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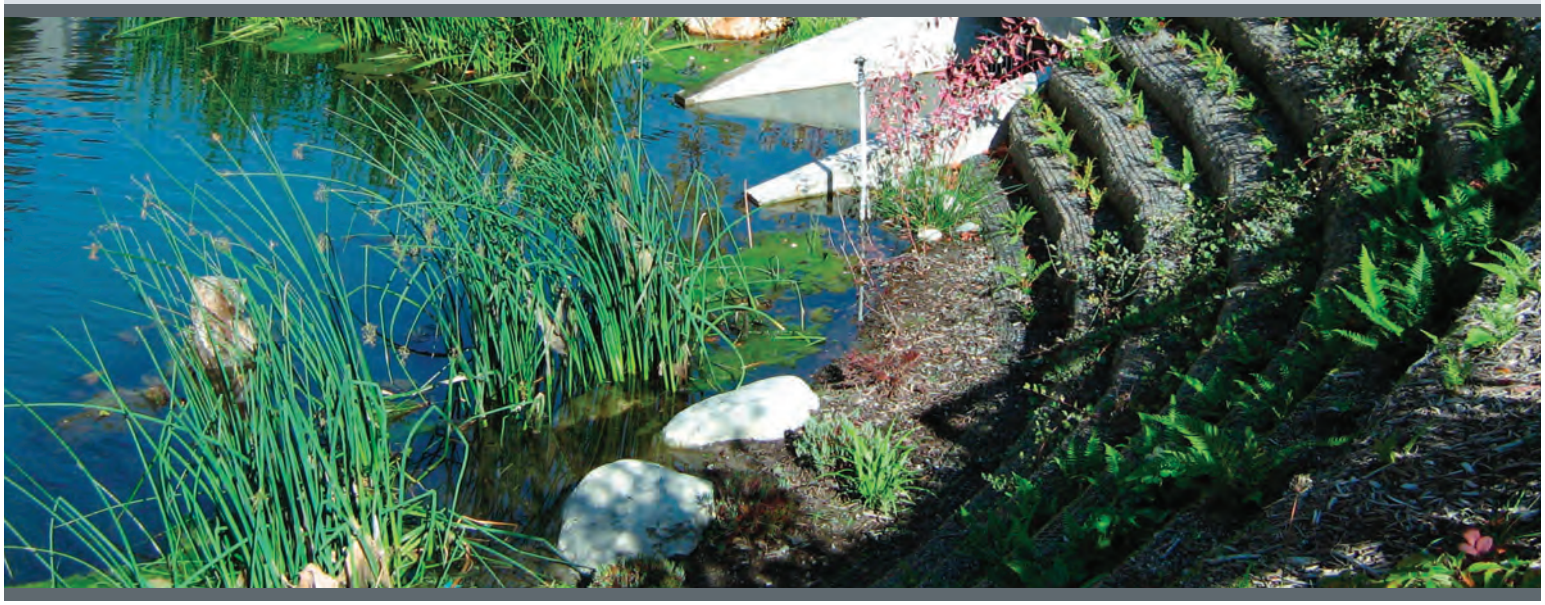
ATTACHMENT 32



*Subsurface Exploration, Geologic Hazard, and Geotechnical Engineering Report*

# LONDO FORBES CREEK

Kirkland, Washington

Prepared For:

**ORCAS MOON, LLC**

Project No. 160384E001
July 28, 2016;
Revised February 20, 2018

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July 28, 2016;
Revised February 20, 2018
Project No. 160384E001

Orcas Moon, LLC
P.O. Box 2710
Redmond, Washington 98073

Attention: Mr. Robert Londo

Subject: Subsurface Exploration, Geologic Hazard, and Geotechnical Engineering Report
Londo Forbes Creek
20th Avenue and 4th Place
Kirkland, Washington

Dear Mr. Londo:

We are pleased to present copies of the above-referenced report. This report summarizes the results of our subsurface exploration, geologic hazard, and geotechnical engineering studies and offers recommendations for the design and development of the proposed project. We should be allowed to review and modify, if necessary, the recommendations presented in this report when the project design has been finalized.

We have enjoyed working with you on this study and are confident that the recommendations presented in this report will aid in the successful completion of your project. If you should have any questions or if we can be of additional help to you, please do not hesitate to call.

Sincerely,
**ASSOCIATED EARTH SCIENCES, INC.**
**Kirkland, Washington**

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

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# SUBSURFACE EXPLORATION, GEOLOGIC HAZARD, AND GEOTECHNICAL ENGINEERING REPORT

# LONDO FORBES CREEK

## Kirkland, Washington

*Prepared for*:
**Orcas Moon, LLC**
P.O. Box 2710
Redmond, Washington 98073

*Prepared by*:
**Associated Earth Sciences, Inc.**
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Kirkland, Washington 98033
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# I. PROJECT AND SITE CONDITIONS

## 1.0 INTRODUCTION

This report presents the results of our subsurface exploration, geologic hazard, and geotechnical engineering study for the Londo Forbes Creek project, located near the intersection of 20th Avenue and 4th Place in Kirkland, Washington (Figure 1). The approximate locations of explorations completed or referenced for this study are shown on the "Site and Exploration Plan," Figure 2. Interpretive exploration logs are included in the Appendix. At the time of this report, site grading, structural plans, and construction methods have not been finalized. As the nature, design, and locations of the site improvements and lots are planned, the conclusions and recommendations contained in this report should be reviewed and modified, or verified, as necessary.

