



Timothy Gross, P.E.  
Senior Project Manager  
City of Newport  
169 SW Coast Highway  
Newport, Oregon 97365

March 23, 2012

**Tsunami Evacuation Area**  
**Proposal for Additional Geotechnical Consultation**  
**Newport, Oregon**

**Project 2111062**

Dear Mr. Gross:

Please consider this letter as our proposal to provide the requested additional geotechnical consultation for the above-referenced project. Details of our proposed scope of work, estimated costs and schedule are summarized below.

**BACKGROUND**

The City of Newport (City) plans to develop a tsunami evacuation site to serve the South Beach area. The proposed evacuation site consists of an undeveloped hill located immediately adjacent to Highway 101, southwest of the Yaquina Bay Bridge.

The hill is wooded and currently can be accessed by a relatively steep, unpaved road on the south side and a rough, narrow pedestrian trail on the north side. The City plans to regrade and pave the access road on the south side of the hill to provide access for emergency and maintenance vehicles. A short retaining wall will be required along the edge of the road. Improvements for pedestrian access will include widening and regrading the existing trail on the north slope of the hill, constructing relatively inexpensive, gravel-surfaced access ramps, and constructing stairs on the south slope. It is proposed to level the open space at the top of the hill to provide an assembly area, leaving several of the existing trees in place.

The City retained Foundation Engineering, Inc. (FEI) as the geotechnical consultant. FEI completed a geotechnical investigation at the site, focusing on its suitability as an emergency evacuation area during a tsunami. The findings were summarized in a letter report dated January 9, 2012. At the City's request, Dr. Kenneth Goettel (Goettel & Associates, Inc.) reviewed our report and offered several comments with respect to satisfying FEMA application requirements. Dr. Goettel's comments and a proposed work scope were presented in a memorandum dated February 8, 2012. We discussed this information with you on March 19 and 21. Our proposal for additional work and expansion of our report reflects our recent discussions and information needed to address Dr. Goettel's comments.

Additionally, detailed topographic survey data and design information for the proposed pedestrian stairs on the south side of the hill were not available at the time our report was prepared. Therefore, additional work will be needed to determine the foundation requirements for the stairs and the actual length and height of any retaining walls.

## **PROPOSED SCOPE OF ADDITIONAL WORK**

### **Evaluate the Variability of Ground Water Levels**

The ground water level for our liquefaction analysis was based on our previous borings in the South Beach area in and around the tsunami evacuation site. To better define the ground water level, we propose to install a piezometer near the toe of the north slope. A water level will be recorded at the time of drilling. We will allow the piezometer to stabilize and return to the site to measure the static ground water level.

### **Additional Drilling and Liquefaction Analysis**

Our investigation to date included two borings completed on the top of the hill and south slope. The borings encountered medium dense sand grading to dense to very dense sand below  $\pm$ El. 30. In the lower boring, very dense sand extended below the bottom of the hill to  $\pm$ El. 3.5 (the limits of the exploration). In addition, our exploration for the previously-proposed Expo Center facility, located  $\pm$ 1,100 feet northeast of the Tsunami Evacuation site, encountered predominantly medium dense to very dense sand to  $\pm$ 100 feet (El. -84). Based on the available borings, we concluded medium dense to very dense sand is present below the hill and, therefore, the risk of liquefaction is low.

To better quantify the liquefaction risk, we propose to supplement the available subsurface data by drilling an additional boring near the north toe of the slope, adjacent to the proposed pedestrian trail. The boring will extend to a depth of  $\pm$ 75 feet and will include SPT sampling at 5-foot intervals. The SPT data will be used in additional liquefaction analysis. Upon completion of drilling, we will install a standpipe piezometer in the borehole to a depth of  $\pm$ 30 feet with a 10-foot long screened tip. A flush-mounted cover will be installed to protect the installation. We have assumed the site is accessible with a truck-mounted drill rig and the drill cuttings can be left on site.

Additional liquefaction analysis will be completed using the subsurface and ground water information from the supplemental boring. The information will also be used to evaluate the risk of lateral spread.

### **Additional Slope Stability Analysis**

Our work to date included a series of slope stability analyses. The analyses indicate the risk of a large, deep-seated landslide is low. Rather, the greatest risk of instability involves shallow failures or sloughing of the slope surface.

To help quantify the slope stability hazard and the uncertainty in the level and duration of shaking, we plan to perform additional slope stability analyses using a range of peak ground accelerations. The ground water data from the piezometer will be used. Yield accelerations (corresponding to insipient lateral movement and a factor of safety of 1) will be established and Newmark analyses will be completed to estimate the lateral movement of the slope associated with the design peak ground accelerations. Amplification of the ground accelerations from the bedrock to the ground surface will be estimated using empirical data. No SHAKE analysis is planned.

