

July 19, 2012

Project No. 1014940294-001-L-Rev0

Gordon Cory
Worthington Business
Suite 304, The Central Building
153 Seymour Street
Kamloops, BC
V2C 2C7

**REVISED GEOHAZARD ASSESSMENT PROPOSED SUBDIVISION OF PROPERTY NE1/4 OF
SECTION 27, TP22, RG.17 W6M KDYD PLAN B11979, WESTSYDE ROAD, NORTH OF KAMLOOPS, BC**

Dear Mr. Cory:

As requested, Golder Associates Ltd. (Golder) performed a Geotechnical Assessment of potential terrain hazards at the above-noted property for the purpose of identifying areas suitable for construction of a residential house on each lot with respect to identified geohazards, that is, to confirm that the land may be used safely for the use intended. This letter is the revision, based on additional information, of the original report issued on January 25, 2011, and supercedes that previous report. This report provides the results of our field review and assessment of the site.

The professional services retained for this project are limited to the specified Geohazard Assessment at the site, as outlined in our Proposal P0-1494-0294 dated January 28, 2010. The scope of services does not include any investigations, analytical testing or assessments of possible soil and groundwater contamination, biological or archaeological considerations or sediment control measures.

The reader is referred to the section entitled "Important Information and Limitations of this Report" which follows the text but forms an integral part of this document and affects the proper use and interpretation of this report.

This report has been prepared for Mr. Gordon Cory in support of the proposed lot subdivision. Reliance on this material by any party other than Mr. Gordon Cory and his immediate design team, or for any other purpose other than assessment of the proposed land subdivision is expressly forbidden, unless authorized in writing by Golder Associates Ltd. The Ministry of Transportation and Thompson Nicola Regional District may rely on this report for subdivision approval purposes associated with the intended use of the property.

1.0 BACKGROUND INFORMATION

The subject site is an approximately 114.8 acre parcel west of Westsyde Road, north of Kamloops (Figure 1). The site contains an approximately 50 to 120 m wide strip of gently sloped grassland adjacent to Westsyde Road, while the western portion of the property consists of vegetated moderately-steep slopes covered with trees. The subject subdivision is currently undeveloped but is understood to have an existing well.

It is understood that the Owner proposes to subdivide the subject property into four lots, Lot A to Lot D, as shown of Figure 2. It is also understood that the proposed building locations for all four proposed lots are on the gently sloping grassland area which is adjacent to Westsyde Road.

The BC Ministry of Transportation (MoT) considers that the subject site may be subject to natural geohazards and a site specific geohazard assessment is required in support of the subdivision application.

2.0 METHOD

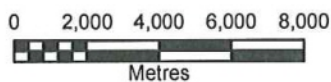
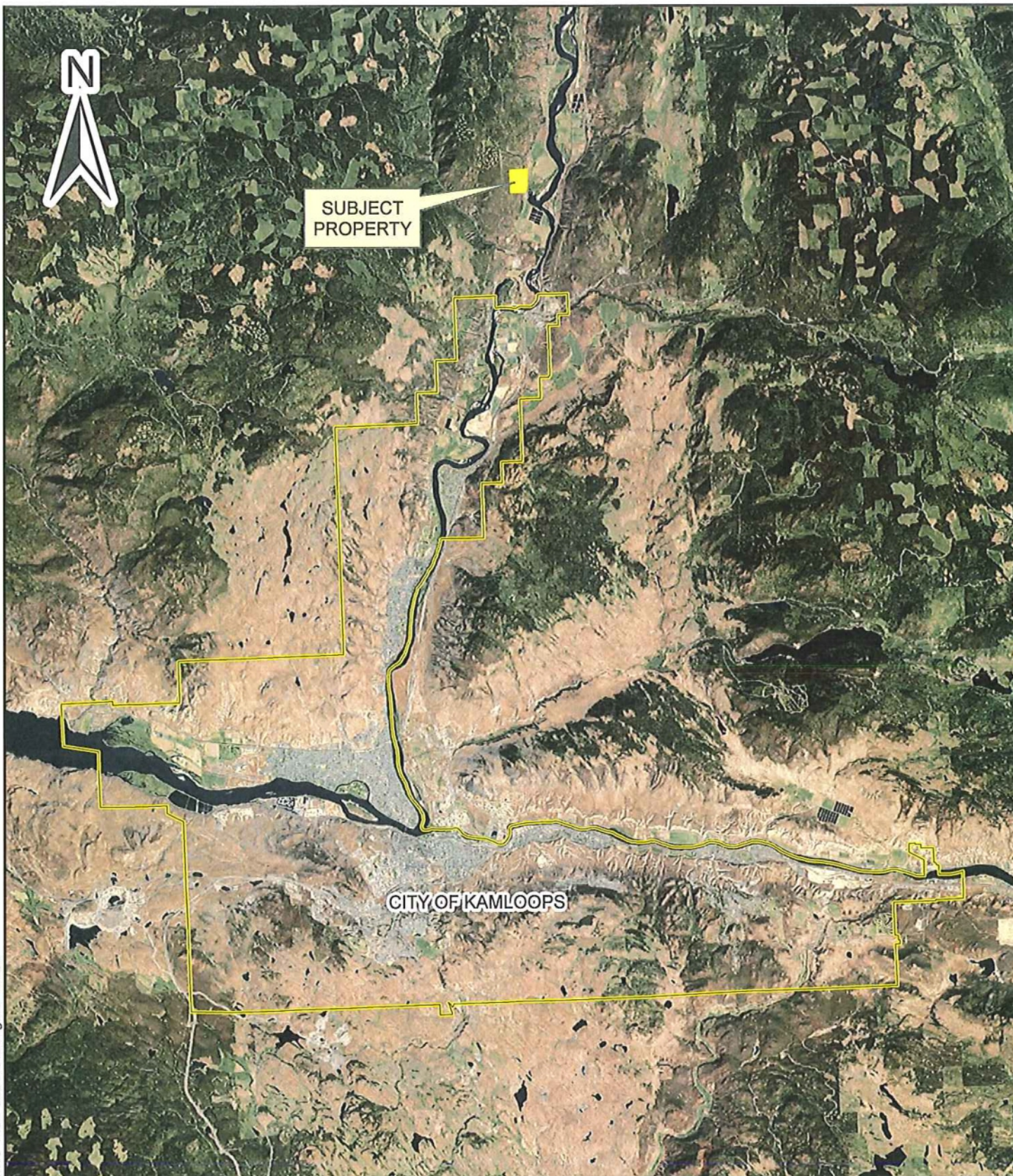
Aerial photographs were used to review large scale topographic features of the subject site and adjoining area and identify potential geohazards to be subsequently examined and assessed in the field during the site reconnaissance.

The initial site reconnaissance, performed on November 18, 2010, consisted of a walk-over of the subject site. GPS waypoints were recorded using a handheld unit to identify the approximate locations of selected terrain features. Several approximate slope profiles were measured in the field using a hand held clinometer. A second targeted reconnaissance of some specific features was conducted on December 2, 2011. On December 13, 2011, the undersigned returned to the site to flag the toe of the steep slopes to the west, during which time Allnorth Land Surveyors (Allnorth) initiated the survey of the flagged line. It is understood that Allnorth completed the survey of the flagged line on January 5, 2012.

3.0 SITE DESCRIPTION


The site is located along the west side of Westsyde Road, approximately 30 km north of the downtown core of Kamloops, BC and about 3 km south of the Black Pines Settlement. The subject property is divided into four proposed lots (Lot A to Lot D) as shown in Figure 2.

