December 14, 2016
ES-4011.05

Earth Solutions NW LLC

• Geotechnical Engineering
• Construction Monitoring
• Environmental Sciences

LBG 38, LLC
1040 West Georgia Street, Ste. 300
Vancouver, BC Canada V6E4H1

Attention: Mr. Tom Timmons

Subject: Seismic Stability Assessment
Soundview Technology Center
Everett, Washington

Reference: Earth Solutions NW, LLC
Geotechnical Engineering Study
ES-4011.05, Revised December 13, 2016

Dear Mr. Timmons:

In accordance with your request, Earth Solutions NW, LLC (ESNW) has prepared this letter and assessment of stability at two representative areas of descending slope along the north and west margins of the proposed development area. Our scope of services included onsite investigation of subsurface conditions, review of the current site plan, and preparation of this stability analysis.

Project Description and Geology

The subject site is located northwest of the terminus of 36th Avenue West in Everett, Washington. The property consists of one tax parcel (Snohomish County Parcel Number 28040300200100) totaling approximately 39.48 acres. Development of a light industrial business center is currently proposed at the subject property. The proposed development will include a series of light industrial warehouse buildings, paved parking areas, and associated infrastructure improvements. Grading activities will involve cuts and fills on the order of roughly 20 to 40 feet (or more in some areas) to establish design grades. Stormwater will be conveyed to a series of detention vault structures that will be founded on dense native soil deposits. It should be noted that recent plan modifications have now positioned the vault structures further away from the immediate edges of the descending slope areas such that possible slope stability impacts have been adequately mitigated.

Based on review of the referenced geotechnical report, the subject site is underlain by dense and competent glacial till deposits. An overall site plan and subsurface data relevant to the stability analysis are provided as an attachment to this letter. Consistent with the findings of the subsurface explorations, the geologic mapping of the area (Minard 1982) identifies glacial till (Qvt) deposits throughout the site and surrounding areas. Throughout the descending sloped areas to the north and west, advance outwash (Qva) is identified, with localized exposures of undivided till (Qtu).

Geologically Hazardous Areas – EMC 37.080

As defined by the referenced City of Everett Municipal Code (EMC 37.080 – Geologically hazardous areas), portions of the planned development along the north and west margins of the site will be located adjacent to (or partially within) areas of descending slope. Based on recent reconnaissance of the slopes along the north and west margins of the property, existing stability within and beyond the property limits is characterized as good. The slopes are heavily forested, and no indications of large scale instability were identified. In this respect, the planned positioning of the development along or partially within portions of the descending slope area is acceptable from a geotechnical standpoint based on our analysis. The planned development activities within segments of the descending slope area would be subject to the municipal code and provision for alterations (EMC 37.080C – Permitted Alterations). As part of the requirements for allowing alterations within a designated landslide hazard area, an evaluation of slope stability is required.

Analysis of Proposal (EMC 37.080C – Permitted Alterations)

Alterations within designated landslide hazard areas can only occur if the planned development activities will not create a hazard to the site and surrounding properties. To evaluate the level of hazard, a slope stability analysis was conducted with respect to the development and areas along the north and west margins of the site.

Stability Analysis – Vault Structures

Analysis of slope stability (static and seismic) was completed as part of our overall evaluation of the site. For purposes of the stability analysis, two representative locations (Cross Sections A-A' and B-B') located along the north and west margins of the site were chosen. The attached site plan (Plate 1) illustrates the approximate location of the two representative cross sections chosen for this analysis. Boring and test pit logs located within the vicinity of the two cross sections, and that are relevant to the analysis, are also provided as an attachment. A limit equilibrium computer modeling program (Slope-W) was used to model the static and seismic slope stability through the representative cross sections. The soil strength parameters used in the analysis were based in part on the identified site geologic conditions and engineering judgment. The following table provides the soil strength parameters used for the slope stability analyses:

Soil Type	Saturated Unit Weight (pcf)	Moist Unit Weight (pcf)	Friction Angle (degrees)	Cohesion Intercept (psf)
Structural Fill	135	125	34	0
Dense Till *	135	125	38	250

*** The soil strength parameters assumed in the analysis are considered conservative with respect to the underlying dense till deposits.**

