October 18, 2024
Project No. 20240026E004

PACE Engineers, Inc.
11255 Kirkland Way, Suite 300
Kirkland, Washington 98033-00152

Attention: Mr. John Forba

Subject: Geotechnical Review
Lakeview Townhomes 2023-CSD-0002
3803 NE 155th Street
Lake Forest Park, Washington

Dear Mr. Forba:

In accordance with your request, Associated Earth Sciences, Inc. (AESI) has reviewed the following documents:

- *Response to Permit Review Comments, Proposed Townhomes, 3803 NE 155th Street, Lake Forest Park, Washington*, prepared by Geo Group Northwest, Inc. (GGN) for Rev Properties Group, dated April 8, 2024.
- *Updated Geotechnical Engineering Study, Proposed Townhomes, 3803 NE 155th Street, Lake Forest Park,* Washington, prepared by GGN for Rev Properties Group, dated October 29, 2021.

The subject site consists of a single parcel with a reported area of 0.7 acre. The topography of the northern portion of the parcel generally slopes gently down toward southeast at an average inclination of about 15 percent. The topography slopes steeply down toward the south to southeast in the southern portion of the site and along a portion of its southeastern margin. This slope consists of the northern flank of a drainage ravine. Inclinations on the slope generally range from approximately 65 to 80 percent over a height of about 50 feet. Portions of the slope locally steepen to approximately 150 percent. King County mapping indicates that a creek is located at the bottom of the ravine. An existing single-family home with a detached garage and an asphalt paved driveway is located in the gently sloping, northern portion of the parcel.

Review of the *Geologic Map of Northeastern Seattle (Part of the Seattle North 7.5' x 15' Quadrangle), King County*, by Booth, Troost, and Schimel (2009) indicates that the site is located near the contact between Vashon recessional outwash deposits and older, pre-Fraser aged deposits. The map also identifies the upper portion of the steep ravine slope as a landslide scarp with the lower portion of the slope underlain by landslide deposits. This is consistent with

LiDAR-based shaded relief imagery of the site, which indicates the presence of hummocky topography on the lower portion of the slope both within the subject parcel and on the adjoining parcels to the east and west. The 2021 GGN report states that a landslide occurred on the portion of the steep slope on the subject parcel in the early 1990s with additional, older landslide activity reported by the resident on the neighboring property to the east. The 2021 GGN report also states that they observed ground surface cracking in the east-central portion of the northern (flatter-lying) portion of the subject parcel during a previous site visit in 2015.

Subsurface exploration completed at the site by GGN includes 8 borings drilled over the period from 2006 to 2016 to depths ranging from approximately 21.5 to 71.5 feet. The GGN report also includes 8 test pit logs from previous work at the site by Cascade Geotechnical in 1990 and 1996. The exploration data indicates that most of the site is underlain by uncontrolled fill, portions of which contain abundant wood and other organic debris. The fill is thickest near the top of the steep slope in the southern portion of the site where it was found to range in thickness from approximately 32 feet (B-7) to 39 feet (B-8). With the exception of boring B-2, where no groundwater was encountered, groundwater was encountered in the borings at depths ranging from approximately 17 to 22 feet.

Proposed development plans include construction of two townhouse buildings to include a total of 11 units. Each building will include a lower level parking garage below three levels of residential living space. The finished floor elevation of the parking garages is planned at 143 feet. Existing ground surface elevations in the building areas range from approximately 140 to 156 feet. The project will also include construction of a paved driveway, two exterior parking stalls, and a paver-surfaced, community open space area. All of the proposed improvements will be located in the northern, flatter-lying portion of the parcel. The GGN report recommends the use of augercast piles for foundation support of the buildings and soldier pile shoring walls for excavation support. It is not clear if the soldier pile walls will be temporary or permanent.

Upon completion of our review, we offer the following comments:

1. The steep slope classifies as a Landslide Hazard Area and a Steep Slope Hazard Area under the Lake Forest Park Municipal Code (LFPMC). Sections 16.16.290A and 16.16.310A of the code requires that a minimum buffer of 50 feet be established from all edges of Landslide Hazard and Steep Slope Hazard Areas. These sections of the code allow a reduction of the buffer to a minimum of 25 feet when a qualified professional demonstrates that the reduction will adequately protect the proposed development, adjacent developments, uses, and the Landslide Hazard or Steep Slope Hazard Area. The GGN report recommends the minimum buffer allowed under the code of 25 feet along the top of the steep slope. In their discussion of past landslide activity at the site GGN mentions ground surface cracking observed in the area between borings B-4 and B-5. This area is beyond the recommended buffer and appears to lie within the proposed building area. Although the use of pile foundations for building support will reduce the potential for additional loading on the slope, the existing data (presence of large thicknesses of loose fill, topographic conditions,

observed ground cracking, history of recent slide activity) suggests that the stability of the slope is low in its existing state. We request that the geotechnical engineer present the results of a slope stability analysis, and/or other supporting analysis, demonstrating that the recommended buffer is sufficient to mitigate landslide hazards. The response should include supporting justification of the groundwater levels and soil strength parameters used in the analysis.

2. Plate 2B in the 2021 GGN report shows a sidewalk and some other improvements extending into the 15-foot setback area east of the proposed townhome buildings. A portion of the sidewalk also extends into the buffer. The April 2024 GGN comment response letter states that these improvements include retaining walls up to 5 feet high, a set of stairs, two parking stalls, and a paver-surfaced public open space. Section 16.16.310A(2) of the LFPMC requires a minimum 15-foot setback from a Steep Slope Hazard Area buffer for buildings or other structures. Although some exceptions exist for steep slopes less than 20 feet in height, and minor activities such as trail construction and some utility projects, these exceptions do not apply in this case. Accordingly, these improvements should be eliminated or relocated outside of the building setback area and buffer.