Slopes rising to the west above the site comprise the east flank of Jamieson Range, a generally flat topped ridge located between the Jamieson Creek valley and the North Thompson River valley. At the site location, the ridge rises about 550 m above the toe of the ridge slope on the subject property. Available topographic mapping (Map 92-I/16, Heffley Creek, Ministry of Energy, Mines and Resources Canada, 1:50,000 scale) indicates that the average grade of the slopes above the site is roughly 2.3 horizontal to 1 vertical (23.5 degrees) or flatter. The slopes are covered with trees and low vegetation. Dead standing trees and fallen trees are commonly observed at the site. As previously described, located between the toe of the ridge slopes and Westsyde Road is a strip of gently sloping grassland. No large cobbles and boulders indicative of potential rockfall hazard, and no depositional elements indicative of debris flow activity, were observed on the gently sloping proposed development area or at the toe of the steeper slopes.

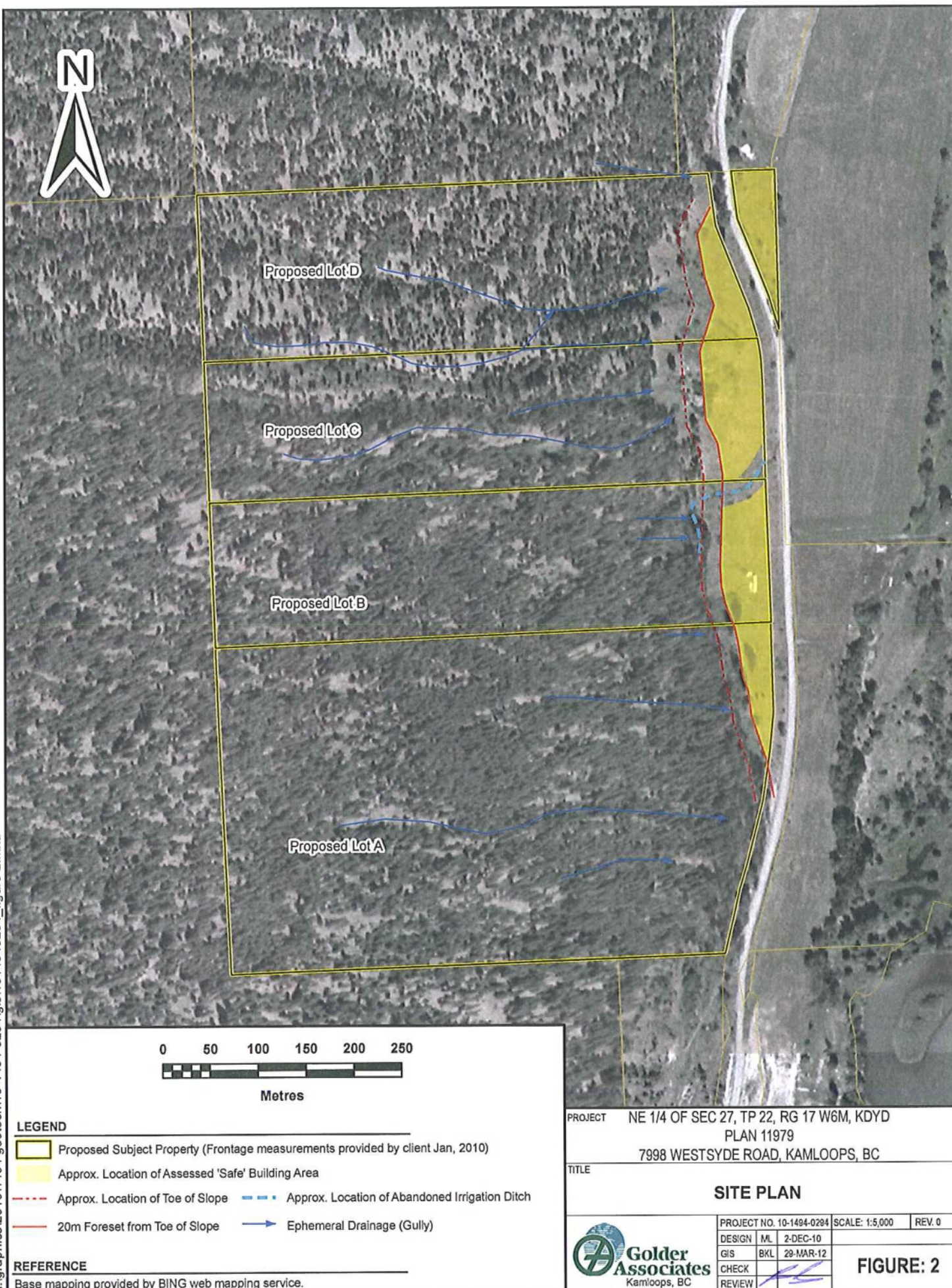


REFERENCE

Base mapping provided by BING web mapping service.

PROJECT		NE 1/4 OF SEC 27, TP 22, RG 17 W6M, KDYD PLAN 11979 7998 WESTSYDE ROAD, KAMLOOPS, BC		
TITLE		KEY PLAN		
 Golder Associates Kamloops, BC		PROJECT NO. 10-1494-0294	SCALE: 1:200,000	REV. 0
		DESIGN ML	2-DEC-10	FIGURE: 1
		GIS BL	2-DEC-10	
		CHECK ML	25-JAN-11	
		REVIEW BB	25-JAN-11	

n:\graphics\2010\1494 geotech\10-1494-0294\gis\1014940294_figure 2.mxd



The slopes above the proposed development area are incised by a series of well separated minor gullies oriented in the downslope direction. The gullies are assessed to be ephemeral drainage channels that terminate in colluvial fans, commonly coalescing colluvial fans, which comprise the gently sloping terrain on the eastern parts on the proposed lots. However, there were observed to be localized occurrences of steeply sloping fan deposits containing cobbles which have developed at the outlets of some of the minor gullies. At the time of the reconnaissance, the gullies were dry and the gently sloping terrain at the toe of the ridge (beyond any local steeply sloping fan deposits) was covered by grass with no observed signs of recently deposited material. There are reportedly two irrigation ditches on the lower slopes (only the lower ditch was observed in the reconnaissance) both of which were reportedly historically fed by diversion from Jamieson Creek in the early 20th Century. As reported by Mr. Cory, it is understood that the irrigation ditches have been abandoned and non-functional for in excess of 70 years. The lower of the two abandoned irrigation ditches crosses through the south side of Lot C (refer to Figure 2).

Based on surficial geology mapping of the area (Surficial Geology, Kamloops Lake, West of sixth Meridian, British Columbia. Fulton, R J, 1976. Geological Survey of Canada, 1394A.), the surficial deposits in the proposed development area at the toe of the slopes are mapped as fan deposits consisting of poorly sorted gravel, sand, silt and clay. On the slopes the deposits are mapped as morainal soils (glacial till) consisting of poorly sorted gravel, boulders, sand, silt and clay. Based on information contained on the BC Geological Survey website (<http://webmap.em.gov.bc.ca/mapplace/minpot/bcgs.cfm>), the underlying bedrock consists of mudstone, siltstone and shale bedrock of the Harper Ranch and Nicola Groups.

Some soil exposures and bedrock outcrops were observed during the site reconnaissance. The observed soil deposits were found to comprise a mixture of poorly sorted silt and sand with some gravel, containing cobbles and small boulders. The bedrock outcrops consist of siltstone and shale bedrock. Small boulders and cobbles with diameters up to 300 mm were commonly observed mainly on the slopes and near (typically within 10 m of) the toe of the slopes, however, the rocks were not prominent, but were typically fully embedded in the surrounding soil.