The Slope-W stability analysis provides a theoretical factor-of-safety with respect to stability of the slope (and structure) evaluated. In general, a static factor-of-safety of at least 1.5 and a seismic factor-of-safety of at least 1.2 are considered acceptable. With respect to seismic loading, and based on review of local mapping of peak ground acceleration, a lateral seismic coefficient of 0.25g was used for the seismic stability analysis. Based on the results of the slope stability analysis, the following factors-of-safety for static and seismic stability were calculated:

Cross Section	A-A'	B-B'
Static F.S.	2.255	2.170
Seismic F.S.	1.308	1.202

Based on our analysis, the factors-of-safety meet or exceed the 1.5 for static conditions and 1.2 for seismic loading, indicating acceptable overall site stability. The results of the stability analysis and accompanying computer output are provided as an attachment to this letter.

While the results of the slope stability analysis indicate an adequate factor-of-safety for deep-seated rotational failure, the potential for relatively shallow debris flow type failures does exist. Although no areas of historic debris flow activity were identified as part of our site investigation and fieldwork, the potential does exist, and is common for most sloped topographic settings. With respect to the existing slope areas of the site that will remain unaltered as part of the proposed development, maintaining the current vegetative cover that currently exists on the slopes will help mitigate the potential for shallow debris flow events. Areas of existing vegetation disturbed as part of the development activities should be permanently stabilized with hydroseed or mulch, and replanted with appropriate species of vegetation.

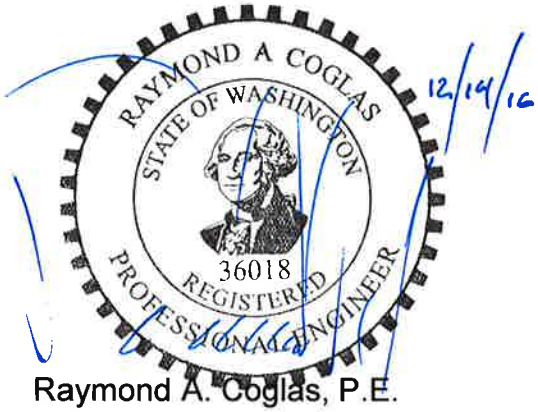
Conclusions

Based on the above stability analysis and review of the provisions for permitted alterations of designated landslide hazard areas (EMC 37.080C), the planned construction adjacent to areas of descending slope along the north and west margins of the site is feasible from a geotechnical standpoint. As previously noted, recent plan modifications have also now positioned the proposed vault structures further away from the immediate edges of the descending slope areas such that possible slope stability impacts have been adequately mitigated. The vault structures will also be founded firmly within dense and competent glacial till deposits. To mitigate erosion hazards, surface water controls during construction will require appropriate BMP implementation. The completed vault structures and stormwater conveyance systems will provide permanent mitigation of the erosion potential. The geotechnical engineer should review the final design documents related elements of the earthwork construction. As necessary, supplement recommendations for mitigating hazards associated with slope stability and erosion potential will be provided.

We trust the letter and assessment of static and seismic slope stability meet your current needs. Should you require additional information, or have questions, please call.