Additional analyses will be completed to define the factors of safety associated with deep-seated slides that could potentially extend to the assembly area. Analyses will also be completed taking into account the stability of the slope following potential scour of the toe of the north slope. The results of our analyses will be peer-reviewed by Dr. Steve Dickenson, P.E. (a former geotechnical professor at OSU and a well known seismic and earthquake expert).

In our expanded report, we will include a discussion of potential mitigation options to reduce this risk from shallow failures or sloughing of the slope surface. However, we anticipate mitigation of shallow instability will not be cost-efficient and could require relatively drastic alternations of the exiting hillside.

#### **Evaluation of Scour/Erosion to Tsunami Inundation**

It is our understanding DOGAMI is currently revising their tsunami inundation maps and wave run-up estimates. However, these maps are not due to be released until the end of 2012 or early 2013. Therefore, we anticipate information will not be available to quantitatively evaluate run-up heights and scour depths. Scour risks will be evaluated in terms of the effect of toe erosion on slope stability by incrementally removing material from the toe of the north cross-section (i.e., the area most likely to be impacted by erosion) and analyzing the slope stability.

We will include in our expanded report a discussion of possible options for mitigating potential scour or erosion of the slope due to wave run-up or tsunami inundation. However, these options are likely to be costly and/or require extensive modification of the hillside or its toe. To safely evacuate, we believe individuals will need to reach the hill prior to the arrival of a wave capable of causing erosion. It is our understanding the intent of the project is to provide a safe evacuation route and assembly area. Preservation of the hillside to pre-tsunami conditions is not a requirement. Therefore, scour protection will only be provided if it is needed to maintain the stability of the assembly area.

#### **Evaluate the Design Basis for Retaining Walls**

The previous report included analysis of a relatively short, modular block retaining wall along the south access road. The wall is expected to have a total height of  $\pm 5$  feet and a maximum exposed height of 3 feet. Analysis was completed using Allowable Stress Design (ASD) methods. If required, we will provide Load Resistance Factor Design (LRFD) for the wall, but we anticipate the results will be similar.

### **Foundation Design for the South Stairway**

At the time our report was completed, design information for the proposed pedestrian stairs on the south side of the hill was not available. Therefore, additional analysis will be needed to determine the foundation requirements for the stairs. We anticipate pile foundations, drilled foundations or spread footings tied down with anchors will be required.

### **Engineering Report**

We will expand our previous geotechnical report to address the items discussed above. We anticipate the expanded report will include:

- Results of additional exploratory drilling
- Ground water measurements
- Refined site grades (assuming detailed topographic data is available)
- Additional liquefaction analyses
- Additional slope stability analyses
- Discussion of scour/erosion and possible mitigation options
- Foundation recommendations for the south stairway

### **Design Meeting**

We have assumed one, 4-hour design meeting attended by a Senior Engineer may be required to discuss the findings of our work.

### **ESTIMATED COSTS**

Table 1 provides a breakdown in the estimated costs for the proposed scope of work. These costs are based on our normal hourly rates.

**Table 1. Estimated Costs**

Item	Estimated Costs
Additional drilling and initial water level measurement	\$2,290
Laboratory testing	\$375
Additional engineering analyses and report preparation	\$7,990
Meeting	\$820
Reimbursable expenses	\$210
Foundation Engineering subtotal	\$11,685
Drilling subcontractor fees	\$4,640
<b>TOTAL</b>	<b>\$16,325</b>

This total represents our best estimate of the project costs. We will notify you immediately following the field work in the event we encounter unanticipated soil conditions that would require modifying our proposed scope of work.

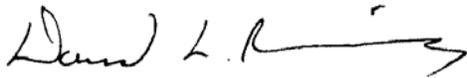
#### **SCHEDULE**

We are prepared to begin work immediately upon notification to proceed. We expect the subsurface exploration can be completed with one day on site. An additional two to three weeks will be required for the laboratory testing, engineering analysis and preparation of the expanded report. Our first task, upon authorization to proceed, will be to locate underground utilities and coordinate the field exploration.

We appreciate the opportunity to submit this proposal. Please do not hesitate to call if you have any questions regarding the proposed scope of work, estimated costs or schedule.

Sincerely,

FOUNDATION ENGINEERING, INC.

A handwritten signature in black ink, appearing to read "David L. Running". The signature is fluid and cursive, with a long horizontal stroke at the end.

David L. Running, P.E., G.E.  
Senior Engineer

DLR/cs