4.0 GEOHAZARD ASSESSMENT

For purposes of this assessment, a "safe" building site refers to a site in which the identified geohazards are assessed to satisfy, either before or after mitigation, the commonly used provincial geohazard guideline of 10% probability of occurrence in 50 years. For this site, it is assessed that "safe" building areas can be achieved by positioning proposed buildings outside of existing ephemeral drainage paths, and by application of suitable foresets from the toe of adjoining slopes.

The following potential terrain hazards were identified on the subject site:

- Rockfall / Rolling Rocks;
- Ephemeral Drainage including steeply slope fan deposits at some gully outlets; and
- Other Hazards.

4.1 Fragmental Rockfall / Rolling Rock

Based on interpretation of available information and site observation, it is inferred that below the surficial layer, the slopes generally consist of bedrock overlain by morainal soil cover (generally glacial till) of variable thickness, commonly containing boulders and cobbles with diameters up to 300 mm. Empirical assessment (Evans and Hungr, The Assessment of Rockfall Hazard at the Base of Talus Slopes, Cdn Geotechnical Journal, v.30, 1993) has shown that rolling rock from fragmental rockfall is confined within a rockfall shadow zone defined by a 27.5 degree projection from the top of the talus fan. Available mapping indicates that the ridge slopes average about 23.5 degrees from horizontal and site observation confirms that the lower ridge slopes are generally moderate and show no evidence of a developed talus fan. Accordingly, it is assessed that, within the proposed gently sloped development area between the toe of the ridge slopes and Westsyde Road any cobbles and boulders on the slope are, in general, stable and will not move unless actively disturbed by physical force (such as someone pushing them). Even if disturbed, cobbles and boulders will tend to come to rest on the slope or within a few metres of the toe of the slope.

To address the potential of rolling rocks reaching building sites, a conservative minimum building foreset of 20 m from the toe of the moderately steep ridge slopes is recommended. As previously noted, the toe of the steep ridge slopes was flagged by Golder, and the flagged line was surveyed by Allnorth Land Surveyors. Residential building sites on the subject site which have a minimum 20 m foreset from the flagged line are considered to be "safe" with respect of geotechnical rolling rock hazard. This foreset is not intended to apply to septic fields and backup fields, yards, gardens, or storage sheds which are considered acceptable uses of the residential building foreset zone.

4.2 Drainage

The gullies noted on the hillside are assessed to be ephemeral drainage channels. Available mapping indicates that the gullies have quite limited collection areas. The channels appear to terminate where the slopes of the valley wall intercept the colluvial fans. At some gully locations, small local steeply sloping fans have developed at the gully outlets; the steep fans consisting largely of coarse rocky debris washed out of the gullies and deposited just beyond the outlet. At the time of the reconnaissance, the gullies were dry and the fan deposits extending from the gully outlets were covered by grass with no obvious signs of active drainage channels or recently deposited alluvium. Though the gullies are assessed to be generally inactive at this time other than for ephemeral drainage, recent experience with forest fires suggests that minor gullies such as those present on the subject site may become more active and susceptible to debris flood for a period of several years following a forest fire.

Accordingly, it is our professional opinion that the drainage hazard to the proposed site from flow originating within the hillside gullies is low, with the potential to increase to moderate for several years after the slopes have denuded by forest fire, and that appropriate site selection and minor site grading works, such as locating houses outside the direct path of any drainage which might come from the ephemeral drainage channels and raising the lower floor level 1 m above the surrounding grade to direct surface water away from the houses, should provide adequate protection from runoff. Accordingly, it is recommended that:

- 1) houses be located offset at least 30 m from the projected discharge path from outlet of each of the main gullies;
- 2) houses be located outside the area of any local low lying land, ditch or ephemeral drainage channel;

- 3) the perimeter grade surrounding the houses be elevated at least 1 m above any nearby low point or apparent ephemeral drainage channel; and
- 4) the house perimeter grade to be shaped and graded to direct surface runoff away from the building.

If any of the above four drainage recommendations is not satisfied by the selected site location and grading, a geotechnical engineer should be retained to review the proposed site grading and, if required, to recommend measures such as ditching, regrading and/or deflection berms to mitigate the assessed drainage hazard.

4.3 Other Hazards

The forest on the hillside contains a relatively high proportion of dead trees that are still standing, and some fallen trees. In the event that the houses are located close to the forested hillside there is a risk of forest fire and falling trees. While forest fire is not considered as geotechnical hazard, it is recommended that a fire risk study be prepared for the site by specialists in the field.

5.0 PROPOSED BUILDING SITES

Golder has identified and delineated a "safe" building area on the property with respect to rolling rock geohazard which includes land suitable for development of a single family residential house on each lot, as indicated in Figure 2. The lot boundaries and the location of assessed toe of slope as flagged in the field by Golder are shown in Figure 2, and are located as provided to Golder by the client on an unsigned Allnorth Subdivision Plan received by Golder on January 27, 2012. The location of the toe of slope provided in the Allnorth Subdivision Plan also matches our own GPS reference points collected during flagging of the line, providing corroboration that the toe of slope line is accurately located.

The assessed safe building areas (with respect to rolling rock geohazard) for single family house development were determined by adding a 20 m foreset from the surveyed toe of slope line. The assessed building areas are all located on the lower gently sloping and grass covered portion of the lots near Westsyde Road.

Safe Building Area – Lot A

The identified safe building area for a single family residential dwelling on proposed Lot A is located on the north east corner of the Lot. We understand that there may be some interest in locating a building site on a small elevated terrace within the tree covered slope. While this study has not determined that the elevated terrace site is safe with respect to geotechnical hazard for house construction, the terrace building site could be considered in future, subject to the results of a site specific geohazard assessment of this alternate potential building site.

Safe Building Area – Lots B & C

The identified safe building area for a single family residential dwelling on each of proposed Lots B and C is located along the east side of the Lots.

Safe Building Area – Lot D

The identified safe building area for a single family residential dwelling on proposed Lot D is located along the east side of the lot, but does not extend fully to the north end of the lot where the ground is rougher and steeper than elsewhere on the lot.

It is assessed that the recommended 20 m foreset from the toe of slope, together with the four drainage recommendations, are sufficient to define safe building sites for single family residential dwellings and "land that may be used safely for the use intended". The location and topography of the house sites to be selected within the identified safe building area on each lot (with respect to rolling rock geohazard) is not known at this time. If a selected house site and proposed grading does not satisfy the four drainage recommendations, then it is recommended that a geotechnical engineer with suitable training and experience in geohazard assessments be retained to review the selected house site. The geotechnical engineer may approve the selected house site with respect to geohazards or recommend relocation or mitigation, as appropriate.

6.0 CONCLUSIONS

The results of the Geohazard Assessment indicate that each of the proposed subject lots contain "land that may be used safely for the use intended" with respect to rolling rock geotechnical hazard, located as shown on Figure 2, and development on the subject site is considered feasible with respect to the identified geohazards, subject to a 20 m foreset from the assessed "toe of slope" and implementation of the four drainage recommendations provided herein.

The assessed toe of slope was flagged by Golder and surveyed by Allnorth

If the four drainage recommendations are not satisfied by the selected house site and grading, it is recommended that a geotechnical engineer with suitable training and experience in geohazard assessments be retained to review the selected house site.