### 1.1 Purpose and Scope

The purpose of this study was to provide subsurface data to be utilized in design and construction of the site improvements and residences at the above-referenced site. Our study included a review of available geologic literature and exploration logs, completion of three exploration borings, and performing geologic studies to assess the type, thickness, distribution, and physical properties of the subsurface sediments and shallow groundwater conditions. A geologic hazards assessment and a geotechnical engineering study were also completed to determine suitable geologic hazard mitigation techniques, the type of suitable foundations, allowable foundation soil bearing pressures, anticipated foundation settlements, erosion considerations, drainage considerations, and construction recommendations. This report summarizes our fieldwork and offers geologic hazard mitigation and development recommendations based on our present understanding of the project.

### 1.2 Authorization

Written authorization to proceed with this study was granted by Mr. Robert Londo of Orcas Moon, LLC. This report has been prepared for the exclusive use of Orcas Moon, LLC and its agents for specific application to this project. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering and engineering geology practices in effect in this area at the time our report was prepared. No other warranty, express or implied, is made. It must be understood that no recommendations or engineering design can yield a guarantee of stable slopes. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the owner.

## 2.0 PROJECT AND SITE DESCRIPTION

This report was completed with an understanding of the project based on our discussions with you, and review of project plans, prepared by Blueline and dated November 21, 2017. We understand that you are currently planning 15 single-family cottage residences, with associated grading, access, and utilities, at the subject site. Modular block retaining walls, ranging up to approximately 14 feet in exposed height, are planned to face fills placed for roadways and building pads.

The property was situated north of the intersection of 20th Avenue and 4th Place in Kirkland, Washington (King County Parcel Nos. 3890100050 and 3890100055). The approximately 7-acre property generally slopes down to the north and is situated on the south flank of the Forbes Creek valley. The total elevation change across the property was on the order of 120 feet. Incised depressions on the slope appeared to serve as collectors of surface runoff above and for the upper third of the subject property. Locally, the depressions contained slopes on the order of 40 to 50 percent. We were informed that three sections of corrugated metal pipe were laid in the incised depressions and extend down the slope with water exiting the pipes near Forbes Creek Drive. It is our understanding that the pipe was installed to carry runoff water from 20th Avenue to the south of the site.

The property is accessed via a roughly graded road entering from Forbes Creek Drive along the northern property boundary. The site contains remnants of a demolished house and pump house. The site contains a moderate growth of native vegetation consisting of maple and evergreen trees, blackberry bushes, ferns, and short grass. While on-site, we did not observe bowed trees or similar conditions that would indicate creep or downslope movement of the existing slope. The only significant erosion features we observed were along the previously mentioned incised depressions running north-south on the face of the slope.

## 3.0 SUBSURFACE EXPLORATION

Our previous field study, completed in 2005, included excavating 10 exploration pits to gain information about the site. Our recent study included three exploration borings and installation of two groundwater monitoring wells to supplement previously gathered information. The various types of sediments, as well as the depths where characteristics of the sediments changed, are indicated on the exploration logs presented in the Appendix. The depths indicated on the logs where conditions changed may represent gradational variations between sediment types. Our explorations were approximately located in the field by measuring from known site features.

The conclusions and recommendations presented in this report are based on the subsurface explorations completed for this study. The number, locations, and depths of the explorations were completed within site and budgetary constraints. Because of the nature of exploratory work below ground, extrapolation of subsurface conditions between field explorations is necessary. It should be noted that differing subsurface conditions may sometimes be present due to the random nature of deposition and the alteration of topography by past grading and/or filling. The nature and extent of any variations between the field explorations may not become fully evident until construction. If variations are observed at that time, it may be necessary to re-evaluate specific recommendations in this report and make appropriate changes.

## 3.1 Exploration Pits

Exploration pits were excavated with a trackhoe. The pits permitted direct, visual observation of subsurface conditions. Materials encountered in the exploration pits were studied and classified in the field by a geotechnical engineer from our firm. All exploration pits were backfilled immediately after examination and logging. Selected samples were then transported to our laboratory for further visual classification and testing, as necessary.

## 3.2 Exploration Borings

The borings were completed on the subject site using track-mounted drilling equipment advancing a hollow-stem auger. During the drilling process, samples were obtained at 5-foot intervals. The borings were continuously observed and logged by representatives from our firm. The exploration logs presented in the Appendix are based on the field logs, drilling action, and inspection of the samples secured.

Disturbed but representative samples were obtained by using the Standard Penetration Test (SPT) procedure in accordance with *American Society for Testing and Materials* (ASTM) D-1586. This test and sampling method consists of driving a standard, 2-inch outside-diameter, split barrel sampler a distance of 18 inches into the soil with a 140-pound hammer free-falling a distance of 30 inches. The number of blows for each 6-inch interval is recorded, and the number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance (“N”) or blow count. If a total of 50 blows are recorded at or before the end of one 6-inch interval, the blow count is recorded as the number of blows for the corresponding number of inches of penetration. The resistance, or N-value, provides a measure of the relative density of granular soils or the relative consistency of cohesive soils. These values are plotted on the attached boring logs.

