirements to ascertain that the work being carried out is in general conformity with the recommendations made by GeoWest. Any reduction from the level of services recommended by GeoWest will result in GeoWest providing qualified opinions regarding adequacy of work.

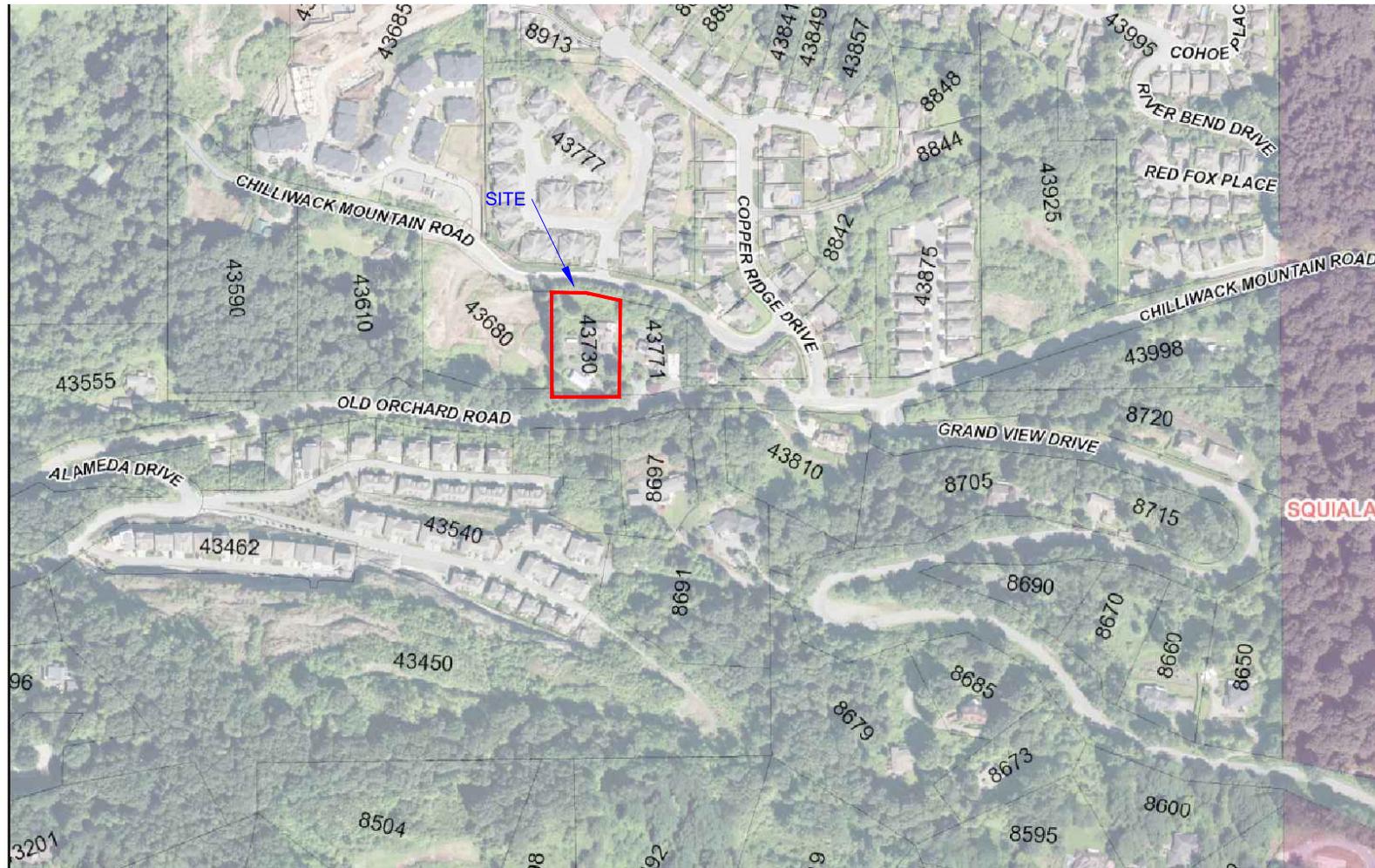
6. ALTERNATE REPORT FORMAT

When GeoWest submits both electronic and hard copy versions of the Instruments of Professional Services, the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding upon GeoWest. The hard copy versions submitted by GeoWest shall be the original documents for record and working purposes, and, in the event of a dispute or discrepancy, the hard copy versions shall govern over the electronic versions; furthermore, the Client agrees and waives all future right of dispute that the original hard copy signed and sealed versions of the Instruments of Professional Services maintained or retained, or both, by GeoWest shall be deemed to be the overall originals for the Project.

The Client agrees that the electronic file and hard copy versions of Instruments of Professional Services shall not, under any circumstances, no matter who owns or uses them, be altered by any party except GeoWest. The Client warrants that the Instruments of Professional Services will be used only and exactly as submitted by GeoWest.

The Client recognizes and agrees that GeoWest prepared and submitted electronic files using specific software or hardware systems, or both. GeoWest makes no representation about the compatibility of these files with the current or future software and hardware systems of the Client, the Approved Users or any other party. The Client further agrees that GeoWest is under no obligation, unless otherwise expressly specified, to provide the Client, the Approved Users and any other party, or any or all of them, with specific software and hardware systems that are compatible with the electronic files submitted by GeoWest. The Client further agrees that should the Client, an Approved User or a third party require GeoWest to provide specific software or hardware systems or both, compatible with electronic files prepared and submitted by GeoWest, for any reason whatsoever included but not restricted to and order from a court, then the Client will pay GeoWest for all reasonable costs related to the provision of the specific software or hardware systems, or both. The Client further agrees to indemnify and hold harmless GeoWest, its officers, directors, employees, agents, representative or sub-consultant, or any or all of them, against any claim or any nature whatsoever brought against GeoWest, whether in contract or in tort, arising or related to the provision or use of any specific software or hardware provided by GeoWest.

FIGURES



REVISIONS				
REV	Date	Issue/Revision Description	Drawn	Check
△	27 November 2017	Issued for Review	DJ	CB