The identification of "safe" building areas (or land that may be used safely for the use intended) based on a limited scope of study does not preclude the possibility that additional "safe" areas might be identified through additional study. Accordingly, where there are proposed alternate building sites located outside the currently defined limits, such sites could be reviewed in an additional site specific geohazard assessment beyond the scope of the current study. Please note that the results of such a site specific geohazard assessment may or may not support development of a selected alternate site. Golder would be pleased to prepare a proposal for additional site specific geohazard assessments, if requested.

No other geohazards were identified as potentially affecting the potential house sites.

The Geohazard Assessment conducted was subjective and limited to review of available topographic maps and aerial photographs, and ground reconnaissance of the area of the subject property. Assessments were based on geomorphic interpretation of landforms to evaluate the spatial distribution of past geohazard occurrences as an indicator of the nature and distribution of future geohazards likely to affect the site.

Subject to the implementation of the recommendations provided herein, the geohazards would not be expected to be life-threatening or catastrophic and, accordingly, the 1 in 10,000 year hazard criterion is not considered applicable. Accordingly, subject to implementation of the recommendations contained herein, the building areas shown on Figure 2 are considered to satisfy a 10% in 50 years hazard risk criterion for the identified geohazards.

This geohazard assessment was prepared based on information available at the time of assessment. If new information relevant to this geohazard assessment becomes available, Golder should be retained to review the new information and to confirm or amend the geotechnical recommendations provided herein, as appropriate in the light of the new information.

7.0 CLOSURE

We trust that this report meets your requirements at this time. Golder appreciates the opportunity of working on this project with you. If you have questions, please contact the undersigned.

Yours truly,

GOLDER ASSOCIATES LTD.

 
Bruce Bosdet, M.A.Sc., P.Eng.
Principal, Senior Geotechnical Engineer
July 19/2012

ML/BB/ap

Attachments: Important Information and Limitations of this Report

n:\active\2010\1494 geotech\10-1494-0294 geohazard north of kamloops\deliverables to client\word\1014940294-001-l-rev0-geohazard assessment 19jul_12.docx

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT (cont'd)

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. **The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report.** The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.

SURVEY PLAN CERTIFICATION
PROVINCE OF BRITISH COLUMBIA

By incorporating your electronic signature into this form you are also incorporating your electronic signature into the attached plan and you
(a) represent that you are a subscriber and that you have incorporated your electronic signature to the attached electronic plan in accordance with section 168.73 (3) of the Land Title Act, RSBC 1996 c.250; and
(b) certify the matters set out in section 168.73 (4) of the Land Title Act,
Each term used in this representation and certification is to be given the meaning ascribed to it in part 10.1 of the Land Title Act.

WALTER
SINGER
KWX6B1

Digitally signed by WALTER SINGER
KWX6B1
DN: c=CA, cn=WALTER SINGER
KWX6B1, o=BC Land Surveyor,
ou=Verify ID at www.juricert.com/
LKUP.cfm?id=KWX6B1
Date: 2014.01.16 12:23:08 -08'00'

1. BC LAND SURVEYOR: (Name, address, phone number)

Import Profile

WALTER H SINGER
ALLNORTH LAND SURVEYORS
SUITE 301 - 7 ST PAUL STREET WEST
KAMLOOPS BC V2C 1E9

wsinger@allnorth.com
250-374-5331
13LS0388 COV

☐ Surveyor General Certification [For Surveyor General Use Only]

2. PLAN IDENTIFICATION:

138-990-3788

Plan Number: EPP25754

3. CERTIFICATION:

☒ Form 9 ☐ Explanatory Plan ☐ Form 9A

2012	November	10	
2012	December	20	144384
2005	January	01	

☒ None ☐ Strata Form S

☒ None ☐ Strata Form U1 ☐ Strata Form U1/U2

Arterial Highway ☐

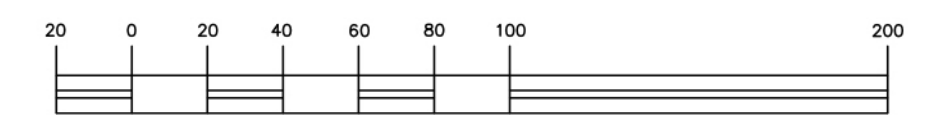
4. ALTERATION: ☐

PLAN EPP25754

REFERENCE PLAN TO ACCOMPANY
A COVENANT IN
LOTS A,B,C AND D, Sec. 27, Tp. 22, R. 17, W6M
KAMLOOPS DIVISION YALE DISTRICT
PLAN EPP25753

PURSUANT TO SECTION 99(1)(e) OF
THE LAND TITLE ACT

B.C.G.S. 92 I .089



SCALE 1:2000
All distances are in metres

THE INTENDED PLOT SIZE OF THIS PLAN IS 864mm IN WIDTH BY
560mm IN HEIGHT (D SIZE) WHEN PLOTTED AT A SCALE OF 1:2000.

BEARINGS ARE ASTRONOMIC AND ARE DERIVED FROM PLAN EPP25753.

LEGEND
●STANDARD IRON POST FOUND
○STANDARD IRON POST PLACED
⊙STANDARD CAPPED POST FOUND
RP.....DENOTES REFERENCE POST
▲TRAVERSE HUB FOUND
Pcl. ..DENOTES PARCEL

BEARINGS TO BEARING TREES ARE MAGNETIC.

THIS PLAN LIES WITHIN THE THOMPSON-NICOLA REGIONAL DISTRICT.

THE FIELD SURVEY REPRESENTED BY THIS PLAN WAS COMPLETED
BY WALTER SINGER, BCLS ON THE 10th DAY OF NOVEMBER, 2012.

ALLNORTH LAND SURVEYORS
#301-7 ST. PAUL STREET WEST,
KAMLOOPS, BC, V2C 1E9
TEL: 250-374-5331 FAX: 250-374-5332
DRAWN BY: WS
DRAWING NO: 11LC0388 COV (EPP25754)
FILE NO: 11LC0388
FB: 315 P: 92-
FB: 283 P: 109-114

Sec. 34
Tp. 22,
S.W. 1/4
R. 17,
W. 6 M.
L.S. 2

Fd. BT'S	Mkd.	Meas
0.25 FIR 147"	11.95	11.95
0.35 FIR 050"	10.95	10.95
0.35 FIR 358"	6.7	6.7

LOT D
AREA REQUIRED Pcl. A = 0.439ha
AREA REQUIRED Pcl. B = 0.427ha
TOTAL AREA REQUIRED = 0.866ha

PLAN EPP25753

LOT C
AREA REQUIRED = 0.866ha

LOT B
AREA REQUIRED = 0.756ha

LOT A
AREA REQUIRED = 0.376ha

PLAN EPP25753

Sec. 27, Tp. 22, R. 17

S.W. 1/4
Sec. 27
Tp. 22
R. 17
W. 6 M.

Fd. BT'S	Mkd.	MEAS.
0.25 FIR 240"	4.87	4.87
0.35 FIR 323"	5.54	5.54
0.35 FIR 120"	11.24	11.24

Rem. S.E.1/4

Sec. 27, Tp. 22, R. 17, W. 6 M.

