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September 18, 2017

Project No.: 5077

Kevin Brooks
City of Campbell River
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|---|---|
| Regarding: | Clarification Response to Third Party Geotechnical Review (exp Services Inc. – July 25, 2017) |
| Site Location: | 1430 South Island Hwy, Campbell River, BC |
| Project Description: | Proposed 6-level Residential Development |

Dear Ms. Wade,

**1.0 Preamble**:

The purpose of this memo is to provide a response and clarification to exp Services Inc. (exp's) recent third party geotechnical review for the proposed 6-level residential development at 1430 South Island Highway, Campbell River. The basis of clarification are from the following documents:

1) Terran Geotechnical Consultants Ltd (Terran Geo's) report titled "Geotechnical Investigation Report – Proposed Residential Building at 1430 South Island Hwy," issued on April 27, 2017;
2) Terran Geotechnical Consultants Ltd (Terran Geo's) drawing titled "Proposed Slope Improvement," issued on September 11, 2017; and
3) Exp's geotechnical report titled "Third Party Geotechnical Review Proposed 6-level residential development," issued on July 25, 2017;
4) McElhanney's Meeting Minutes held on July 27, 2017 (teleconference).

**2.0 Response to Clarification**:

- Exp's Clarification Request No.1:
    - **Response**:
      The soil profile and associated parameters used in the analysis are based on a slope model which assumes a thin layer of weak silty sand veneer (Post Vashon deposits) overlying glacial till (Vashon Drift) and dense clay (possibly Pre-Vashon Drift). This assumption is supported by previous geological mapping studies, shallow boreholes, soil outcrop

mapping, and wildcat penetrometer on the slope. Terran Geo assumed an average 3 m thick silty sand veneer continuous along the slope for slope stability modelling purposes in the Geotechnical Investigation Report. Soil parameters were estimated using a combination of back analysis based on the north landslide failure, engineering judgment based on observations and field tests including wildcat and pocket penetrometer testing. Thicknesses of sand veneer to be confirmed during site remediation.

- Clarification Request No.2
  - **Response**:
    TerranGeo agrees rapid mudflow forms part of the overall landslide failure mechanisms that occurred on this site in the past. The landslide that occurred on the site is complex in nature and likely involved a combination of mudflow, translational slides, and rotational slides due to catalytic factors such as storms, land regrading, and development as discussed in the geotechnical report.
    TerranGeo believes the mudflow hazard can be reduced to acceptable levels as indicated by the attached stability model by installing an interceptor ditch at the top of slope to capture groundwater seepage and overland flows, and installing a high tensile steel mesh/soil nail system to stabilize steep as conceptually shown in TerranGeo's Proposed Slope Improvement Drawing, September 11, 2017. High Tensile steel mesh and soil nail system have been used in the past to stabilize steep eroding slope in the Cowichan bay, BC by Ministry Transportation and Infrastructure (MOTI). Given the proposed slope improvement measures and case study by MOTI, a runout zone is not required at the bottom of slope.

- Clarification Request No.3
  - **Response**:
    Overall global stability for pseudo-static and static stability meets or exceeds the minimum factor of safety. There are local surficial small slip surfaces within the top soil and sand veneer less than the minimum factor of safety which were presented in the geotechnical investigation report.

- Clarification Request No.4
  *Fatality Risk & Run-Out Distance*
  - **Response**:
    Reducing the mudflow hazard to acceptable levels by implementing the slope improvement measures, avoids the requirement of a runout zone. Similarly, there is very low risk of fatality if the critical mode of landslide failure is removed.

We trust that this meets your current requirements. If you should have any concerns or questions, please do not hesitate to contact us.

Kind Regards,
Terran Geotechnical Consultants Ltd.

PROFESSIONAL ENGINEER
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# 37452