The samples obtained from the split-barrel sampler were classified in the field and representative portions placed in watertight containers. The samples were then transported to our laboratory for further visual classification and geotechnical laboratory testing, as necessary. The various types of soil and groundwater elevations, as well as the depths where soil and groundwater characteristics changed, are indicated on the exploration boring logs presented in the Appendix of this report. Our explorations and reconnaissance were approximately located by measuring from known site features.

### 3.3 Monitoring Wells

Exploration borings EB-1W and EB-2W were completed as 2-inch-diameter monitoring wells, each with 10 feet of machine-slotted Schedule 40 polyvinyl chloride (PVC) well screen and a flush-mount monument. The sand pack materials consisted of 10/20 Colorado Silica Sand. The wells were sealed with a combination of bentonite chips and concrete. Well construction details are presented on the boring logs in the Appendix. Hand water level data was collected after well development was completed, on February 2, 2018.

## 4.0 SUBSURFACE CONDITIONS

Subsurface conditions at the subject site were inferred from the field explorations referenced for this study, visual reconnaissance of the site, and review of applicable geologic literature. The approximate locations of the explorations are shown on Figure 2. As shown on the field logs, the exploration pits generally encountered medium dense sand with varying amounts of silt and gravel or stiff to hard silts, and the exploration borings generally encountered stiff to hard silt overlying very dense pre-Fraser-age deposits, with colluvium encountered at the lower, northern end of the site. Minor amounts of fill may occur at some locations, particularly those in the northern portion of the site, adjacent to the roadway, or within utility trenches across the property and in the vicinity of previous structures. The following section presents more detailed subsurface information.

### 4.1 Stratigraphy

*Topsoil*

Topsoil consisting of loose, moist, dark brown, silty sand was encountered in most of the explorations. The topsoil ranged in thickness from about 0.5 to 1.5 feet. This material is unsuitable for structure or pavement support.

*Fill*

We observed fill soils covering buried, approximately 12-inch–diameter, corrugated pipes laid along the steep site slopes. The pipes appeared to be between 1.5 and 2 feet below existing site grades at the locations we observed. Fill may also be encountered around utilities and foundation areas associated with the demolished structure. This material is unsuitable for structure or pavement support.

*Colluvium*

Colluvial soils were encountered at the location of exploration boring EB-2W to a depth of approximately 12.5 feet below the ground surface. The colluvium generally consisted of loose, silty fine to medium sand with trace gravel. Portions of the colluvium contained organic material. Colluvium is a material derived from upslope and deposited by gravity or through the potential disturbance of upslope activity. Due to their variable density and organic debris content, the existing colluvial soils are not suitable for foundation support.

*Recessional Outwash*

Sediments encountered below the topsoil layer consisted of medium dense, fine to medium sand with varying quantities of silt. We interpret these sediments to be representative of recessional outwash. The recessional outwash consists of sediments that were deposited by meltwater streams that emanated from the retreating glacial ice during the latter portion of the Vashon Stade of the Fraser Glaciation ending approximately 12,500 years ago. Where glacial sediments are exposed at the ground surface throughout the Puget Sound region, the upper several feet of these sediments typically become weathered. The recessional outwash sediments generally extended about 4 to 5 feet below existing grades, but in exploration pit EP-1, extended to the bottom of the exploration at 16 feet. When properly prepared, the recessional outwash will be suitable for the support of foundations.

*Advance Outwash*

An advance outwash deposit consisting of medium dense to very dense sand containing variable amounts of disseminated silt, interbeds of clayey silt, and few amounts of scattered gravel was encountered below the topsoil and recessional deposits. The advance outwash deposit was generally encountered between 4 to 6 feet below existing grades in exploration pits EP-6 and EP-9, or approximately the middle third of the slope. The advance outwash was deposited ahead of the advancing Vashon-age glacial ice sheet in meltwater streams and subsequently overridden by several thousand feet of ice. Consequently, these materials are medium dense to very dense, possess high shear strength, and have low compressibility characteristics. The advance outwash deposit is suitable for direct foundation support.

*Transitional Beds/Lawton Clay*

A hard, clayey silt and silty clay deposit containing trace amounts of fine sand interpreted to be transitional beds was generally encountered in the upper portions (south end) of the property, including in exploration borings EB-1W and EB-3. The glaciolacustrine clayey silt and silty clay was deposited in freshwater lakes or slow-moving rivers far ahead of the advancing Vashon-age glacial ice sheet and was also overridden by several thousand feet of ice. These materials are hard, have low compressibility characteristics, and are relatively impermeable. The transitional beds are considered suitable for support of shallow foundations with proper preparation. The transitional beds are typically highly moisture-sensitive and susceptible to disturbance when wet. Care should be taken not to disturb planned load-bearing surfaces that are composed of the transitional beds during periods of wet site or weather conditions.

