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November 1, 2016
Project No. KE160553A

Doug and Lyn Lee
16002 Beach Drive NE
Lake Forest Park, Washington 98155

Subject: Proposed Replacement Bulkhead
Lee Residence
16002 Beach Drive NE
Lake Forest Park, Washington

Dear Mr. and Ms. Lee:

At your request, Associated Earth Sciences, Inc. (AESI) has prepared this letter discussing our opinion of the proposed bulkhead replacement at the above-referenced address. This letter was prepared in accordance with our authorized scope of work and cost estimate dated October 6, 2016. For our use in preparing this letter, we have been provided with project plans prepared by Waterfront Construction, Inc., dated as revised April 27, 2016.

Project Understanding

The subject site is the single-family residential property located at 16002 Beach Drive NE in Lake Forest Park, Washington. The property is a waterfront parcel along the western shoreline of Lake Washington. Based on our discussions with Mr. Greg Rauch of Waterfront Construction, Inc., we understand that an existing rock bulkhead shows signs of distress. You are proposing a replacement system for the existing bulkhead as a mitigation for the observed distress. The new shoreline system will include a rock staircase area bound by short sections of rock bulkhead tying the system to adjacent shoreline structures. We understand that the City of Lake Forest Park has required comments related to the need for the proposed project, and we have been asked to provide geotechnical consultation regarding the observed distress to the existing bulkhead and the need for a replacement shoreline stabilization system.



Site Observations

We visited the site on October 19, 2016 to observe existing site conditions. The subject property includes a single-family residence, with a rear yard extending to Lake Washington. The shoreline is generally north-south trending, with an inlet leading approximately 40 to 45 feet westward into the property near the south side boundary. Much of the shoreline at the site, including the north and south sides of the inlet, is faced with existing timber bulkheads. A rock bulkhead faces the west end of the inlet. This rock bulkhead structure displays signs of distress, with rocks having toppled into the lake. The residence is located approximately 35 feet from the bulkhead and lake, with associated deck and patio areas approaching to within approximately 5 to 10 feet. Also, the residence on the adjacent property to the south of the subject site approaches to within approximately 30 feet from the distressed rock bulkhead, with associated patio areas approaching to within approximately 10 feet. The lakebed near the shoreline consists of granular materials ranging from sand to pebble gravel and scattered cobbles.

Conclusions/Response to City Comments

Based on our observations, it is our opinion that a rock bulkhead, like that currently proposed, is necessary to provide protection of the retained soil mass, as well as the upland infrastructure (such as the residence, deck and patio areas, utilities, and other structures) on the subject site, as well as on the adjacent property to the south. In our opinion, the bulkhead is necessary to protect property from shoreline erosion and ground loss. The following paragraphs provide our responses to the three comments presented in Section 8.3.E.4.a of the *Lake Forest Park Shoreline Master Program* (LFPSMP), which requires a “written narrative that provides a demonstration of need.”

LFPSMP 8.3.E.4.a(1)

An assessment of the necessity for hard or soft structural stabilization, considering site-specific conditions such as water depth, orientation of the shoreline, wave fetch, and location of the nearest structure.

The orientation of the shoreline at the subject site is unusual for properties along Lake Washington, as it includes an inlet leading approximately 40 to 45 feet westward from the lake into the property near the south side boundary. The impact of storm- or boat-generated waves to the west end of the inlet will lead to the erosion of soil from behind the intact timber bulkhead along the north side of the inlet, as well as from behind the existing timber bulkhead at the adjacent property to the south, potentially resulting in backyard or patio areas of both properties being washed out from around the ends of the existing timber walls. Construction



of the proposed rock bulkhead segments extending to these adjacent shoreline structures is necessary to mitigate the effects of soil piping from behind these structures.

LFPSMP 8.3.E.4.a(2)

An assessment of erosion potential resulting from the action of waves or other natural processes operating at or waterward of the OHWM in the absence of the hard or soft structural shoreline stabilization.

We do not anticipate that much of the shoreline erosion at the subject site will be occurring at a quantifiable steady rate over time. In our experience, erosion events are episodic and result in large-scale loss of land over very short periods of time. Although many storm systems passing through the Puget Sound area include southerly to westerly winds, storms can feature northerly or easterly winds. An example of such an episode was the storm of November 22 to 23, 2010, which included strong northerly winds not typically associated with wet season storms in the Puget Sound area. During that storm, waves surged over the tops of many residential bulkheads resulting in significant erosion and property damage.

The impact of storm- or boat-generated waves to the west end of the inlet will lead to the erosion of soil from behind the intact timber bulkhead along the north side of the inlet, as well as from behind the existing timber bulkhead at the adjacent property to the south, potentially resulting in backyard or patio areas of both properties being washed out from around the ends of the existing timber walls.

LFPSMP 8.3.E.4.a(3)

An assessment of the feasibility of using soft structural stabilization measures in lieu of hard structural shoreline stabilization measures. Soft stabilization may include the use of gravels, cobbles, boulders, and logs, as well as vegetation.

The subject project includes the placement of spawning gravel at the areas of both the existing timber bulkhead and the proposed replacement rock bulkhead. Also, the proposed bulkhead and steps consist chiefly of cobbles and boulders. These are all considered soft stabilization measures under LFPSMP 8.3.E.4.a(3). It is also our opinion that a bioengineered solution, such as using plants or other natural material to stabilize the shore, is not practical at this location due to the proximity of the inlet and proposed replacement bulkhead to existing improvements, both on the subject site and at the adjacent property.

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If you should have any questions concerning this letter, please do not hesitate to call our office.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington



Jeffrey P. Laub, L.G., L.E.G.
Senior Project Engineering Geologist



Bruce L. Blyton, P.E.
Senior Principal Engineer