



# PRELIMINARY GEOTECHNICAL TERRAIN ASSESSMENT

for

## SCHOONER COVE AT FAIRWINDS

## NANOOSE BAY, B.C.

File No.: 081-01233

### PREPARED FOR

bcIMC Realty Corporation 3536696 Canada Inc & Bentall LP  
(Collectively the "Client")  
c/o Fairwinds Real Estate Management Inc.  
3455 Fairwinds Drive  
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Attention: Mr. Russell Tibbles

April 28, 2009

Prepared by:

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## ATTACHMENTS

### Interpretation & Use of Study and Report

Key Plan.....081-01233-01

Site Plan – Geologic Hazard Areas.....081-01233-02

## **1.0 INTRODUCTION**

Authorization to proceed with a preliminary geotechnical assessment of existing terrain within the Subject Property (see Drawing 081-01233-01) was issued to Trow Associates Inc. (Trow) by Mr. Russell Tibbles on behalf of the client in August 2008. Our scope of work was presented in the Trow proposal dated 2008 August 1.

The purpose of our assessment is to identify and provide a characterization of areas where naturally occurring geologic events (rock fall, slope failures, flooding, etc.) have occurred within or adjacent to the Subject Property in recent history. In addition, we have identified areas where anthropologic changes to the natural terrain have created potential geologic hazards. This preliminary terrain assessment is intended to provide general guidance for design of the development layout with respect to avoiding the influence areas for identified potential geologic hazards. Preliminary geotechnical recommendations regarding site preparation and foundation design guidelines for the Subject Property, including the filled foreshore area will be presented under separate cover.

Information used in our assessment includes a desk top study involving the following tasks:

- Review of 1992 aerial photographs;
- Review of topographic plans showing 0.5 metres contour intervals, proposed roadway alignment and development areas;
- Review of provided proposed layout and site grading plans for the Subject Property.

In addition, a field reconnaissance was conducted by Trow personnel in July, 2009 to identify and assess potential naturally occurring geological hazards which may exist within or adjacent to subject property. The field reconnaissance included a visual assessment of surficial exposures of soils and bedrock, signs of recent soil movement (bent trees, unusual topography, etc.) and other indications of recent occurrence of naturally occurring geological hazard events.

Attached to this report are a Key Plan and a Site Plan showing identified hazard areas.

## **2.0 SITE DESCRIPTION**

The Subject Property is located approximately 25 km northwest of Nanaimo on the eastern shoreline of a peninsula of land bordered by Nanoose Bay, the Ballenas Channel and the Strait of Georgia to the north (see Drawing 081-01233-01). Access to the property is via Dolphin Drive off of Northwest Bay Road which connects to Highway 19.

The Subject Property is bordered by the ocean and Schooner House to the north and existing developments and roadways to the south, west and east. Mooring for the Schooner Cove Marina is located to the north of the Subject Property. Within the northern portion of the Subject Property lies the main building for the Schooner Cove Marina with associated parking areas. The central portion of this site contains a neighbourhood park with a tennis court. The northeastern

portion of this property contains a single residential dwelling. A breakwater has been constructed immediately east of Schooner House. The locations of these structures and parking areas are shown on Drawing 081-01233-02.

Existing topography generally includes a raised knoll in the central east portion with gently inclined side slopes connecting to the shoreline to the north and a relatively flat lying infilled ravine area to the south. The north and south flanks of the knoll contain numerous bedrock outcrops. This indicates a bedrock controlled topography with thin soil veneers in the area of the knoll.

Anthropologic modifications to natural topography include significant fill placed in the area of the tennis court, main building and parking areas for the marina. Along the foreshore boulder fill has been placed from east of the breakwater to the western boundary of the Subject Property. These modifications to the original topography have created the gently inclined slopes along the foreshore and the flat lying area in the southern portion of the Subject Property. In addition, some constructed rock cuts up to about 5 metres in height were observed along an access road which terminates at the east side of the Schooner House.

The foreshore modifications appear to mainly consist of the placement of large blasted boulders as fill material. Test pits and boreholes indicate that placed fill in the parking areas generally consist of earth fill overlying bedrock or blasted boulder fill overlying bedrock. In the area of the park and tennis court, subsurface investigations indicated earth fill overlying native SILT.