*Pre-Fraser Non-Glacial Deposits*

Below the Lawton clay deposits, exploration borings EB-1W and EB-3 encountered very stiff to hard sandy silt or very dense sand, which extended to 52 feet below the ground surface at EB-3, and below the maximum depth explored of 60 feet below the ground surface at EB-1W. This soil was interpreted to represent non-glacial deposits placed prior to the Vashon Stade of the Fraser Glaciation and subsequently compacted by the weight of the overlying glacial ice. The very stiff to hard/very dense material is generally considered suitable for support of light to heavily loaded foundations when in an intact, undisturbed condition.

*Pre-Olympia Glacial Deposits*

Underlying the colluvium at exploration boring EB-2W, and below the pre-Fraser-age deposits at exploration boring EB-3, we encountered dense to very dense fine to medium sand, with varying amounts of silt and gravel, and gravel beds in places, which extended below the maximum depths explored of 31.5 feet and 60.5 feet, respectively. This deposit was interpreted to represent sediments placed prior to the Olympia interglaciation and subsequently compacted by the weight of the overlying glacial ice. The dense to very dense material is generally considered suitable for support of light to heavily loaded foundations when in an intact, undisturbed condition. This material is somewhat moisture-sensitive and susceptible to disturbance when wet.

## 4.2 Hydrology

Groundwater seepage was encountered in exploration pit EP-5 at the time of our field study in June 2005, and in exploration boring EB-2W during our January 2018 study. We expect shallow groundwater seepage across much of the site to be limited to interflow. Interflow occurs when surface water percolates down through the surficial weathered or higher-permeability

sediments and becomes perched atop underlying, lower-permeability sediments. It should be noted that fluctuations in the level of the groundwater may occur due to the time of the year, variations in the amount of precipitation, and changes in site development. Seepage may also occur at random depths and locations in unsupervised or non-uniform fills. During our site reconnaissance, we did not observe springs emanating from the steeply sloping areas. As stated in our letter, dated October 13, 2016 (attached), the likely predominant water source leading to the wet conditions observed at previously-delineated Wetland "A" includes the drainage system originating along 20th Avenue and point-discharging onto the subject site.

## II. GEOLOGIC HAZARDS AND MITIGATIONS

The following discussion of potential geologic hazards is based on the geologic, slope, and shallow groundwater conditions, as observed and discussed herein.

### 5.0 LANDSLIDE HAZARDS AND MITIGATION

Kirkland Zoning Code (KZC) 85.13(3)(a) defines "High Landslide Hazard Areas" as *"Areas sloping 40 percent or greater, areas subject to previous landslide activities and areas sloping between 15 percent and 40 percent with zones of emergent groundwater or underlain by or embedded with impermeable silts or clays."* Given the predominance of fine-grained "Lawton Clay" deposits encountered in our recent exploration borings, the portions of the subject site greater than 15 percent would be classified as "High Landslide Hazard Areas", as defined in the KZC. The following paragraphs discuss the stability of the slopes and recommendations to mitigate risks to the public health, safety, or welfare. It must be understood that no recommendations or engineering design can yield a guarantee of stable slopes. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the owner.

During our site reconnaissance and our subsurface exploration, we found no visual evidence of tension cracks, emergent seepage, hummocky topography, or other indications of recent slope instability at the subject site. We observed that many of the large trees scattered across the site, including those near to or at the top of the steep slopes, were vertically oriented, suggesting that ongoing deep-seated slope movement is not occurring at the subject parcel.

#### 5.1 Numerical Slope Stability Analysis

Associated Earth Sciences, Inc. (AESI) used GeoStudio 2016, Version 8.16.3.14580, by Geo-Slope International, Ltd. to perform the analysis of slope stability with the proposed project. The Morgenstern-Price method was used for both static and seismic models. We used the topography presented on the grading plan provided by Blueline (Figure 2) to create two profiles within the subject property. Data from the recent exploration borings were used to model the steep slopes and underlying soil contacts. The soil densities and other soil properties in the model were estimated based on the subsurface conditions encountered in our explorations, our experience with similar soils, and correlation with published information. Soil strength parameters used for our analysis, along with interpretive geologic cross-sections, are shown on Figures 3 through 6. A surcharge of 500 pounds per square foot (psf) was used for our analysis to represent proposed residences, and the modeled cross-sections include the currently proposed fill placement shown in the Blueline plans, including mechanically stabilized earth (MSE) retaining wall systems placed at the tops of the adjacent slopes. Seismic forces

were modeled using a pseudo static acceleration of 0.25g, which is consistent with current local standards of practice for slope stability modeling.

Slope stability is expressed as a factor of safety, which is a ratio between resisting and driving forces for a given slope failure scenario. A factor of safety of 1.0 indicates that resisting and driving forces are equal, and a failure is predicted. Factors of safety greater than 1 indicate that resisting forces exceed driving forces, and a failure is not predicted. A static factor of safety of 1.50 would be considered suitable with respect to generally accepted geotechnical engineering practice. During short-term seismic loading, a dynamic factor of safety of 1.15 is generally considered acceptable. Using the above soil parameters, groundwater conditions, and the geometry shown on Figures 3 through 6, including the embedment of the proposed MSE wall systems into underlying very stiff to hard Lawton Clay deposits, the resulting factors of safety for slope movement impacting the proposed improvements exceeded 1.50 under static conditions and 1.15 under seismic conditions. Based on our analyses, the proposed construction of new residences and MSE walls at the approximate locations shown on Figure 2 appears feasible from a geotechnical standpoint.

