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June 22, 2005

Project No. 0405-001-02

Mr. Jozsef L. Dioszeghy, P.Eng.
District North Vancouver
355 West Queens Road
North Vancouver, BC
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Dear Sir,

RE: SLOPE STABILITY ANALYSES AT 2175 BERKLEY AVENUE

This letter presents the results of a slope stability evaluation for the house located at 2175 Berkley Avenue.

GEOTECHNICAL SITE INVESTIGATION

Following the landslide, a geotechnical site investigation was carried out, which included completion of topographic surveys, test pits, cone penetration tests, shallow and deep drill holes, laboratory testing, and installation and monitoring of piezometers. The results have been used to establish the slope geometry, soil stratigraphy, shear strength and groundwater conditions necessary for slope stability modelling.

SLOPE STABILITY MODEL CALIBRATION

A stratigraphic cross section through the property was developed for the purpose of slope stability modelling (Figure 1).

Limit equilibrium slope stability analyses were carried out using the commercially available software GeoStudio 2004-Slope/W, produced by Geo-Slope International. The Morgenstern-Price method was used to determine the factor of safety against failure for trial slip surfaces.

Soil strength parameters were determined based on visual classification, cone penetration testing, laboratory testing, and engineering judgement. Slope/W's 'Auto Locate' function was used to identify the slip surface with the lowest factor of safety along each cross section.

A number of 'reality checks' were carried out, including verification that:

- groundwater levels measured in the piezometers matched observations of seepage around the headscarp of the landslide; and,
- the factor of safety under the highest groundwater conditions measured by the piezometers following the landslide exceeded 1.0 near the edge of the escarpment for the cross section shown in Figure 1.

FACTORS OF SAFETY AGAINST SLOPE FAILURE AFFECTING THE SUBJECT HOUSE

Once the slope stability model was calibrated, additional analyses were undertaken to evaluate the factor of safety against failure along hypothetical slip surfaces that were forced to intersect the edge of the house. Groundwater conditions measured on June 7, 2005 (the most recent data) and on March 21, 2005 (the highest groundwater conditions observed since piezometer installation) were used in the analyses. Additional analyses were carried out using groundwater conditions 0.5 m higher than observed on March 21. This level was selected arbitrarily so as to evaluate the sensitivity of the analyses to an elevated water table. Table 1 summarizes the results:

Table 1. Calculated Factors of Safety for Surfaces Intersecting the House at 2175 Berkley

Cross Section	Property	June 7, 2005 Groundwater Level	March 21, 2005 Groundwater Level	March 21, 2005 Groundwater Level + 0.5 m
B-B'	2175 Berkley	1.3	1.2	<1.0

It is important to note that the factors of safety presented in Table 1 and the slip surface geometry shown in Figure 1 do not represent critical slip surfaces or minimum factors of safety near the edge of the headscarp of the January 19, 2005 landslide. Shallower slip surfaces located closer to the edge of the escarpment have lower factors of safety than those presented in Table 1. For example, the factor of safety on the critical slip surface in the back yard of 2175 Berkley under March 21, 2005 groundwater levels is about 1.0, compared to a factor of safety of 1.2 for a slip surface that is forced to pass deeper into the slope and intersect the house.

RECOMMENDATIONS

Standard geotechnical engineering practice requires permanent slopes be designed with a minimum factor of safety of 1.5. Factors of safety of 1.3 are sometimes accepted for slopes where the consequences of failure are low, or where a loss of strength during shearing is not anticipated. Neither of these conditions applies along the Berkley-Riverside Escarpment, thus BGC recommends adopting a factor of safety of 1.5 as the minimum acceptable level for house re-occupation.

Based on these guidelines and the results of the slope stability analyses reported in Table 1, BGC recommends that the residence at 2175 Berkley should remain unoccupied until such time as remedial measures are undertaken to raise the factor of safety above a value of 1.5. BGC's preliminary assessment, however, is that remediation to allow re-occupation of 2175 Berkley is unlikely to be practical when the cost-benefit of remediation is considered.

Furthermore, until some form of slope remediation is carried out, the potential for small landslides originating from the headscarp of the January 19, 2005 slide will remain high. Although the failure volumes from such events are expected to be small, thus not posing a significant risk to houses at the bottom of the escarpment, they could continue to undermine the slopes at either edge of the property, possibly placing the houses and back yards of 2157 and 2191 Berkley at greater risk. This of course is a safety hazard for anyone in the back yards of these homes.