### **3.0 SCHOONER COVE VILLAGE – PROPOSED DEVELOPMENT PROGRAM**

We understand that substantial regrading and development of the Subject Property is proposed. Proposed regrading of the Subject Property includes a general flattening of the slope in the area of the existing parking for the Schooner Cove Marina. Retaining walls (up to about 6 metres in height) to support roadway structure are proposed along the northern edge of an existing access road between parking for the tennis court area and parking for Schooner Cove Marina.

The proposed development includes multiple dwelling unit structures in various locations throughout the Subject Property, waterfront boardwalks, restaurants, and stores.

### **4.0 DISCUSSION**

Due to the relatively gentle inclination of the natural slopes within the Subject Property naturally occurring geologic hazards such as rockfall and slope stability issues are generally considered to have a low to very low probability of hazard occurrence. Exceptions to this are located near Parcel 2 of the Subject Property where a bedrock cut constructed along the access road to the eastern side of Schooner House presents potential slope stability and rockfall issues which may affect construction of structures at its crest and along the foreshore where boulder fills have been placed.

Extensive regrading of the Subject Property may eliminate the potential slope stability/rockfall hazard within Parcel 2; however if existing grades are to remain in this area, a setback of 3 metres from the crest of this bedrock cut is recommended to prevent potential future raveling of rock from undermining building foundations. This hazard location is shown on the attached Drawing 081-01233-02 and may affect a proposed structure in the northeast corner of the development. In addition some mitigative works (including but not limited to constructed catchment, wire mesh and scaling) along the toe of the constructed bedrock cut may be required to allow for a low to very low probability of occurrence of rockfall along the access road.

Placed blasted rock fill along the foreshore may experience some lateral movement as a result of cyclic loading from a design seismic event. However; based on Trow's previous experience in similar shoreline developments, we are of the opinion that foundation design (options such as steel pipe piles and raft slabs) may be sufficient to reduce the effects of potential lateral movement, within or below the boulder fill. Alternatively ground improvement techniques can be used on foreshore soils (densification piles, dredging, etc.) to limit potential lateral movements to acceptable levels. Further study would be required to properly analyze mitigation options and fully cost potential options related to this issue.

Steeply inclined slopes on the north and south flanks of the knoll have bedrock at or near surface. No indications of slope instability were noted on either flank of the knoll and, therefore, provided slope failures in the natural slopes are not considered to be an issue.

In view of the above discussion, we are of the opinion that a majority of the development property has little, if any, exposure to the natural hazard events of rock fall and landslide. A small localized potential rock fall area was identified just east of the Schooner House structures. Mitigation measures and/or building setback guidelines will adequately limit any influence that this rock fall source would have on the development. Fill areas within the property can undergo settlement and/or lateral movement during earthquake loading or as a result of building loads. Ground improvement techniques are available to control ground response to tolerable levels.

Based on this level of review, we are satisfied that the risk of natural events (landslides and rock falls) adversely affecting the property would be very low.

## **5.0 CLOSURE**

The above-noted and attached information presents our understanding of the proposed development program, interpretations of site conditions and opinions as to the existence of geologic hazards and their potential influence areas within or adjacent to the Subject Property. We would point out that there is an inherent level of uncertainty associated with the prediction of long-term stability of natural mountain slopes. This uncertainty combined with the lack of comprehensive historical record(s) within and adjacent to the proposed development site, significantly limits our ability to complete a quantitative risk assessment of specifically identified hazard events. Therefore, we are providing a qualitative assessment of potential hazards that may influence proposed development areas based on our experience and interpretations of existing site

conditions. Some understanding of terminology and associated ranges of annual probability of occurrence connected with this approach is provided in a reference prepared by the Resource Inventory Committee, Government of British Columbia, Slope Stability Task Group (1996) and shown in Table A below.

**TABLE A**  
**Relative Terms and Ranges of Annual Probability of Hazard Occurrence**  
**(Resource Inventory Committee, 1996)**

Relative Term of Probability	Range of Annual Probability of Occurrence (Pa)	Comments
Very High	>1/20	Indicates that hazard is imminent and well within the lifetime of a person or typical structure. Event occurring with a return interval of 1/20 or less generally have clear and relatively fresh signs of disturbance.
High	1/100 to 1/20	Indicates that the hazard can happen within the approximate lifetime for a person or typical structure. Events are clearly identifiable from deposits and vegetation, but may not appear fresh.
Moderate	1/500 to 1/100	Indicates that the hazard within a given lifetime is not likely, but possible. Signs of previous events, such as vegetation damage may not be easily noted.
Low	1/2500 to 1/500	Indicates the hazard is of uncertain significance.
Very Low	>1/2500	

In addition, only events with an interpreted return period less than 475 years (greater than 10% chance in 50 years) have been considered in our hazard assessment. This approach is consistent with the terms of reference presented in the subdivision guidelines proposed by the Ministry of Transportation. We expect that the approving authority will use a similar guideline during their review of the proposed development.