3. Section 4.1 of the 2021 GGN report recommends Site Class E for structural design based on the 2018 International Building Code (IBC). We request that the geotechnical engineer provide a recommended site class based on the current 2021 IBC. The recommendation must indicate the version of ASCE 7 on which the recommended site class is based. In addition, if the site is underlain by liquefiable sediments, the correct site class would be F (see Comments 4 and 8)

4. Section 4.2 indicates that potentially liquefiable soils were encountered but were confined to layers less than 5 feet thick. The section continues to state that silt presence suggests liquefaction is unlikely at other depths within the borings. Numerous case studies have shown that saturated, soft silt soils can be highly susceptible to liquefaction. We request that the geotechnical engineer perform a liquefaction triggering analysis for all non-glacially consolidated soils and provided an assessment of liquefaction induced total and differential settlement.

5. We request that the geotechnical engineer revise or confirm the recommended lateral seismic surcharge pressure of 8H pounds per square foot recommended for retaining wall design based on the revised IBC/ASCE 7 code requirements.

6. Section 6.1.2 of the GGN report states that temporary excavations in the native soils can be inclined as steep as 1:1. These soils are described in Section 3.1 as loose to medium dense, “apparent old topsoil or alluvium.” We request that the geotechnical engineer re-evaluate the recommended maximum allowable temporary slopes considering applicable OSHA guidelines including “1926 Subpart P App B.”

7. Section 6.2 of the 2021 GGN report provides recommended allowable augercast pile capacities based on pile embedment. The first paragraph in this section of the report states

that the piles should be embedded a minimum of 20 feet into dense, native soils. The second paragraph in this section states that pile capacities are based on skin friction and end bearing in medium dense to dense soils. A table between these two paragraphs recommends minimum pile embedments ranging from 20 to 30 feet but does not specify if this refers to embedment below the ground surface or a specific buried bearing stratum. We request that the geotechnical engineer clarify what the minimum recommended embedments are for each of the allowable capacities provided and define the material to which the recommended embedments apply.

8. Section 4.2 of the 2021 GGN report states that the site is susceptible to liquefaction and recommends the use of drilled piers or augercast piles for mitigation of liquefaction risk. We request that the geotechnical engineer specify a minimum pile depth for mitigation of liquefaction risk.

9. Section 6.2 of the 2021 GGN report, which provides augercast pile recommendations, recommends a coefficient of friction of 0.35 for use between the improved subgrade and foundation elements. We request that the geotechnical engineer specify where this value may be applied. The response should consider that pile supported grade beams may lose contact with the underlying subgrade if settlement were to occur. We also request that the geotechnical engineer indicate if this is an allowable or ultimate value.

10. Section 6.2 of the GGN report recommends a passive soil pressure of 250 pounds per cubic foot (pcf) for recompacted subgrade, while section 6.3 recommends a passive pressure of 350 pcf for compacted granular fill. The first paragraph on Page 19 of the 2021 GGN report provides recommended passive earth pressures of 175 pcf and 350 pcf for unimproved soil and compacted granular fill, respectively. We request that the geotechnical engineer indicate if these are ultimate or allowable values. We also request that the geotechnical engineer expand on the criteria or soil parameters considered in the calculation of the passive pressure values.

11. Page 17 of the 2021 GGN report provides a recommended passive soil pressure of 350 pounds per cubic foot (pcf) for soldier pile wall design. The accompanying pressure diagram (Plate 5) indicates that the depth over which the passive pressure will be applied is assumed to consist of dense native soil. We request that the geotechnical engineer indicate if the recommended passive pressure is an allowable or ultimate value. We also request that the geotechnical engineer identify the location and height of the soldier pile wall and confirm that the embedded portion of the pile over which the passive pressure will be applied consists of entirely of dense soil based on the exploration data.

12. Section 6.4 of the 2021 GGN report recommends that conventional basement walls and retaining walls be supported on competent native soil, structural fill placed over a prepared subgrade, or on piles. We request that the geotechnical engineer indicate whether or not a prepared subgrade may consist of uncontrolled fill. This section of the report also recommends a base friction coefficient of 0.35. We request that the geotechnical engineer

indicate if this is an allowable or ultimate value and if it applies to pile supported foundations.

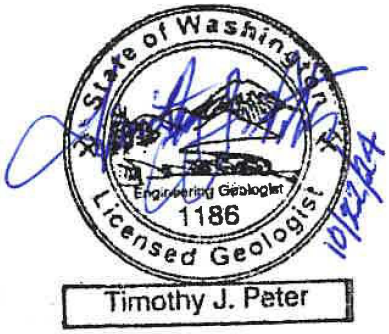
When responding to this letter, we request that the geotechnical professional restate each comment in full, followed by their response.

CLOSURE

Our scope of work for this letter was limited to a review of the documents supplied to us. Our scope did not include a site visit, exploration of actual subsurface conditions, or verification of the accuracy of the information provided for our review.

We trust this letter meets your current needs. Should you have any questions, please contact us at your convenience.

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington



Timothy J. Peter, L.E.G., L.Hg.
Senior Engineering Geologist

Matthew A. Miller, P.E.
Principal Geotechnical Engineer