EASTERLY 3/4
OF THE S. 1/2
OF L.S. 1
EXCEPT
D.L. 335

L.S. 1

D.L. 335

WESTSYDE ROAD

R/W PLAN A1362
S.R.W. PLAN KAP44430

PLAN KAP91162

Fr. L.S. 8

NORTH THOMPSON RIVER

July 19, 2012

Project No. 1014940294-001-L-Rev0

Gordon Cory
Worthington Business
Suite 304, The Central Building
153 Seymour Street
Kamloops, BC
V2C 2C7

**REVISED GEOHAZARD ASSESSMENT PROPOSED SUBDIVISION OF PROPERTY NE1/4 OF
SECTION 27, TP22, RG.17 W6M KDYD PLAN B11979, WESTSYDE ROAD, NORTH OF KAMLOOPS, BC**

Dear Mr. Cory:

As requested, Golder Associates Ltd. (Golder) performed a Geotechnical Assessment of potential terrain hazards at the above-noted property for the purpose of identifying areas suitable for construction of a residential house on each lot with respect to identified geohazards, that is, to confirm that the land may be used safely for the use intended. This letter is the revision, based on additional information, of the original report issued on January 25, 2011, and supercedes that previous report. This report provides the results of our field review and assessment of the site.

The professional services retained for this project are limited to the specified Geohazard Assessment at the site, as outlined in our Proposal P0-1494-0294 dated January 28, 2010. The scope of services does not include any investigations, analytical testing or assessments of possible soil and groundwater contamination, biological or archaeological considerations or sediment control measures.

The reader is referred to the section entitled "Important Information and Limitations of this Report" which follows the text but forms an integral part of this document and affects the proper use and interpretation of this report.

This report has been prepared for Mr. Gordon Cory in support of the proposed lot subdivision. Reliance on this material by any party other than Mr. Gordon Cory and his immediate design team, or for any other purpose other than assessment of the proposed land subdivision is expressly forbidden, unless authorized in writing by Golder Associates Ltd. The Ministry of Transportation and Thompson Nicola Regional District may rely on this report for subdivision approval purposes associated with the intended use of the property.

1.0 BACKGROUND INFORMATION

The subject site is an approximately 114.8 acre parcel west of Westsyde Road, north of Kamloops (Figure 1). The site contains an approximately 50 to 120 m wide strip of gently sloped grassland adjacent to Westsyde Road, while the western portion of the property consists of vegetated moderately-steep slopes covered with trees. The subject subdivision is currently undeveloped but is understood to have an existing well.

It is understood that the Owner proposes to subdivide the subject property into four lots, Lot A to Lot D, as shown of Figure 2. It is also understood that the proposed building locations for all four proposed lots are on the gently sloping grassland area which is adjacent to Westsyde Road.

The BC Ministry of Transportation (MoT) considers that the subject site may be subject to natural geohazards and a site specific geohazard assessment is required in support of the subdivision application.

2.0 METHOD

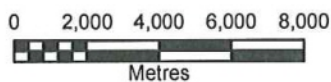
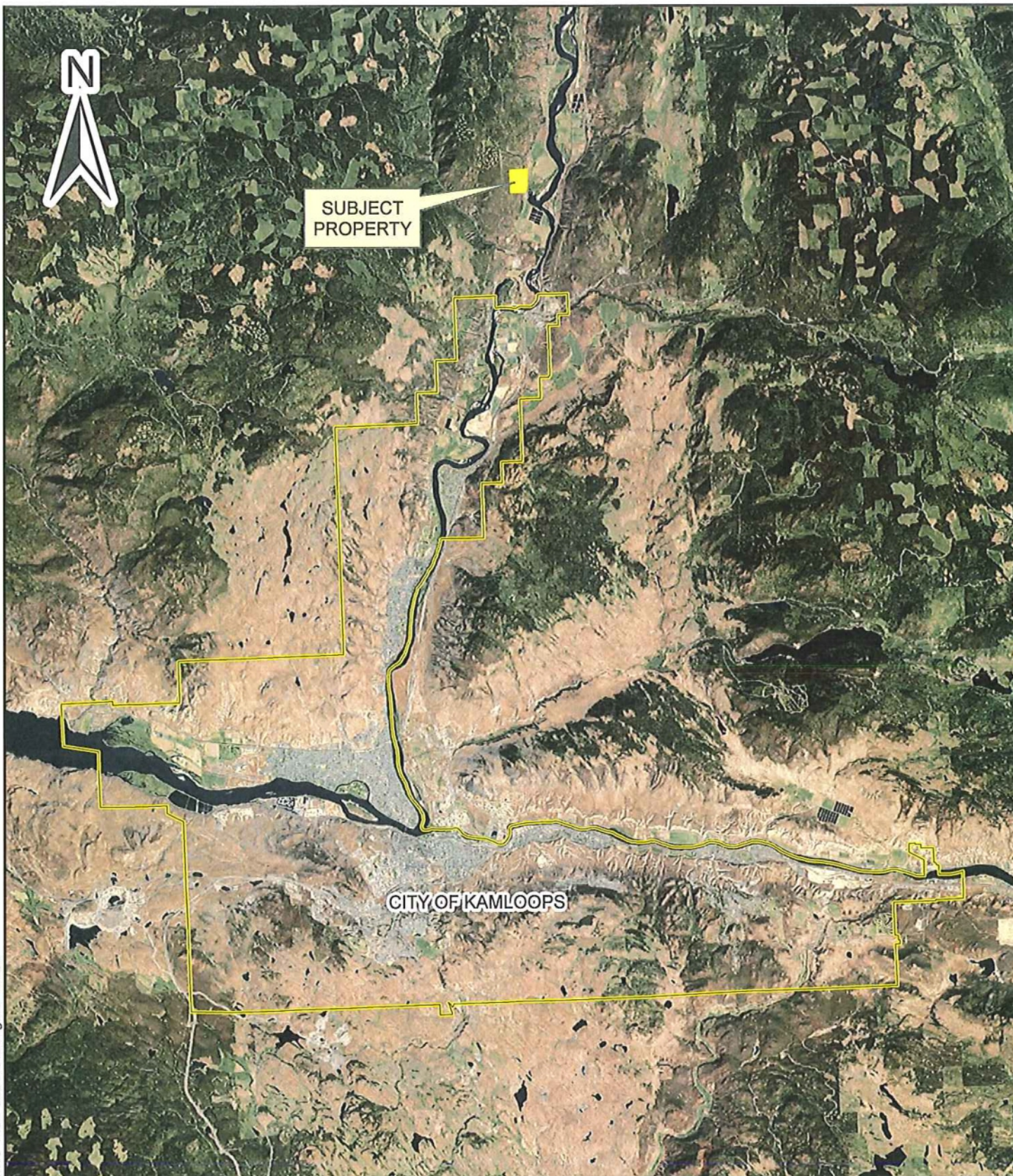
Aerial photographs were used to review large scale topographic features of the subject site and adjoining area and identify potential geohazards to be subsequently examined and assessed in the field during the site reconnaissance.

The initial site reconnaissance, performed on November 18, 2010, consisted of a walk-over of the subject site. GPS waypoints were recorded using a handheld unit to identify the approximate locations of selected terrain features. Several approximate slope profiles were measured in the field using a hand held clinometer. A second targeted reconnaissance of some specific features was conducted on December 2, 2011. On December 13, 2011, the undersigned returned to the site to flag the toe of the steep slopes to the west, during which time Allnorth Land Surveyors (Allnorth) initiated the survey of the flagged line. It is understood that Allnorth completed the survey of the flagged line on January 5, 2012.

3.0 SITE DESCRIPTION


The site is located along the west side of Westsyde Road, approximately 30 km north of the downtown core of Kamloops, BC and about 3 km south of the Black Pines Settlement. The subject property is divided into four proposed lots (Lot A to Lot D) as shown in Figure 2.