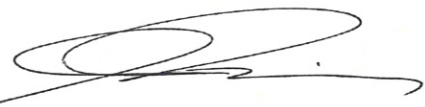
Based on our work, and the above-mentioned criteria, we have determined some areas of proposed development are currently considered unsuitable for the construction of habitable dwellings without implementation of suitable mitigative works as described in Section 4.0; however, we are of the opinion that hazards that are not eliminated during regrading (i.e., Parcel 2) may be mitigated through suitable geotechnical measures to provide adequate stability for the proposed development. Our determination relates to anticipated potential influence areas from identified potential geologic hazards. Provided suitable mitigative measures are undertaken during construction of the proposed development we are of the opinion that the probability of geological hazard occurrence would be low to very low.

This report was prepared for the exclusive use of our client, Fairwinds and their designated consultant, agents or lenders, and may not be used by other parties without written consent of Trow Associates Inc. This report contains our *Interpretation & Use of Study and Report*. These interpretations form an integral part of this report and must be included with any copies of this report.

**Trow Associates Inc.**

  
Evan Sykes, P.Eng.  
Geotechnical Engineer

**Reviewed by:**

  
Jim O'Brien, P.Eng.  
Senior Engineer

ES/es



## INTERPRETATION & USE OF STUDY AND REPORT

### 1. STANDARD OF CARE

This study and Report have been prepared in accordance with generally accepted engineering consulting practices in this area. No other warranty, expressed or implied, is made. Engineering studies and reports do not include environmental consulting unless specifically stated in the engineering report.

### 2. COMPLETE REPORT

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

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

### 3. BASIS OF THE REPORT

The Report has been prepared for the specific site, development, building, design or building assessment objectives and purpose that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document are only valid to the extent that there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation.

### 4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT. WE WILL CONSENT TO ANY REASONABLE REQUEST BY THE CLIENT TO APPROVE THE USE OF THIS REPORT BY OTHER PARTIES AS "APPROVED USERS". The contents of the Report remain our copyright property and we authorize only the Client and Approved Users to make copies of the Report 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 the Report, or any portion thereof, available to any party without our written permission. Any use which a third party makes of the Report, or any portion of the Report, are the sole responsibility of such third parties. We accept no responsibility for damages suffered by any third party resulting from unauthorized use of the Report.

### 5. INTERPRETATION OF THE REPORT

- a. Nature and Exactness of Descriptions: Classification and identification of soils, rocks, geological units, contaminant materials, building envelopment assessments, and engineering estimates have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature and even comprehensive sampling and testing programs, implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations, or building envelope descriptions, utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarising 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 change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b. Reliance on Provided information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we 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. To avoid misunderstandings, Trow Associates Inc. (Trow) should be retained to work with the other design professionals to explain relevant engineering findings and to review their plans, drawings, and specifications relative to engineering issues pertaining to consulting services provided by Trow. Further, Trow should be retained to provide field reviews during the construction, consistent with building codes guidelines and generally accepted practices. Where applicable, the field services recommended for the project are the minimum necessary to ascertain that the Contractor's work is being carried out in general conformity with Trow's recommendations. Any reduction from the level of services normally recommended will result in Trow providing qualified opinions regarding adequacy of the work.