As with all steep slopes, surface drainage should be properly controlled and directed away from sloping areas. At no time should loose fill be pushed over the top of the slope or soil excavated from the toe area without support by an engineered retaining structure. Uncontrolled fill on slopes or toe excavation may promote landslides or debris flow activity. AESI should review grading plans as the project design develops and possibly changes from that upon which this report is based.

## 6.0 SEISMIC HAZARDS AND MITIGATIONS

Earthquakes occur regularly in the Puget Lowland. Most of these events are small and are not felt by humans. However, large earthquakes do occur, as evidenced by the 2001, 6.8-magnitude event; the 1965, 6.5-magnitude event; and the 1949, 7.2-magnitude event. The 1949 earthquake appears to have been the largest in this region during recorded history and was centered in the Olympia area. Evaluation of earthquake return rates indicates that an earthquake of the magnitude between 5.5 and 6.0 is likely within a given 20-year period.

Generally, there are four types of potential geologic hazards associated with large seismic events: 1) surficial ground rupture, 2) seismically induced landslides, 3) liquefaction, and 4) ground motion. The potential for each of these hazards to adversely impact the proposed project is discussed below.

## 6.1 Surficial Ground Rupture

The nearest known fault traces to the project site are the South Whidbey Island-Lake Alice Fault located approximately 4 miles to the north, and the Seattle Fault located approximately 5 miles to the south. Recent studies of both the Seattle Fault and the South Whidbey Island-Lake Alice Fault indicate that they are active faults capable of generating surface ruptures. The recognition of these faults is relatively new, and data pertaining to them are limited, with the studies still ongoing. According to the U.S. Geological Society (USGS) studies, the recurrence interval of movements along these faults is unknown, but is speculated to be on the order of 1,100 years. Due to the distance from the site to the known fault zones, and due to the long recurrence interval that is suspected for these fault systems, the risk for damage to the project during the expected life of the structures due to surface faulting is expected to be low, in our opinion.

## 6.2 Seismically Induced Landslides

Due to the field observations and slope stability analysis noted in Section 5.0, it is our opinion that the risk of seismically induced landslides at the subject site is low. Therefore, as noted previously, this opinion is dependent upon site grading and construction practices being completed in accordance with the geotechnical recommendations presented in this report.

## 6.3 Liquefaction

Liquefaction is a temporary loss in soil shear strength that can occur when loose granular soils below the groundwater table are exposed to cyclic accelerations, such as those that occur during earthquakes. The observed site soils were relatively dense and unsaturated and are not expected to be prone to liquefaction. A detailed liquefaction hazard analysis was not performed as part of this study, and none is warranted, in our opinion.

## 6.4 Seismic Site Class

In our opinion the subsurface conditions at the site are consistent with seismic Site Class D in accordance with the 2015 *International Building Code* (IBC), and the publication ASCE 7 referenced therein, the most recent version of which is ASCE 7-10.

# 7.0 EROSION HAZARDS AND MITIGATION

The on-site sediments contain a high percentage of silt and fine sand and are sensitive to erosion. In order to control erosion and reduce the amount of sediment transport off the site during construction, the following recommendations should be followed.

1. Construction activity should be scheduled or phased as much as possible to reduce the amount of earthwork activity that is performed during the winter months.

2. The winter performance of a site is dependent on a well-conceived plan for control of site erosion and stormwater runoff. The project temporary erosion and sediment control (TESC) plan should include ground-cover measures, access roads, and staging areas. The contractor must implement and maintain the required measures. A site maintenance plan should be in place in the event stormwater turbidity measurements are greater than the Washington State Department of Ecology (Ecology) standards.

3. TESC measures for a given area to be graded or otherwise worked should be installed soon after ground clearing. The recommended sequence of construction within a given area after clearing would be to install sediment traps and/or ponds and establish perimeter flow control prior to starting mass grading.

4. During the wetter months of the year, or when large storm events are predicted during the summer months, each work area should be stabilized so that if showers occur, the work area can receive the rainfall without excessive erosion or sediment transport. The required measures for an area to be “buttoned-up” will depend on the time of year and the duration the area will be left unworked. During the winter months, areas that are to be left unworked for more than 2 days should be mulched or covered with plastic. During the summer months, stabilization will usually consist of seal-rolling the subgrade. Such measures will aid in the contractor’s ability to get back into a work area after a storm event. The stabilization process also includes establishing temporary stormwater conveyance channels through work areas to route runoff to the approved treatment facilities.

5. All disturbed areas should be revegetated as soon as possible. If it is outside of the growing season, the disturbed areas should be covered with mulch, as recommended in the erosion control plan. Straw mulch provides a cost-effective cover measure and can be made wind-resistant with the application of a tackifier after it is placed.

6. Surface runoff and discharge should be controlled during and following development. Uncontrolled discharge may promote erosion and sediment transport.

7. Soils that are to be reused around the site should be stored in such a manner as to reduce erosion from the stockpile. Protective measures may include, but are not limited to, covering with plastic sheeting, the use of low stockpiles in flat areas, or the use of silt fences around pile perimeters.