Slopes rising to the west above the site comprise the east flank of Jamieson Range, a generally flat topped ridge located between the Jamieson Creek valley and the North Thompson River valley. At the site location, the ridge rises about 550 m above the toe of the ridge slope on the subject property. Available topographic mapping (Map 92-I/16, Heffley Creek, Ministry of Energy, Mines and Resources Canada, 1:50,000 scale) indicates that the average grade of the slopes above the site is roughly 2.3 horizontal to 1 vertical (23.5 degrees) or flatter. The slopes are covered with trees and low vegetation. Dead standing trees and fallen trees are commonly observed at the site. As previously described, located between the toe of the ridge slopes and Westsyde Road is a strip of gently sloping grassland. No large cobbles and boulders indicative of potential rockfall hazard, and no depositional elements indicative of debris flow activity, were observed on the gently sloping proposed development area or at the toe of the steeper slopes.

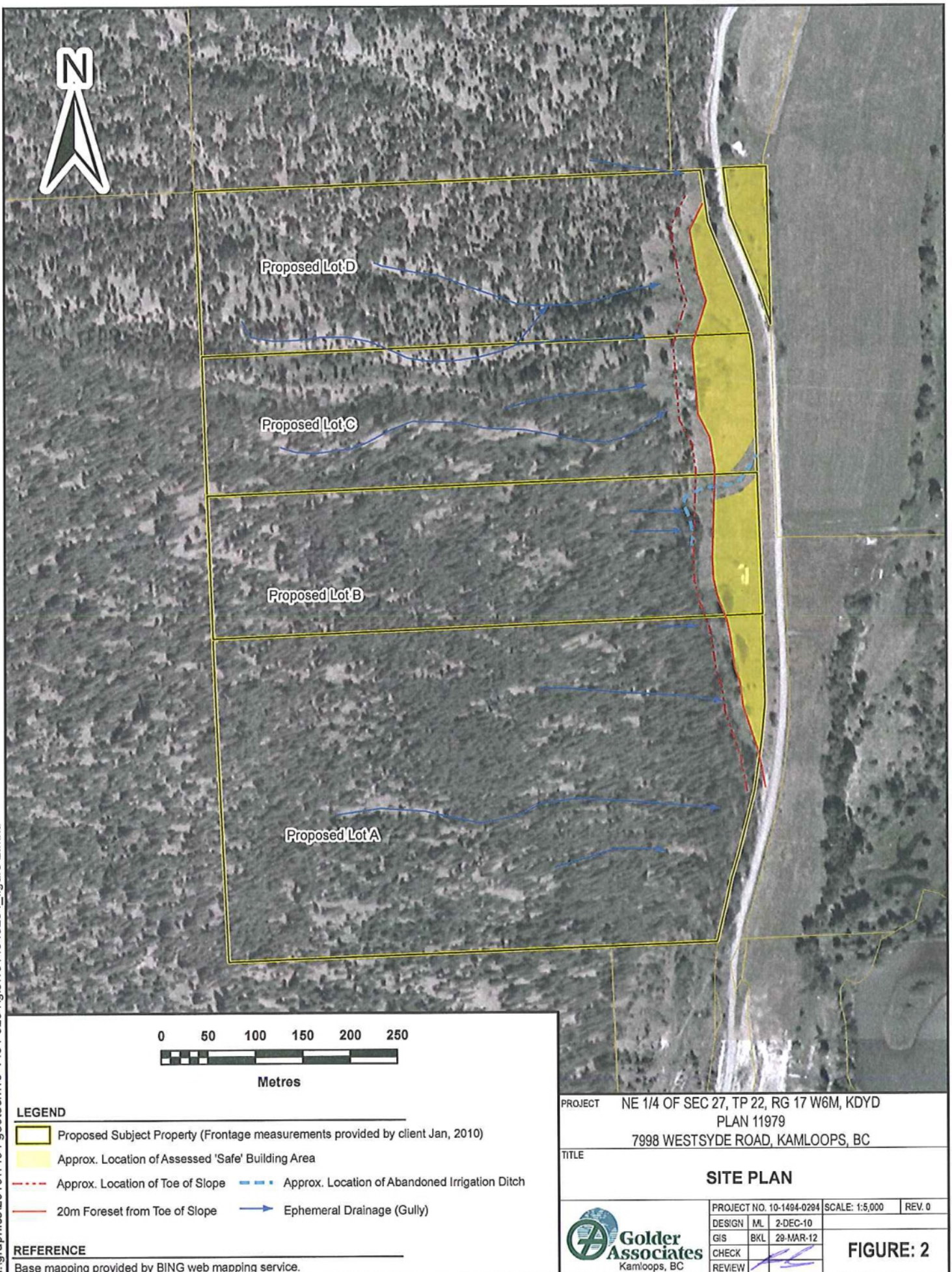


REFERENCE

Base mapping provided by BING web mapping service.

PROJECT		NE 1/4 OF SEC 27, TP 22, RG 17 W6M, KDYD PLAN 11979 7998 WESTSYDE ROAD, KAMLOOPS, BC		
TITLE		KEY PLAN		
 Golder Associates Kamloops, BC		PROJECT NO. 10-1494-0294	SCALE: 1:200,000	REV. 0
		DESIGN ML	2-DEC-10	FIGURE: 1
		GIS BL	2-DEC-10	
		CHECK ML	25-JAN-11	
		REVIEW BB	25-JAN-11	

n:\graphics\2010\1494 geotech\10-1494-0294\gis\1014940294_figure 2.mxd



The slopes above the proposed development area are incised by a series of well separated minor gullies oriented in the downslope direction. The gullies are assessed to be ephemeral drainage channels that terminate in colluvial fans, commonly coalescing colluvial fans, which comprise the gently sloping terrain on the eastern parts on the proposed lots. However, there were observed to be localized occurrences of steeply sloping fan deposits containing cobbles which have developed at the outlets of some of the minor gullies. At the time of the reconnaissance, the gullies were dry and the gently sloping terrain at the toe of the ridge (beyond any local steeply sloping fan deposits) was covered by grass with no observed signs of recently deposited material. There are reportedly two irrigation ditches on the lower slopes (only the lower ditch was observed in the reconnaissance) both of which were reportedly historically fed by diversion from Jamieson Creek in the early 20th Century. As reported by Mr. Cory, it is understood that the irrigation ditches have been abandoned and non-functional for in excess of 70 years. The lower of the two abandoned irrigation ditches crosses through the south side of Lot C (refer to Figure 2).

Based on surficial geology mapping of the area (Surficial Geology, Kamloops Lake, West of sixth Meridian, British Columbia. Fulton, R J, 1976. Geological Survey of Canada, 1394A.), the surficial deposits in the proposed development area at the toe of the slopes are mapped as fan deposits consisting of poorly sorted gravel, sand, silt and clay. On the slopes the deposits are mapped as morainal soils (glacial till) consisting of poorly sorted gravel, boulders, sand, silt and clay. Based on information contained on the BC Geological Survey website (<http://webmap.em.gov.bc.ca/mapplace/minpot/bcgs.cfm>), the underlying bedrock consists of mudstone, siltstone and shale bedrock of the Harper Ranch and Nicola Groups.

Some soil exposures and bedrock outcrops were observed during the site reconnaissance. The observed soil deposits were found to comprise a mixture of poorly sorted silt and sand with some gravel, containing cobbles and small boulders. The bedrock outcrops consist of siltstone and shale bedrock. Small boulders and cobbles with diameters up to 300 mm were commonly observed mainly on the slopes and near (typically within 10 m of) the toe of the slopes, however, the rocks were not prominent, but were typically fully embedded in the surrounding soil.