ADAPTED FROM:
CITY OF CHILLIWACK WEBMAP

DWG. NO.:
N/A

DATE/REV.:
N/A

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TITLE:
**GEOHAZARD SITE ASSESSMENT
SITE LOCATION MAP**

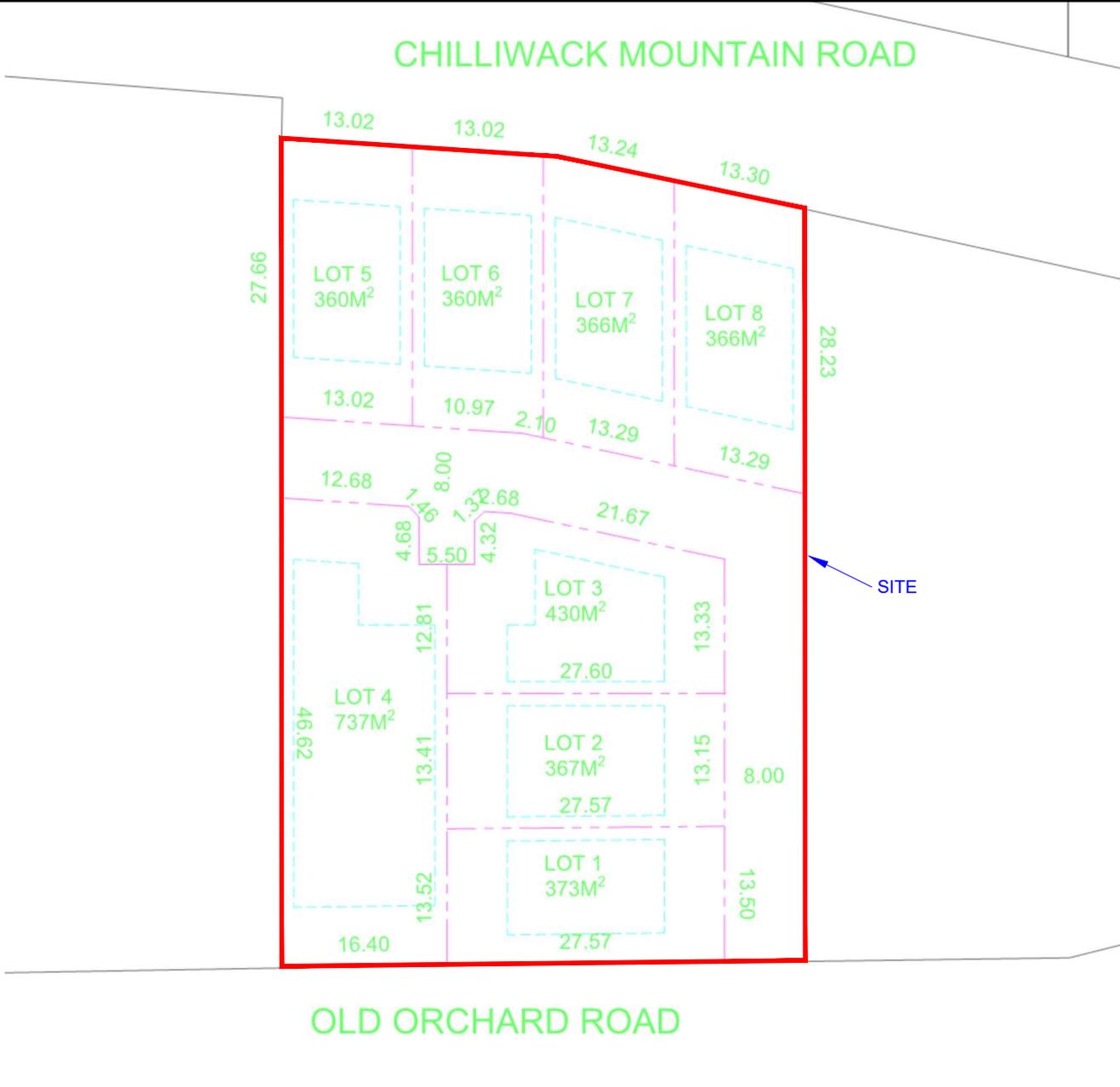
PROJECT:
PROPOSED RESIDENTIAL SUBDIVISION