8. On-site erosion control inspections and turbidity monitoring (when required) should be performed in accordance with Ecology requirements. Weekly and monthly reporting to Ecology should be performed on a regularly scheduled basis. Temporary and permanent erosion control and drainage measures should be adjusted and maintained, as necessary, for the duration of project construction.

It is our opinion that with the proper implementation of the TESC plans and by field-adjusting appropriate mitigation elements (best management practices [BMPs]) throughout construction, as recommended by the erosion control inspector, the potential adverse impacts from erosion hazards on the project may be mitigated.

# III. DESIGN RECOMMENDATIONS

## 8.0 INTRODUCTION

Our explorations indicate that, from a geotechnical standpoint, the subject site is suitable for the proposed development provided the recommendations contained herein are properly followed. The bearing stratum is relatively shallow and spread-footing foundations may be utilized. We understand that the distribution of foundations loads of the proposed residences will be typical; concentrated loads on the order of 2 kips per lineal foot of foundation can be expected. Consequently, the native dense outwash soils, hard transitional bed silts, or structural fills bearing on the native soils are capable of providing suitable building support. Planned MSE retaining walls will need to be designed and constructed with suitable embedment into very stiff to hard Lawton clay deposits to maintain suitable stability.

## 9.0 SITE PREPARATION

Site preparation of planned building, road, and structural fill areas should include removal of all trees, brush, debris and any other deleterious material. Additionally, the upper organic topsoil should be removed and the remaining roots grubbed. Areas where loose surficial soils exist due to grubbing operations should be considered as fill to the depth of disturbance and treated as subsequently recommended for structural fill placement.

Loose topsoil should be stripped down to the underlying, medium dense to dense outwash soils and hard transitional bed silts. Since the density of the soil is variable, random soft pockets may exist and the depth and extent of stripping can best be determined in the field by the geotechnical engineer or his representative. We recommend that road areas be proof-rolled with a loaded dump truck to identify soft spots; soft areas should be overexcavated and backfilled with structural fill.

### 9.1 Temporary Slopes

In our opinion, stable construction slopes should be the responsibility of the contractor and should be determined during construction. For estimating purposes, we anticipate that temporary, unsupported cut slopes in the unsaturated, medium dense recessional outwash soils and stiff silts can be made at a maximum slope of 1.5H:1V, and in the unsaturated native advance outwash sands and gravels and the very stiff to hard silts at 1H:1V. As is typical with earthwork operations, some sloughing and raveling may occur and cut slopes may have to be adjusted in the field. In addition, WISHA/OSHA regulations should be followed at all times.

## 9.2 Moisture-Sensitive Soils

The on-site soils contain a high percentage of fine-grained material, which makes them moisture-sensitive and subject to disturbance when wet. The contractor must use care during site preparation and excavation operations so that the underlying soils are not softened. If disturbance occurs, the softened soils should be removed and the area brought to grade with structural fill. Consideration should be given to protecting access and staging areas with an appropriate section of crushed rock or asphalt treated base (ATB).

If crushed rock is considered for the access and staging areas, it should be underlain by engineering stabilization fabric to reduce the potential of fine-grained materials pumping up through the rock and turning the area to mud. The fabric will also aid in supporting construction equipment, thus reducing the amount of crushed rock required. We recommend that at least 10 inches of rock be placed over the fabric; however, due to the variable nature of the near-surface soils and differences in wheel loads, this thickness may have to be adjusted by the contractor in the field.

# 10.0 STRUCTURAL FILL

Due to the slopes on the site, structural fill will be necessary to establish desired grades. All references to structural fill in this report refer to subgrade preparation, fill type, placement, and compaction of materials as discussed in this section. If a percentage of compaction is specified under another section of this report, the value given in that section should be used.

## 10.1 Subgrade Keying and Benching

If fill is to be placed on slopes steeper than 5H:1V, the base of the fill should be tied to firm, stable subsoil by appropriate keying and benching, which would be established in the field to suit the particular soil conditions at the time of grading. The keyway will act as a shear key to embed the toe of the new fill into the hillside, including the embedment of the proposed MSE wall systems into underlying very stiff to hard Lawton Clay deposits. Generally, the keyway for hillside fills should be at least 8 feet wide and cut into the lower, dense sand or stiff silt. Level benches would then be cut horizontally across the hill following the contours of the slope. No specific width is required for the benches, although they are usually a few feet wider than the dozer being used to cut them. All fills proposed over a slope should be reviewed by our office prior to construction.

We recommend that AESI observe exposed subgrades prior to fill placement. Should wet subgrade conditions be present, we recommend that the wet subgrade areas for fills planned along the slopes be equipped with subfill drains. Subfill drains may consist of

a 1- to 2-foot-thick section of free-draining aggregate placed below the fill and covered with a geotextile fabric. The aggregate should be compacted to 95 percent of the modified Proctor maximum density using *American Society for Testing and Materials* (ASTM) D-1557 as the standard or to a firm and unyielding condition as determined by the geotechnical engineer or his representative. The subfill drains will allow hydrostatic forces, if present, to disperse.