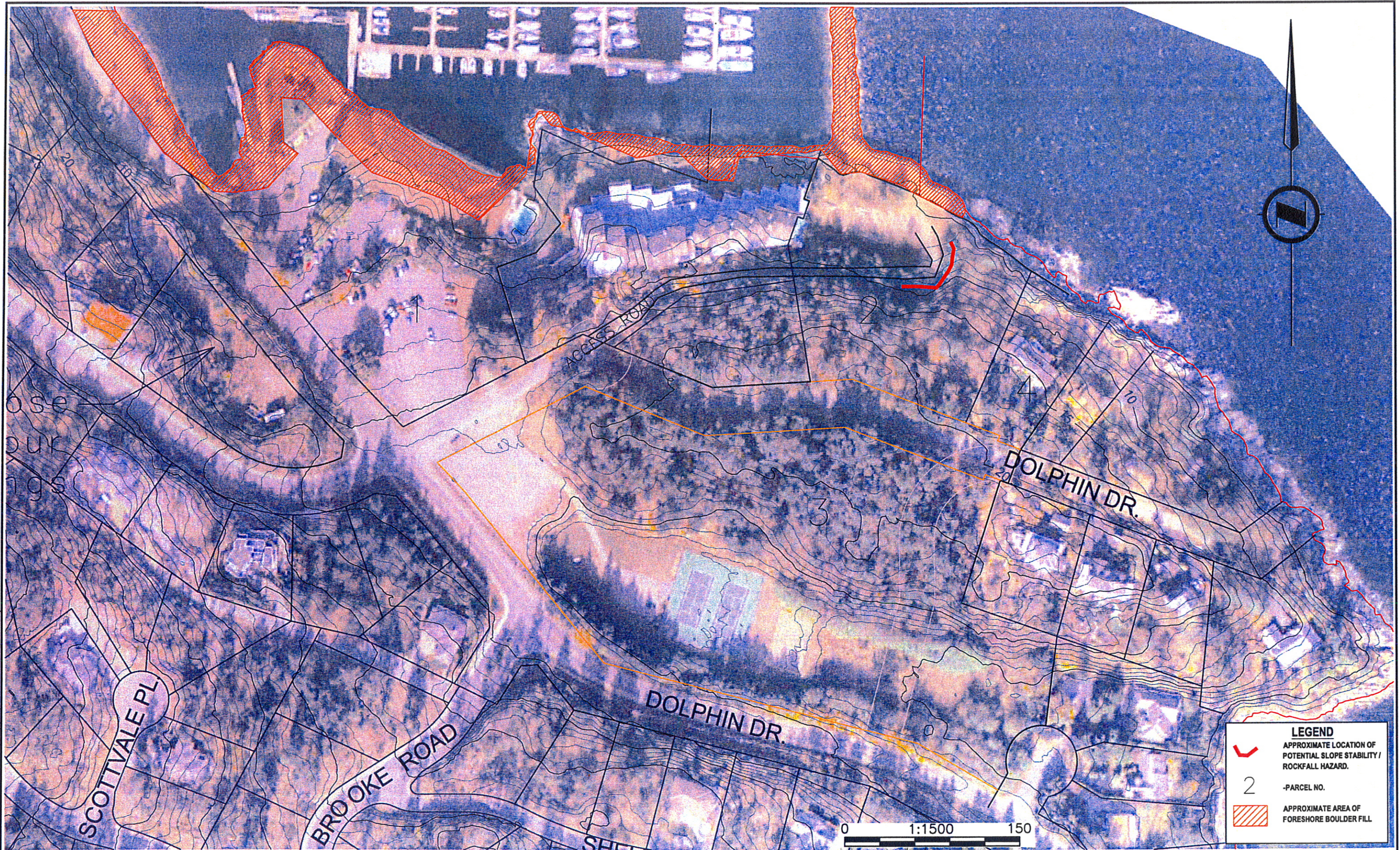
### 6.0 ALTERNATE REPORT FORMAT

When Trow submits both electronic file and hard copies of reports, drawings and other documents and deliverables (Trow's instruments of professional service), the Client agrees that only the signed and sealed hard copy versions shall be considered final and legally binding. The hard copy versions submitted by Trow 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 version archived by Trow shall be deemed to be the overall original for the Project.




The Client agrees that both electronic file and hard copy versions of Trow's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Trow. The Client warrants that Trow's instruments of professional service will be used only and exactly as submitted by Trow.

The Client recognizes and agrees that electronic files submitted by Trow have been prepared and submitted using specific software and hardware systems. Trow makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.





**LEGEND**

-  APPROXIMATE LOCATION OF POTENTIAL SLOPE STABILITY / ROCKFALL HAZARD.
-  -PARCEL NO.
-  APPROXIMATE AREA OF FORESHORE BOULDER FILL

