



## Earth Solutions NW LLC

Geotechnical Engineering, Construction  
Observation/Testing and Environmental Services

August 13, 2019  
ES-6162.01

Mr. Steve and Mrs. Sophy Yang  
c/o Richard A. Fisher Architects  
6600 East Mercer Way  
Mercer Island, Washington 98040

Attention: Mr. and Mrs. Yang

**Subject: Response to Comments and Statement of Risk  
Yang Residence  
6660 East Mercer Way  
Mercer Island, Washington  
Permit Number 1902-005**

Reference: Earth Solutions NW, LLC  
Geotechnical Engineering Study  
ES-6162, Dated August 22, 2018

Shannon & Wilson  
Geotechnical Third-Party Review  
Dated July 24, 2019

Richard A. Fisher Architects  
Yang Residence  
Architectural Plans  
Sheets A1.0 through A6.0  
Dated January 21, 2019

Meyers Engineering, LLC  
Yang Residence  
Structural Plans and Notes  
Sheets S1 through S8  
Dated June 21, 2019

Civil Engineering Solutions  
Yang Residence  
Erosion Control Drainage and TESC  
Notes and Plans  
Dated July 8, 2019

Dear Mr. and Mrs. Yang:

As requested, Earth Solutions NW, LLC (ESNW) has prepared this letter providing a response to comments issued by the City of Mercer Island third party reviewer. ESNW reviewed the referenced documents for the purposes of providing a response to comments and statement of risk.

## **Response to Comments**

The reviewer comment and ESNW response is provided below.

**Reviewer Comment 2:** Please confirm the depth of boring B-1 drilled on the east side of the project site. Page 3 of the ESNW report states that "...the maximum exploration depth of 36.5 feet below existing grades." However, the narrative and boring log in Appendix A show that the boring was drilled and sampled to a maximum depth of 31.5 feet below existing grade. The depth of the boring is important in confirming that the relative density increases with depth.

**ESNW Response:** During ESNWs July, 2018 subsurface exploration Boring B-1 was advanced to a maximum exploration depth of 31.5 feet below existing grades. The soil density was observed to increase with depth beginning at about 20 feet.

**Reviewer Comment 3:** ESNW states in the cover letter and in the Foundation section of their report that up to 9 inches of liquefaction induced settlement. However, in the Seismic Design Considerations section of the report, ESNW states that "In our opinion the site has a low susceptibility to liquefaction, given the relative density of the soil underlying the site and the lack of a near-surface groundwater table." This statement appears to conflict with ESNW's analysis showing up to 9 inches of liquefaction induced settlement. It is our opinion that there is a high potential for liquefaction and liquefaction induced settlements, based on the loose, granular soils and shallow groundwater table (2-feet below ground surface) encountered in boring B-1. Please clarify the liquefaction susceptibility of the site soils and revise the geotechnical recommendations if necessary.

**ESNW Response:** The subject site is located within a high liquefaction hazard area due to a combination of very loose sand soils and shallow groundwater. On this site, the soil profile consists of about 20 feet of very loose deposits, consisting predominantly of gravels and sands. Medium dense poorly graded sand with silt was encountered at a depth of about 20 feet and persisted to the termination depth of 31.5 feet bgs. The proposed development includes driving pipe piles to refusal through the loose liquefiable soils to bear within medium dense native soils.

**Reviewer Comment 4:** The ESNW report states that the 2012 International Building Code (IBC) was used to develop the seismic site class. The City of Mercer Island adopted the 2015 IBC as of July 2016. Please confirm that the analyses, parameters, conclusions, and recommendations regarding seismic design comply with the 2015 IBC.

**ESNW Response:** The analyses, parameters, conclusions, and recommendations regarding seismic design comply with the 2015 IBC.

**Reviewer Comment 5:** Please provide seismic design parameters (accelerations, site coefficients, etc.).

**ESNW Response:** Seismic coefficients for the site are;  $S_s$  of 1.448,  $S_{MS}$  of 1.303g,  $S_{DS}$  of 0.869,  $S_1$  of 0.553g,  $S_{M1}$  of 1.327g and  $S_{D1}$  of 0.885g. These values are applicable to the project.

**Reviewer Comment 6:** Please provide supporting evidence for a Site Class E designation.

**ESNW Response:** Based on boring data, the average N value was calculated per section 20.4.2 of ASCE 7, which results in an N value of less than 15. Therefore, Site Class E is applicable. The Fundamental Period of the building is less than 0.5, according to the structural calculations.

**Reviewer Comment 7:** We understand that battered piles will be used to resist forces caused by lateral spreading.

- a. Please provide lateral resistance and axial capacities for the battered piles.
- b. Please provide an estimate of anticipated lateral spreading displacements and discuss the method used to calculate these displacements.

**ESNW Response:** a. The structural plans indicate 3-inch diameter piles will be used. The recommended axial capacity for piles battered 15 or 20 degrees is 12 kips. Lateral capacities for piles battered at 15 and 20 degrees are 3.1 kips and 4.1 kips, respectively. The structural engineer of record utilized these recommendations in the foundation design.

b. Potential lateral spread displacements were approximated using the Bartlett and Youd approach. Using this method, estimated lateral spread on the order of  $\pm 3.0$  feet or more could occur, based on a magnitude 8.9 seismic event located 20 kilometers from the site. We note that the estimate was also based on the soil conditions at the location of the boring, and that the soil conditions are likely better with respect to relative density and depth within the footprint of the proposed structure.

**Reviewer Comment 8:** Please discuss potential downdrag forces on the piles during a seismic event, estimated magnitudes of these forces, and recommendations for mitigating downdrag forces, if applicable.

**ESNW Response:** The pile capacities provided in the referenced report included the effects of downdrag. In our opinion based on the pile design, there is no further recommendations necessary for the mitigation of downdrag. Estimated downdrag forces for 3-inch and 4-inch diameter piles are approximately 3.5 kips and 2.7 kips.

### **Statement of Risk**

Based on our review, the geologic hazard area will be modified, or the development has been designed so that the risk to the lot and adjacent property is eliminated or mitigated such that the site is determined to be safe.

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**Limitations**

The recommendations and conclusions provided in this letter are professional opinions consistent with the level of care and skill that is typical of other members in the profession currently practicing under similar conditions in this area. Our recommendations are based on the information available at the time of this letter preparation. A warranty is not expressed or implied.

We trust this letter meets your current needs. If you have any questions, or if additional information is required, please call.

Sincerely,

**EARTH SOLUTIONS NW, LLC**



Stephen H. Avril  
Senior Project Geologist



Kyle R. Campbell, P.E.  
Principal Engineer