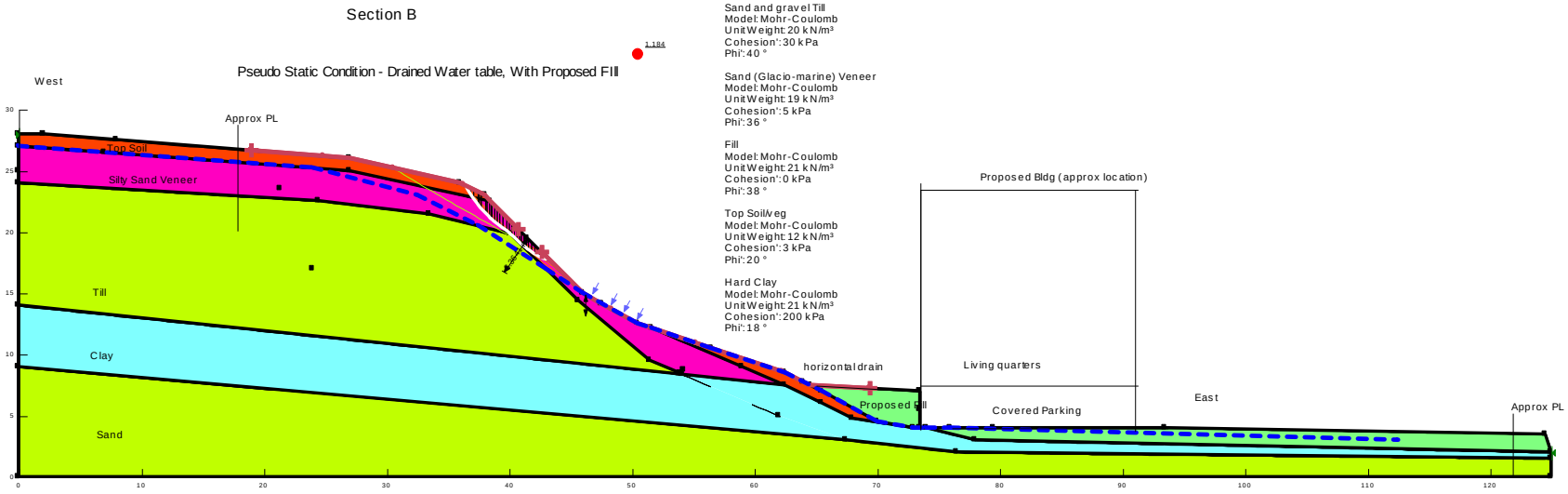
Sept 18, 2017

Dylan Lee, P. Eng.
Project Manager | Geotechnical Engineer

Thanh Le, P. Eng.
Principal | Geotechnical Engineer

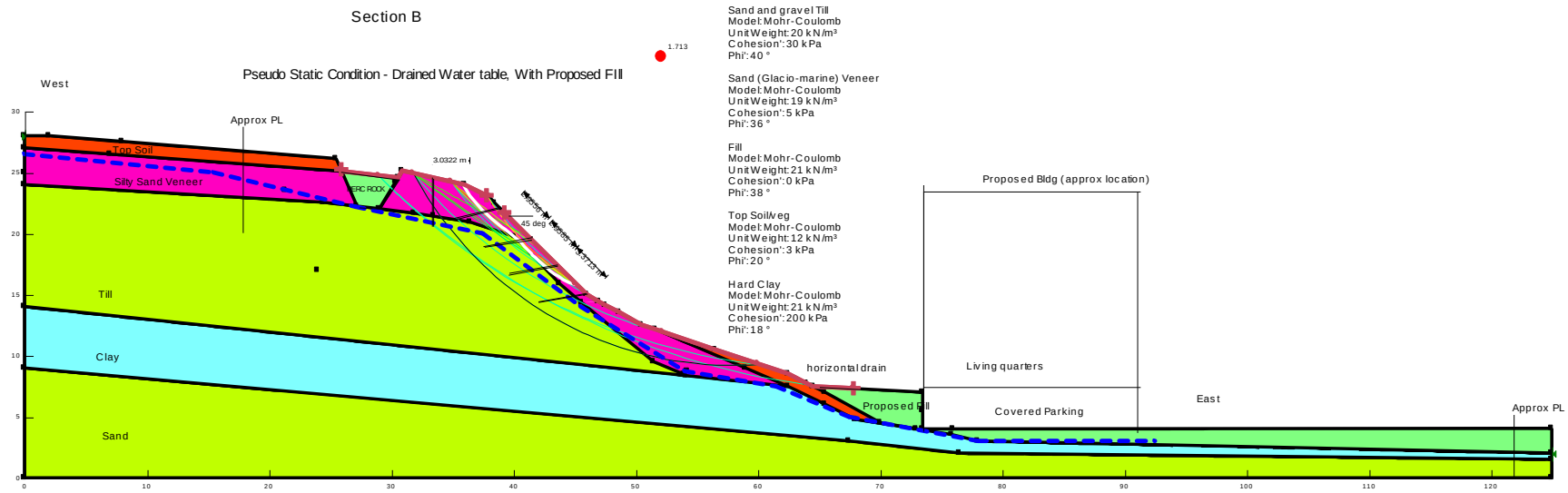
# SLOPE STABILITY

Section B – current site condition without proposed slope measures, pseudo static
FS <1.5 shown. Note, all Slip surfaces exceed FS >1.1



# SLOPE STABILITY

Section B – current site condition <u>with</u> proposed slope measures (Soil nail, interceptor ditch, horizontal drains), pseudo static
Failure surface below soil nail system shown (FS=1.71)




| CONCEPTUAL ALL THREAD BAR ANCHOR DETAILS | | | | |
|---|---|---|---|---|
| **Anchor Designation/ Location** | **Suggested/Anchor Spacing/Pattern** | **Suggested Anchor Depth/Foundation Material** | **Minimum Drilled Hole Diameter** | **Minimum Unfactored Pullout** |
| **Threaded Bar Anchor Bar diameter = #8 (1in) (25 mm)** | **10 ft x 10 ft (3 x 3 m)** | **13.2 ft (4 m min )** | **3 in (75 mm l)** | **14 Kips (62 kN)** |

Note: Conceptual only. Construction details regarding high tensile mesh and soil nails to be provided in final design.