Sincerely,

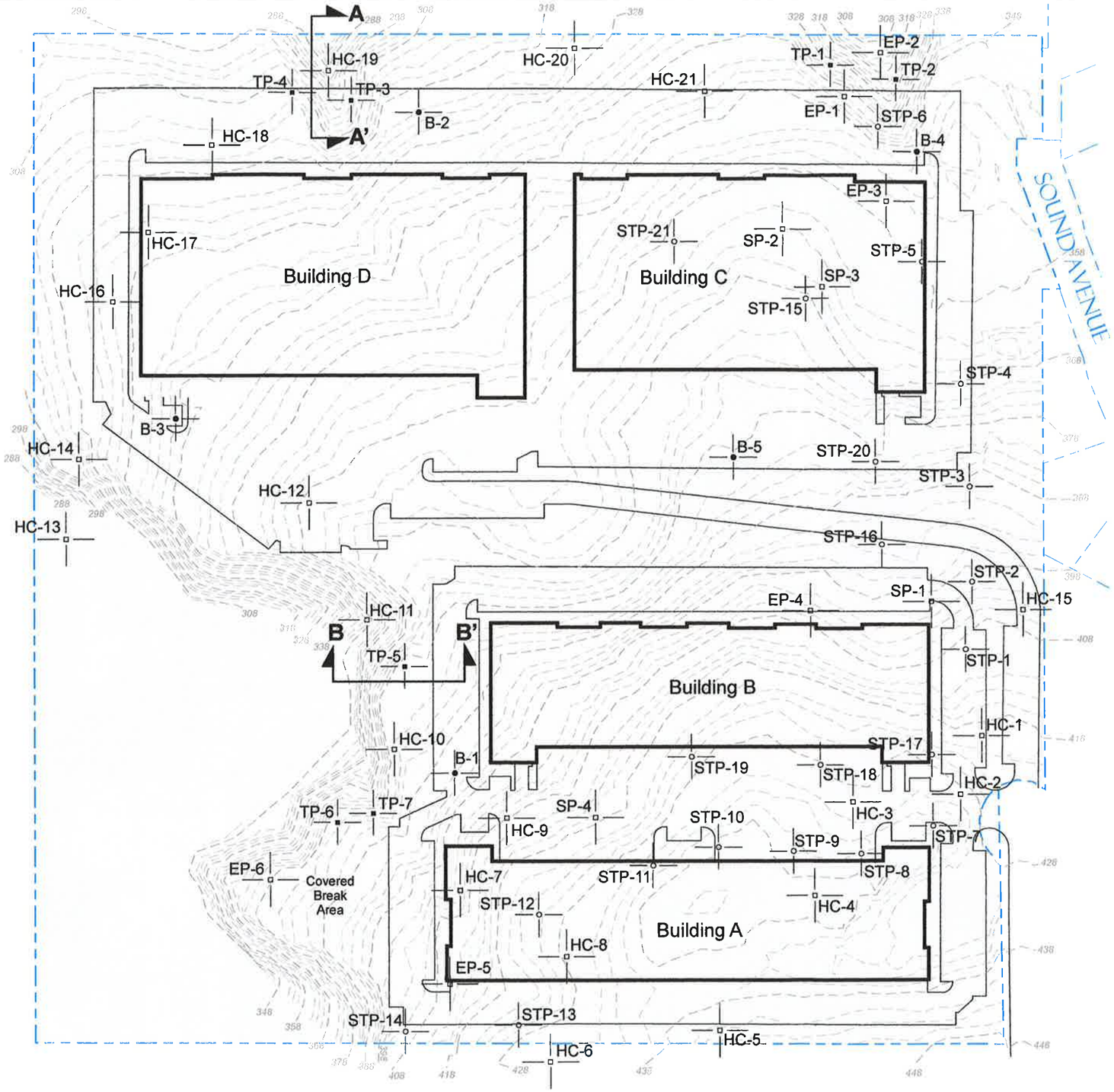
EARTH SOLUTIONS NW, LLC



Raymond A. Coglas, P.E.
Principal

cc: OAC Services, Inc.
Attn: Mr. Chris Heger (email only)

Attachments: Plate 1 - Site Plan (Cross Section Locations)
Test Pit Logs
Slope-W Computer Output and Graphics



LEGEND

B-1 — Approximate Location of ESNW Boring, Proj. No. ES-4011.03, April 2016

TP-1 — Approximate Location of ESNW Test Pit, Proj. No. ES-4011, July 2015

STP-1 — Approximate Location of Shovel Test Probe Proj. No. 2014-077

SP-1 — Approximate Location of Backhoe Shovel Pit Proj. No. 2014-077

EP-1 — Approximate Location of Associated Earth Sciences, Inc. Test Pit, Proj. No. KE00149A March 2000

HC-1 — Approximate Location of Hart Crowser Test Pit Proj. No. J-2306, Dec. 1988

Subject Site

Proposed Building

NORTH

1"=150' 0 75 150 300 Scale in Feet

NOTE: This plate may contain areas of color. ESNW cannot be responsible for any subsequent misinterpretation of the information resulting from black & white reproductions of this plate.

NOTE: The graphics shown on this plate are not intended for design purposes or precise scale measurements, but only to illustrate the approximate test locations relative to the approximate locations of existing and / or proposed site features. The information illustrated is largely based on data provided by the client at the time of our study. ESNW cannot be responsible for subsequent design changes or interpretation of the data by others.

Stability Assessment - Cross Section Plan
Soundview Technology Center
Everett, Washington

Earth Solutions NW LLC
Geotechnical Engineering Construction Monitoring and Environmental Sciences

Drwn. By	MRS
Checked By	RAC
Date	12/14/2016
Proj. No.	4011.05
Plate	1