LIMITATIONS

The discussion on slope stability in this report is based on factual information gathered from site investigations, monitoring and laboratory testing, as well as on geotechnical engineering judgment. Further detailed geotechnical investigations on the subject property or within several hundred metres around it could lead to the discovery of information that will materially influence the slope stability analysis reported here. This is a reality in geotechnical engineering practice, which stems from the need to characterize geological uncertainty at specific reporting junctures with limited information. The reader must accept that this is the standard of geotechnical engineering practice, and its inherent limitations are not unique to the study reported here.

This study addresses static, near-surface slope stability at the west side 2175 Berkley Avenue, specifically the factor of safety regarding retrogression of the adjacent escarpment to the extent that it undermines the foundations of the house. Detailed analysis has not been carried out to evaluate possible deep-seated failure mechanisms, earthquake loadings or runout of landslides onto properties on or below the Berkley Avenue escarpment.

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Yours sincerely,
BGC ENGINEERING INC.
per:



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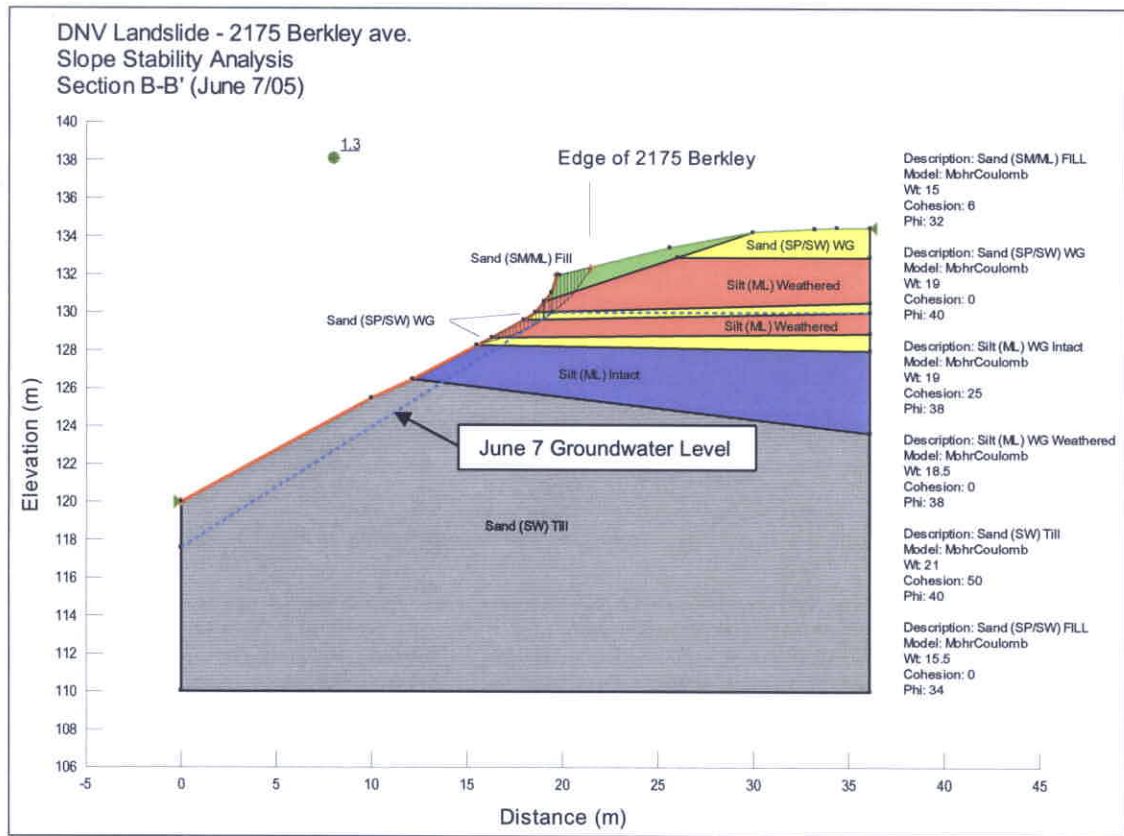
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JUN 24 2005

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Figure 1 - Slope Stability Analysis for Section B-B' (2175 Berkley Avenue)



Note: WG refers to soils of glaciomarine origin