4.0 GEOHAZARD ASSESSMENT

For purposes of this assessment, a "safe" building site refers to a site in which the identified geohazards are assessed to satisfy, either before or after mitigation, the commonly used provincial geohazard guideline of 10% probability of occurrence in 50 years. For this site, it is assessed that "safe" building areas can be achieved by positioning proposed buildings outside of existing ephemeral drainage paths, and by application of suitable foresets from the toe of adjoining slopes.

The following potential terrain hazards were identified on the subject site:

- Rockfall / Rolling Rocks;
- Ephemeral Drainage including steeply slope fan deposits at some gully outlets; and
- Other Hazards.

4.1 Fragmental Rockfall / Rolling Rock

Based on interpretation of available information and site observation, it is inferred that below the surficial layer, the slopes generally consist of bedrock overlain by morainal soil cover (generally glacial till) of variable thickness, commonly containing boulders and cobbles with diameters up to 300 mm. Empirical assessment (Evans and Hungr, The Assessment of Rockfall Hazard at the Base of Talus Slopes, Cdn Geotechnical Journal, v.30, 1993) has shown that rolling rock from fragmental rockfall is confined within a rockfall shadow zone defined by a 27.5 degree projection from the top of the talus fan. Available mapping indicates that the ridge slopes average about 23.5 degrees from horizontal and site observation confirms that the lower ridge slopes are generally moderate and show no evidence of a developed talus fan. Accordingly, it is assessed that, within the proposed gently sloped development area between the toe of the ridge slopes and Westsyde Road any cobbles and boulders on the slope are, in general, stable and will not move unless actively disturbed by physical force (such as someone pushing them). Even if disturbed, cobbles and boulders will tend to come to rest on the slope or within a few metres of the toe of the slope.

To address the potential of rolling rocks reaching building sites, a conservative minimum building foreset of 20 m from the toe of the moderately steep ridge slopes is recommended. As previously noted, the toe of the steep ridge slopes was flagged by Golder, and the flagged line was surveyed by Allnorth Land Surveyors. Residential building sites on the subject site which have a minimum 20 m foreset from the flagged line are considered to be "safe" with respect of geotechnical rolling rock hazard. This foreset is not intended to apply to septic fields and backup fields, yards, gardens, or storage sheds which are considered acceptable uses of the residential building foreset zone.

4.2 Drainage

The gullies noted on the hillside are assessed to be ephemeral drainage channels. Available mapping indicates that the gullies have quite limited collection areas. The channels appear to terminate where the slopes of the valley wall intercept the colluvial fans. At some gully locations, small local steeply sloping fans have developed at the gully outlets; the steep fans consisting largely of coarse rocky debris washed out of the gullies and deposited just beyond the outlet. At the time of the reconnaissance, the gullies were dry and the fan deposits extending from the gully outlets were covered by grass with no obvious signs of active drainage channels or recently deposited alluvium. Though the gullies are assessed to be generally inactive at this time other than for ephemeral drainage, recent experience with forest fires suggests that minor gullies such as those present on the subject site may become more active and susceptible to debris flood for a period of several years following a forest fire.

Accordingly, it is our professional opinion that the drainage hazard to the proposed site from flow originating within the hillside gullies is low, with the potential to increase to moderate for several years after the slopes have denuded by forest fire, and that appropriate site selection and minor site grading works, such as locating houses outside the direct path of any drainage which might come from the ephemeral drainage channels and raising the lower floor level 1 m above the surrounding grade to direct surface water away from the houses, should provide adequate protection from runoff. Accordingly, it is recommended that:

- 1) houses be located offset at least 30 m from the projected discharge path from outlet of each of the main gullies;
- 2) houses be located outside the area of any local low lying land, ditch or ephemeral drainage channel;

- 3) the perimeter grade surrounding the houses be elevated at least 1 m above any nearby low point or apparent ephemeral drainage channel; and
- 4) the house perimeter grade to be shaped and graded to direct surface runoff away from the building.

If any of the above four drainage recommendations is not satisfied by the selected site location and grading, a geotechnical engineer should be retained to review the proposed site grading and, if required, to recommend measures such as ditching, regrading and/or deflection berms to mitigate the assessed drainage hazard.

4.3 Other Hazards

The forest on the hillside contains a relatively high proportion of dead trees that are still standing, and some fallen trees. In the event that the houses are located close to the forested hillside there is a risk of forest fire and falling trees. While forest fire is not considered as geotechnical hazard, it is recommended that a fire risk study be prepared for the site by specialists in the field.

5.0 PROPOSED BUILDING SITES

Golder has identified and delineated a "safe" building area on the property with respect to rolling rock geohazard which includes land suitable for development of a single family residential house on each lot, as indicated in Figure 2. The lot boundaries and the location of assessed toe of slope as flagged in the field by Golder are shown in Figure 2, and are located as provided to Golder by the client on an unsigned Allnorth Subdivision Plan received by Golder on January 27, 2012. The location of the toe of slope provided in the Allnorth Subdivision Plan also matches our own GPS reference points collected during flagging of the line, providing corroboration that the toe of slope line is accurately located.

The assessed safe building areas (with respect to rolling rock geohazard) for single family house development were determined by adding a 20 m foreset from the surveyed toe of slope line. The assessed building areas are all located on the lower gently sloping and grass covered portion of the lots near Westsyde Road.

Safe Building Area – Lot A

The identified safe building area for a single family residential dwelling on proposed Lot A is located on the north east corner of the Lot. We understand that there may be some interest in locating a building site on a small elevated terrace within the tree covered slope. While this study has not determined that the elevated terrace site is safe with respect to geotechnical hazard for house construction, the terrace building site could be considered in future, subject to the results of a site specific geohazard assessment of this alternate potential building site.

Safe Building Area – Lots B & C

The identified safe building area for a single family residential dwelling on each of proposed Lots B and C is located along the east side of the Lots.

Safe Building Area – Lot D

The identified safe building area for a single family residential dwelling on proposed Lot D is located along the east side of the lot, but does not extend fully to the north end of the lot where the ground is rougher and steeper than elsewhere on the lot.

It is assessed that the recommended 20 m foreset from the toe of slope, together with the four drainage recommendations, are sufficient to define safe building sites for single family residential dwellings and "land that may be used safely for the use intended". The location and topography of the house sites to be selected within the identified safe building area on each lot (with respect to rolling rock geohazard) is not known at this time. If a selected house site and proposed grading does not satisfy the four drainage recommendations, then it is recommended that a geotechnical engineer with suitable training and experience in geohazard assessments be retained to review the selected house site. The geotechnical engineer may approve the selected house site with respect to geohazards or recommend relocation or mitigation, as appropriate.

6.0 CONCLUSIONS

The results of the Geohazard Assessment indicate that each of the proposed subject lots contain "land that may be used safely for the use intended" with respect to rolling rock geotechnical hazard, located as shown on Figure 2, and development on the subject site is considered feasible with respect to the identified geohazards, subject to a 20 m foreset from the assessed "toe of slope" and implementation of the four drainage recommendations provided herein.

The assessed toe of slope was flagged by Golder and surveyed by Allnorth

If the four drainage recommendations are not satisfied by the selected house site and grading, it is recommended that a geotechnical engineer with suitable training and experience in geohazard assessments be retained to review the selected house site.

The identification of "safe" building areas (or land that may be used safely for the use intended) based on a limited scope of study does not preclude the possibility that additional "safe" areas might be identified through additional study. Accordingly, where there are proposed alternate building sites located outside the currently defined limits, such sites could be reviewed in an additional site specific geohazard assessment beyond the scope of the current study. Please note that the results of such a site specific geohazard assessment may or may not support development of a selected alternate site. Golder would be pleased to prepare a proposal for additional site specific geohazard assessments, if requested.