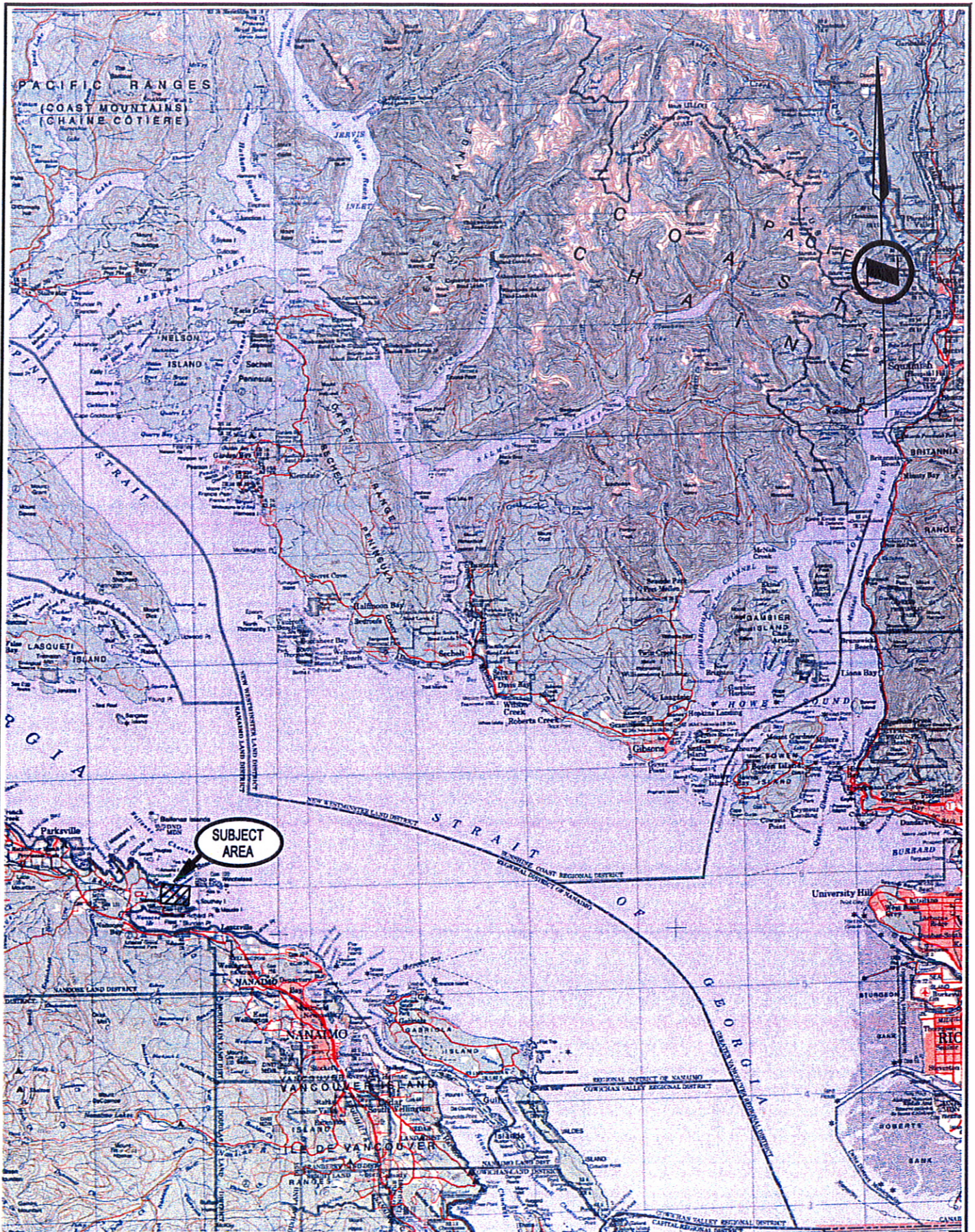
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DFTD.	REVISIONS		
	No.	DESCRIPTION	DATE
EGS			
DSGN.			
CHK.			
EGS			

CLIENT	FAIRWINDS
PROJECT	SCHOONER COVE HOTEL
PROJECT NO.	081-01233

TITLE: SITE PLAN GEOLOGIC HAZARD AREAS			
DATE	DEC. 8, 2008	SCALE:	1:1500
DWG NO.	081-01233-02		



Sep 17, 2008 - 10:58am L:\2007\081-01233 JOB Schooner Cove Marina\Drawings\081-01233.dwg



CLIENT		BCIMC			TITLE:		
PROJECT		SCHOONER COVE MARINA NANOOSE BAY, B.C.			SITE LOCATION PLAN NTS MAPS 92F & 92G		
PROJECT NO.	081-01233	DIFFR.	DSGN.	CHK.	DATE	SCALE:	DWG NO.
		PDL	EGS	JOB	2008-09-17	N.T.S.	081-01233-01