## 10.2 Fill Subgrade Preparation

After overexcavation/stripping has been performed to the satisfaction of the geotechnical engineer/engineering geologist, the upper 12 inches of exposed ground should be recompacted to 90 percent of the modified Proctor maximum density using ASTM D-1557 as the standard or to a firm and unyielding condition as determined by the geotechnical engineer or his representative. If the subgrade contains too much moisture, adequate recompaction may be difficult or impossible to obtain and should probably not be attempted. In lieu of recompaction, the area to receive fill should be blanketed with washed rock or quarry spalls to act as a capillary break between the new fill and the wet subgrade. Where the exposed ground remains soft and further overexcavation is impractical, placement of an engineering stabilization fabric may be necessary to prevent contamination of the free-draining layer by silt migration from below.

## 10.3 Structural Fill Placement and Compaction

After the recompacted ground is tested and approved or a free-draining rock course is laid, structural fill may be placed to attain desired grades. Structural fill is defined as non-organic soil, acceptable to the geotechnical engineer, placed in maximum 10-inch loose lifts with each lift being compacted to at least 95 percent of the modified Proctor maximum density using ASTM D-1557 as the standard. In the case of roadway and utility trench filling, the backfill should be placed and compacted in accordance with current local or county codes and standards. The top of the compacted fill should extend horizontally outward a minimum distance of 3 feet beyond the location of the perimeter footings or roadway edge before sloping down at an angle of 2H:1V.

## 10.4 Moisture-Sensitive Fill Materials

Soils in which the amount of fine-grained material (smaller than the No. 200 sieve) is greater than approximately 5 percent (measured on the minus No. 4 sieve size) should be considered moisture-sensitive. Use of moisture-sensitive soil in structural fills should be limited to favorable dry weather conditions. The on-site soils generally contained significant amounts of silt and are considered moisture-sensitive. In addition, construction equipment traversing the site when the soils are wet can cause considerable disturbance. Due to the sloping, potentially wet conditions at the subject site, and the proposed structures, roadways, utilities, and

rockeries planned for these slope conditions, a select import material consisting of a clean, free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil with the amount of fine-grained material limited to 5 percent by weight when measured on the minus No. 4 sieve fraction. We recommend that imported structural fill conform to Washington State Department of Transportation (WSDOT) Specification 9-03.14(1) (gravel borrow) or similar as determined by the geotechnical engineer.

### 10.5 Structural Fill Testing

The contractor should note that any proposed fill soils must be evaluated by AESI prior to their use in fills. This would require that we have a sample of the material 48 hours in advance of filling activities to perform a Proctor test and determine its field compaction standard. A representative from our firm should inspect the stripped subgrade and be present during placement of structural fill to observe the work and perform a representative number of in-place density tests. In this way, the adequacy of the earthwork may be evaluated as filling progresses and problem areas may be corrected at that time. It is important to understand that taking random compaction tests on a part-time basis will not assure uniformity or acceptable performance of a fill. As such, we are available to aid the owner in developing a suitable monitoring and testing frequency.

## 11.0 FOUNDATIONS

Spread footings may be used for building support when founded on medium dense recessional outwash soils, dense to very dense advance outwash soils, stiff to hard transitional beds, or structural fill placed as previously discussed. We recommend that an allowable bearing pressure of 2,000 psf be utilized for design purposes, including both dead and live loads. An increase of one-third may be used for short-term wind or seismic loading. Perimeter footings should be buried at least 18 inches into the surrounding soil for frost protection. However, all footings must penetrate to the prescribed bearing stratum and no footing should be founded in or above loose, organic, or existing fill soils.

It should be noted that the area bounded by lines extending downward at 1H:1V from any footing must not intersect another footing or intersect a filled area, which has not been compacted to at least 95 percent of ASTM D-1557. In addition, a 1.5H:1V line extending down from any footing must not daylight because sloughing or raveling may eventually undermine the footing. Thus, footings should not be placed near the edge of steps or cuts in the bearing soils.

Anticipated settlement of footings founded on medium dense to very dense outwash soils, stiff to hard transitional bed silts, or approved structural fill should be on the order of 1 inch.

However, disturbed soil not removed from footing excavations prior to footing placement could result in increased settlements. All footing areas should be inspected by AESI prior to placing concrete to verify that the design bearing capacity of the soils has been attained and that construction conforms to the recommendations contained in this report. Such inspections may be required by the City of Kirkland. Perimeter footing drains should be provided as discussed under the section on "Drainage Considerations."

## 12.0 LATERAL WALL PRESSURES

All backfill behind walls or around foundations should be placed following our recommendations for structural fill and as described in this section of the report. Horizontally backfilled walls, which are free to yield laterally at least 0.1 percent of their height, may be designed using an equivalent fluid equal to 35 pounds per cubic foot (pcf). Fully restrained, horizontally backfilled, rigid walls that cannot yield should be designed for an equivalent fluid of 50 pcf. Walls that retain sloping backfill at a maximum angle of 2H:1V should be designed for 55 pcf for yielding conditions and 75 pcf for restrained conditions. If parking areas are adjacent to walls, a surcharge equivalent to 2 feet of soil should be added to the wall height in determining lateral design forces. Undrained walls/structures must be designed for combined soil and hydrostatic pressures (85 pcf for yielding walls, 100 pcf for unyielding walls with horizontal backfill) and for buoyant/uplift forces.