ADDRESS:
43730 CHILLIWACK MT. ROAD, CHILLIWACK

CLIENT:
FREEDOM CONST. c/o OTG DEVELOPMENTS



DESIGN:	N/A	DATE:	NOV. 2017
CHECK:	CB	SCALE:	NTS
DRAWN:	DJ	FILE NO.:	GA17-1083-00
FIGURE NO.:	1		

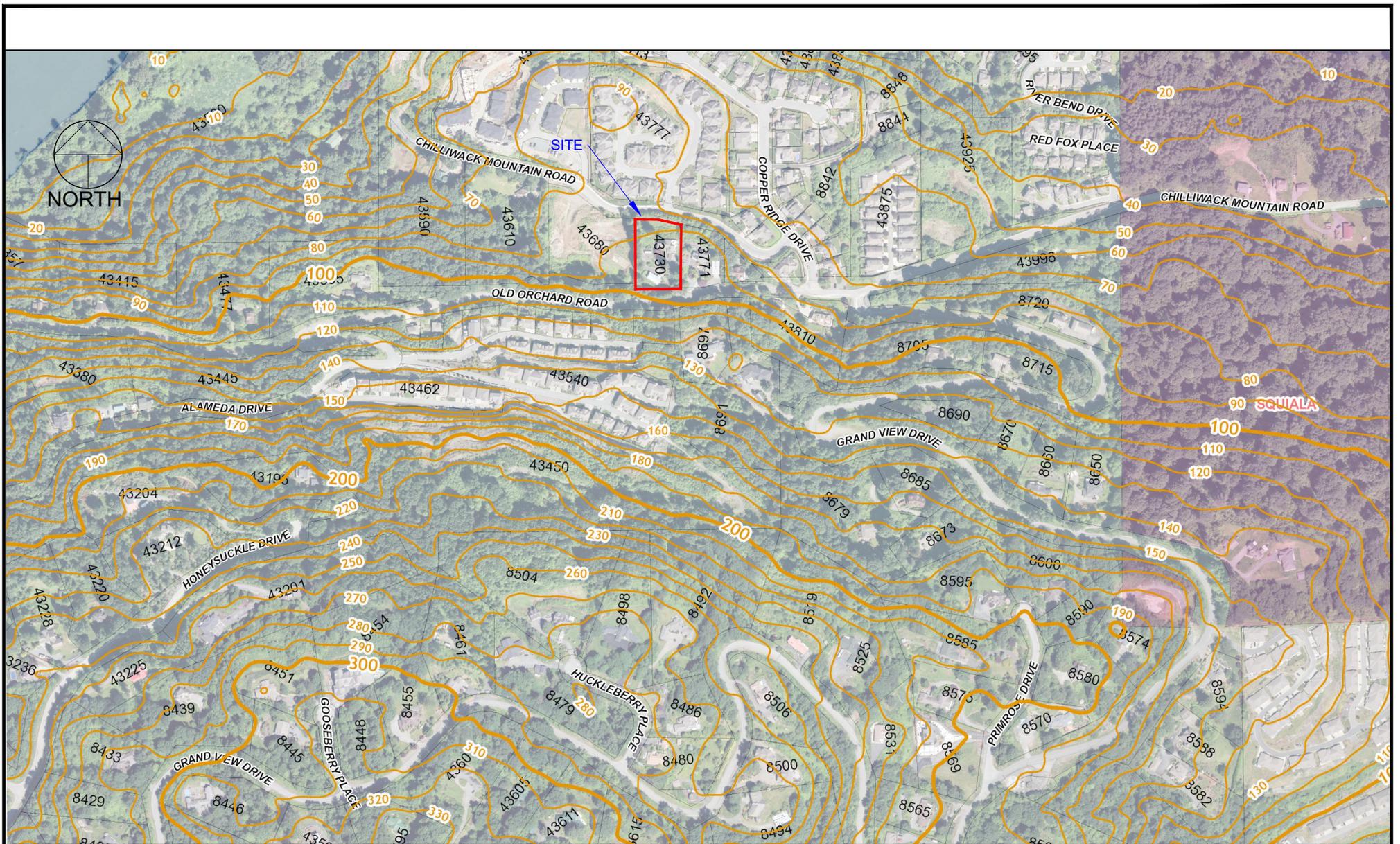


REV	Date	Issue/Revision Description	Drawn	Check
△	27 November 2017	Issued for Review	DJ	CB

ADAPTED FROM: OTG DEVELOPMENT CONCEPTS
DWG. NO.: 1
DATE/REV.: JULY 10, 2017
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TITLE: GEOHAZARD SITE ASSESSMENT SITE PLAN
PROJECT: PROPOSED RESIDENTIAL SUBDIVISION
ADDRESS: 43730 CHILLIWACK MT. ROAD, CHILLIWACK
CLIENT: FREEDOM CONST. c/o OTG DEVELOPMENTS

DESIGN: N/A	DATE: NOV. 2017
CHECK: CB	SCALE: NTS
DRAWN: DJ	FILE NO: GA17-1083-00
FIGURE NO: 2	



REVISIONS				
REV	Date	Issue/Revision Description	Drawn	Check
	27 November 2017	Issued for Review	DJ	CB