No other geohazards were identified as potentially affecting the potential house sites.

The Geohazard Assessment conducted was subjective and limited to review of available topographic maps and aerial photographs, and ground reconnaissance of the area of the subject property. Assessments were based on geomorphic interpretation of landforms to evaluate the spatial distribution of past geohazard occurrences as an indicator of the nature and distribution of future geohazards likely to affect the site.

Subject to the implementation of the recommendations provided herein, the geohazards would not be expected to be life-threatening or catastrophic and, accordingly, the 1 in 10,000 year hazard criterion is not considered applicable. Accordingly, subject to implementation of the recommendations contained herein, the building areas shown on Figure 2 are considered to satisfy a 10% in 50 years hazard risk criterion for the identified geohazards.

This geohazard assessment was prepared based on information available at the time of assessment. If new information relevant to this geohazard assessment becomes available, Golder should be retained to review the new information and to confirm or amend the geotechnical recommendations provided herein, as appropriate in the light of the new information.

7.0 CLOSURE

We trust that this report meets your requirements at this time. Golder appreciates the opportunity of working on this project with you. If you have questions, please contact the undersigned.

Yours truly,

GOLDER ASSOCIATES LTD.

 
Bruce Bosdet, M.A.Sc., P.Eng.
Principal, Senior Geotechnical Engineer
July 19/2012

ML/BB/ap

Attachments: Important Information and Limitations of this Report

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IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT

Standard of Care: Golder Associates Ltd. (Golder) has prepared this report in a manner consistent with that level of care and skill ordinarily exercised by members of the engineering and science professions currently practising under similar conditions in the jurisdiction in which the services are provided, subject to the time limits and physical constraints applicable to this report. No other warranty, expressed or implied is made.

Basis and Use of the Report: This report has been prepared for the specific site, design objective, development and purpose described to Golder by the Client. The factual data, interpretations and recommendations pertain to a specific project as described in this report and are not applicable to any other project or site location. Any change of site conditions, purpose, development plans or if the project is not initiated within eighteen months of the date of the report may alter the validity of the report. Golder can not be responsible for use of this report, or portions thereof, unless Golder is requested to review and, if necessary, revise the report.

The information, recommendations and opinions expressed in this report are for the sole benefit of the Client. No other party may use or rely on this report or any portion thereof without Golder's express written consent. If the report was prepared to be included for a specific permit application process, then upon the reasonable request of the client, Golder may authorize in writing the use of this report by the regulatory agency as an Approved User for the specific and identified purpose of the applicable permit review process. Any other use of this report by others is prohibited and is without responsibility to Golder. The report, all plans, data, drawings and other documents as well as all electronic media prepared by Golder are considered its professional work product and shall remain the copyright property of Golder, who authorizes only the Client and Approved Users to make copies of the report, but only in such quantities as are reasonably necessary for the use of the report by those parties. The Client and Approved Users may not give, lend, sell, or otherwise make available the report or any portion thereof to any other party without the express written permission of Golder. The Client acknowledges that electronic media is susceptible to unauthorized modification, deterioration and incompatibility and therefore the Client can not rely upon the electronic media versions of Golder's report or other work products.

The report is of a summary nature and is not intended to stand alone without reference to the instructions given to Golder by the Client, communications between Golder and the Client, and to any other reports prepared by Golder for the Client relative to the specific site described in the report. In order to properly understand the suggestions, recommendations and opinions expressed in this report, reference must be made to the whole of the report. Golder can not be responsible for use of portions of the report without reference to the entire report.

Unless otherwise stated, the suggestions, recommendations and opinions given in this report are intended only for the guidance of the Client in the design of the specific project. The extent and detail of investigations, including the number of test holes, necessary to determine all of the relevant conditions which may affect construction costs would normally be greater than has been carried out for design purposes. Contractors bidding on, or undertaking the work, should rely on their own investigations, as well as their own interpretations of the factual data presented in the report, as to how subsurface conditions may affect their work, including but not limited to proposed construction techniques, schedule, safety and equipment capabilities.

Soil, Rock and Groundwater Conditions: Classification and identification of soils, rocks, and geologic units have been based on commonly accepted methods employed in the practice of geotechnical engineering and related disciplines. Classification and identification of the type and condition of these materials or units involves judgment, and boundaries between different soil, rock or geologic types or units may be transitional rather than abrupt. Accordingly, Golder does not warrant or guarantee the exactness of the descriptions.

IMPORTANT INFORMATION AND LIMITATIONS OF THIS REPORT (cont'd)

Special risks occur whenever engineering or related disciplines are applied to identify subsurface conditions and even a comprehensive investigation, sampling and testing program may fail to detect all or certain subsurface conditions. The environmental, geologic, geotechnical, geochemical and hydrogeologic conditions that Golder interprets to exist between and beyond sampling points may differ from those that actually exist. In addition to soil variability, fill of variable physical and chemical composition can be present over portions of the site or on adjacent properties. **The professional services retained for this project include only the geotechnical aspects of the subsurface conditions at the site, unless otherwise specifically stated and identified in the report.** The presence or implication(s) of possible surface and/or subsurface contamination resulting from previous activities or uses of the site and/or resulting from the introduction onto the site of materials from off-site sources are outside the terms of reference for this project and have not been investigated or addressed.

Soil and groundwater conditions shown in the factual data and described in the report are the observed conditions at the time of their determination or measurement. Unless otherwise noted, those conditions form the basis of the recommendations in the report. Groundwater conditions may vary between and beyond reported locations and can be affected by annual, seasonal and meteorological conditions. The condition of the soil, rock and groundwater may be significantly altered by construction activities (traffic, excavation, groundwater level lowering, pile driving, blasting, etc.) on the site or on adjacent sites. Excavation may expose the soils to changes due to wetting, drying or frost. Unless otherwise indicated the soil must be protected from these changes during construction.

Sample Disposal: Golder will dispose of all uncontaminated soil and/or rock samples 90 days following issue of this report or, upon written request of the Client, will store uncontaminated samples and materials at the Client's expense. In the event that actual contaminated soils, fills or groundwater are encountered or are inferred to be present, all contaminated samples shall remain the property and responsibility of the Client for proper disposal.

Follow-Up and Construction Services: All details of the design were not known at the time of submission of Golder's report. Golder should be retained to review the final design, project plans and documents prior to construction, to confirm that they are consistent with the intent of Golder's report.

During construction, Golder should be retained to perform sufficient and timely observations of encountered conditions to confirm and document that the subsurface conditions do not materially differ from those interpreted conditions considered in the preparation of Golder's report and to confirm and document that construction activities do not adversely affect the suggestions, recommendations and opinions contained in Golder's report. Adequate field review, observation and testing during construction are necessary for Golder to be able to provide letters of assurance, in accordance with the requirements of many regulatory authorities. In cases where this recommendation is not followed, Golder's responsibility is limited to interpreting accurately the information encountered at the borehole locations, at the time of their initial determination or measurement during the preparation of the Report.

Changed Conditions and Drainage: Where conditions encountered at the site differ significantly from those anticipated in this report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that Golder be notified of any changes and be provided with an opportunity to review or revise the recommendations within this report. Recognition of changed soil and rock conditions requires experience and it is recommended that Golder be employed to visit the site with sufficient frequency to detect if conditions have changed significantly.

Drainage of subsurface water is commonly required either for temporary or permanent installations for the project. Improper design or construction of drainage or dewatering can have serious consequences. Golder takes no responsibility for the effects of drainage unless specifically involved in the detailed design and construction monitoring of the system.