ADAPTED FROM:
CITY OF CHILLIWACK WEBMAP

DWG. NO.: N/A

DATE/REV.: N/A

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TITLE:
**GEOHAZARD SITE ASSESSMENT
TOPOGRAPHIC MAP**

PROJECT:
PROPOSED RESIDENTIAL SUBDIVISION

ADDRESS:
43730 CHILLIWACK MT. ROAD, CHILLIWACK

CLIENT:
FREEDOM CONST. c/o OTG DEVELOPMENTS



DESIGN:	N/A	DATE:	NOV. 2017
CHECK:	CB	SCALE:	NTS
DRAWN:	DJ	FILE NO.:	GA17-1083-00
FIGURE NO.:	3		

APPENDIX A
SITE PHOTOGRAPHS



Photograph 1. – slope in north region of the site, looking northeast



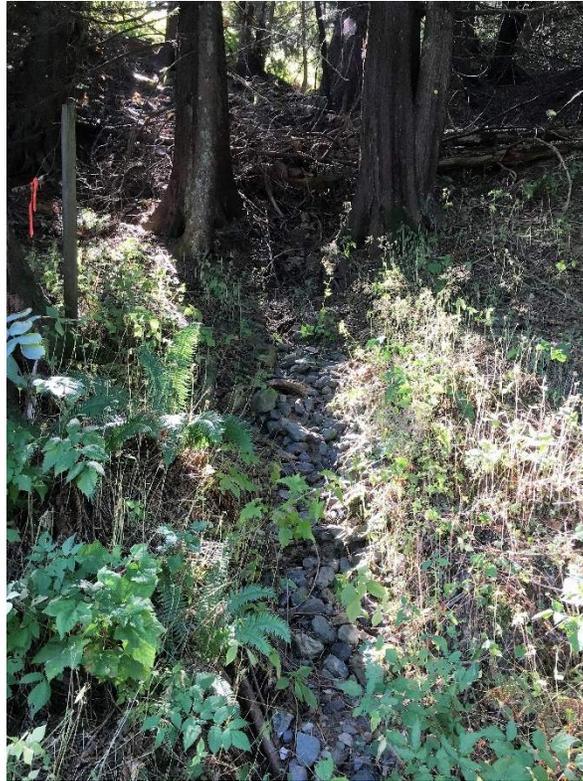
Photograph 2. – test pit



Photograph 3. – slope cut along west property line of the site, looking east



Photograph 4. – slope below Old Orchard Road, looking west



Photograph 5. – ditch above Old Orchard Road



Photograph 6.

APPENDIX B
LANDSLIDE ASSURANCE STATEMENT

APPENDIX D: LANDSLIDE ASSESSMENT ASSURANCE STATEMENT

Note: This Statement is to be read and completed in conjunction with the "APEGBC Guidelines for Legislated Landslide Assessments for Proposed Residential Development in British Columbia", March 2006/Revised September 2008 ("APEGBC Guidelines") and the "2006 BC Building Code (BCBC 2006)" and is to be provided for *landslide assessments* (not floods or flood controls) for the purposes of the Land Title Act, Community Charter or the Local Government Act. Italicized words are defined in the APEGBC Guidelines.

To: The Approving Authority

Date: 27 NOVEMBER 2017

CITY OF CHILLIWACK
8550 YOUNG RD. CHILLIWACK
Jurisdiction and address BC, V2P 8A4

With reference to (check one):

- Land Title Act (Section 86) – Subdivision Approval
- Local Government Act (Sections 919.1 and 920) – Development Permit
- Community Charter (Section 56) – Building Permit
- Local Government Act (Section 910) – Flood Plain Bylaw Variance
- Local Government Act (Section 910) – Flood Plain Bylaw Exemption
- British Columbia Building Code 2006 sentences 4.1.8.16 (8) and 9.4.4.4.(2) (Refer to BC Building and Safety Policy Branch Information Bulletin B10-01 issued January 18, 2010)

For the Property:

LOT 15 DISTRICT LOT 275 GROUP 2 NEW WESTMINSTER DISTRICT PLAN 29819
Legal description and civic address of the Property 43730 CHILLIWACK MT. ROAD, CHILLIWACK

The undersigned hereby gives assurance that he/she is a *Qualified Professional* and is a *Professional Engineer* or *Professional Geoscientist*.

I have signed, sealed and dated, and thereby certified, the attached *landslide assessment* report on the Property in accordance with the *APEGBC Guidelines*. That report must be read in conjunction with this Statement. In preparing that report I have:

Check to the left of applicable items

- 1. Collected and reviewed appropriate background information
- 2. Reviewed the proposed *residential development* on the Property
- 3. Conducted field work on and, if required, beyond the Property
- 4. Reported on the results of the field work on and, if required, beyond the Property
- 5. Considered any changed conditions on and, if required, beyond the Property
- 6. For a *landslide hazard analysis* or *landslide risk analysis* I have:
 - 6.1 reviewed and characterized, if appropriate, any *landslide* that may affect the Property
 - 6.2 estimated the *landslide hazard*
 - 6.3 identified existing and anticipated future *elements at risk* on and, if required, beyond the Property
 - 6.4 estimated the potential *consequences* to those *elements at risk*
- 7. Where the *Approving Authority* has adopted a *level of landslide safety* I have:
 - 7.1 compared the *level of landslide safety* adopted by the *Approving Authority* with the findings of my investigation
 - 7.2 made a finding on the *level of landslide safety* on the Property based on the comparison
 - 7.3 made recommendations to reduce *landslide hazards* and/or *landslide risks*
- 8. Where the *Approving Authority* has **not** adopted a *level of landslide safety* I have:

- 8.1 described the method of *landslide hazard analysis* or *landslide risk analysis* used
- 8.2 referred to an appropriate and identified provincial, national or international guideline for *level of landslide safety*
- 8.3 compared this guideline with the findings of my investigation
- 8.4 made a finding on the *level of landslide safety* on the Property based on the comparison
- 8.5 made recommendations to reduce *landslide hazards* and/or *landslide risks*
- 9. Reported on the requirements for future inspections of the Property and recommended who should conduct those inspections.

Based on my comparison between

Check one

- the findings from the investigation and the adopted *level of landslide safety* (item 7.2 above)
- the appropriate and identified provincial, national or international guideline for *level of landslide safety* (item 8.4 above)

I hereby give my assurance that, based on the conditions^[1] contained in the attached *landslide assessment* report,

Check one

- for subdivision approval, as required by the Land Title Act (Section 86), "that the land may be used safely for the use intended"

Check one

- with one or more recommended registered covenants.
- without any registered covenant.

- for a development permit, as required by the Local Government Act (Sections 919.1 and 920), my report will "assist the local government in determining what conditions or requirements under [Section 920] subsection (7.1) it will impose in the permit".
- for a building permit, as required by the Community Charter (Section 56), "the land may be used safely for the use intended"

Check one

- with one or more recommended registered covenants.
- without any registered covenant.

- for flood plain bylaw variance, as required by the "Flood Hazard Area Land Use Management Guidelines" associated with the Local Government Act (Section 910), "the development may occur safely".
- for flood plain bylaw exemption, as required by the Local Government Act (Section 910), "the land may be used safely for the use intended".

DEJAN JOVANOVIC, P.ENG.

Name (print)



Signature

27 NOVEMBER 2017

Date

^[1] When seismic slope stability assessments are involved, *level of landslide safety* is considered to be a "life safety" criteria as described in the National Building Code of Canada (NBCC 2005), Commentary on Design for Seismic Effects in the User's Guide, Structural Commentaries, Part 4 of Division B. This states:

"The primary objective of seismic design is to provide an acceptable level of safety for building occupants and the general public as the building responds to strong ground motion; in other words, to minimize loss of life. This implies that, although there will likely be extensive structural and non-structural damage, during the DGM (design ground motion), there is a reasonable degree of confidence that the building will not collapse nor will its attachments break off and fall on people near the building. This performance level is termed 'extensive damage' because, although the structure may be heavily damaged and may have lost a substantial amount of its initial strength and stiffness, it retains some margin of resistance against collapse".

106-2480 MT. LEHMAN RD.

Address

ABBOTSFORD, BC V4X 2N3

604 852 9088

Telephone



27 NOV 2017

(Affix Professional seal here)

If the *Qualified Professional* is a member of a firm, complete the following.

I am a member of the firm GEOWEST ENGINEERING LTD.
and I sign this letter on behalf of the firm. (Print name of firm)