In accordance with the 2015 IBC, retaining wall design should include seismic design parameters. Based on the site soils and assumed wall backfill materials, we recommend a seismic surcharge pressure in addition to the equivalent fluid pressures presented above. A rectangular pressure distribution of 4H and 8H psf (where H is the height of the wall in feet) should be included in design for "active" and "at-rest" loading conditions, respectively. The resultant of the rectangular seismic surcharge should be applied at the midpoint of the walls.

### 12.1 Wall Backfill

The lateral pressures presented above are based on the conditions of a uniform backfill consisting of either the on-site glacial sediments, or imported sand and gravel compacted to 92 percent of ASTM D-1557. A higher degree of compaction is not recommended, as this will increase the pressure acting on the walls. A lower compaction may result in unacceptable settlement behind the walls. Thus, the compaction level is critical and must be tested by our firm during placement. The recommended compaction of 92 percent of ASTM D-1557 applies to any structural fill placed behind the wall within a distance equal to the wall height and up to the elevation of the top of the wall. Structural fill used to construct slopes behind retaining walls should be compacted to at least 95 percent of ASTM D-1557 if the fill is placed above the elevation of the top of the wall. Surcharges from adjacent footings, heavy construction

equipment, or sloping ground must be added to the above-recommended lateral pressures. Footing drains should be provided for all retaining walls, as discussed under the "Drainage Considerations" section of this report.

### 12.2 Wall Drainage

It is imperative that proper drainage be provided so that hydrostatic pressures do not develop against the walls. This would involve installation of a minimum, 1-foot-wide blanket drain for the full wall height (excluding the uppermost 1 foot of backfill) using imported washed gravel against the walls. The wall drain material must be hydraulically connected to the footing drain pipe. Wall foundation drains are discussed in Section 15.0 of this report.

### 12.3 Passive Resistance and Friction Factor

Lateral loads can be resisted by friction between the foundation and the natural, medium dense to very dense sediments or supporting structural fill soils, or by passive earth pressure acting on the buried portions of the foundations. The foundations must be backfilled with compacted structural fill to achieve the passive resistance provided below. We recommend the following allowable design parameters.

- Passive equivalent fluid = 250 pcf
- Coefficient of friction = 0.30

## 13.0 FLOOR SUPPORT

Slab-on-grade floors may be constructed either directly on the medium dense to very dense natural sediments, or on structural fill placed over these materials. Areas of the slab subgrade that are disturbed (loosened) during construction should be recompacted to an unyielding condition prior to placing the pea gravel, as described below.

If moisture intrusion through slab-on-grade floors is to be limited, the floors should be constructed atop a capillary break consisting of a minimum thickness of 4 inches of washed pea gravel. The pea gravel should be overlain by a 10-mil (minimum thickness) plastic vapor retarder.

## 14.0 DRAINAGE CONSIDERATIONS

The underlying, glacially compacted soils are relatively impermeable and water will tend to perch atop this stratum. Additionally, traffic across these soils when they are damp or wet will

result in disturbance of the otherwise firm stratum. Therefore, prior to site work and construction, the contractor should be prepared to provide temporary drainage and subgrade protection, as necessary.

All retaining and perimeter footing walls should be provided with a drain at the footing elevation. The drains should consist of rigid, perforated, PVC pipe surrounded by washed pea gravel. The level of the perforations in the pipe should be set approximately 2 inches below the bottom of the footing, and the drains should be constructed with sufficient gradient to allow gravity discharge away from the buildings. All retaining walls should be lined with a minimum, 12-inch-thick, washed gravel blanket provided to within 1 foot of finish grade, and which ties into the footing drain. Roof and surface runoff should not discharge into the footing drain system, but should be handled by a separate, rigid, tightline drain.

Exterior grades adjacent to walls should be sloped downward away from the structures to achieve surface drainage. Final exterior grades should promote free and positive drainage away from the buildings at all times. Water must not be allowed to pond or to collect adjacent to foundations or within the immediate building areas. It is recommended that a gradient of at least 3 percent for a minimum distance of 10 feet from the building perimeters be provided, except in paved locations. In paved locations, a minimum gradient of 1 percent should be provided unless provisions are included for collection and disposal of surface water adjacent to the structures. Additionally, pavement subgrades should be crowned to provide drainage toward catch basins and pavement edges. Crawl space areas should be provided with drains at low points to prevent water from accumulating.

## 15.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

At the time of this report, site grading, structural plans, and construction methods have not been finalized. We are available to provide additional geotechnical consultation, including MSE wall design services, as the project design develops and possibly changes from that upon which this report is based. We recommend that AESI perform a geotechnical review of the plans prior to final design completion. In this way, our earthwork and foundation recommendations may be properly interpreted and implemented in the design. This plan review is not included in the current scope of work and budget.

We are also available to provide geotechnical engineering and monitoring services during construction. The integrity of the foundations depends on proper site preparation and construction procedures. In addition, engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent. Construction monitoring services are not part of this current scope of work. If these services are desired, please let us know and we will prepare a cost proposal.

We have enjoyed working with you on this study and are confident these recommendations will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

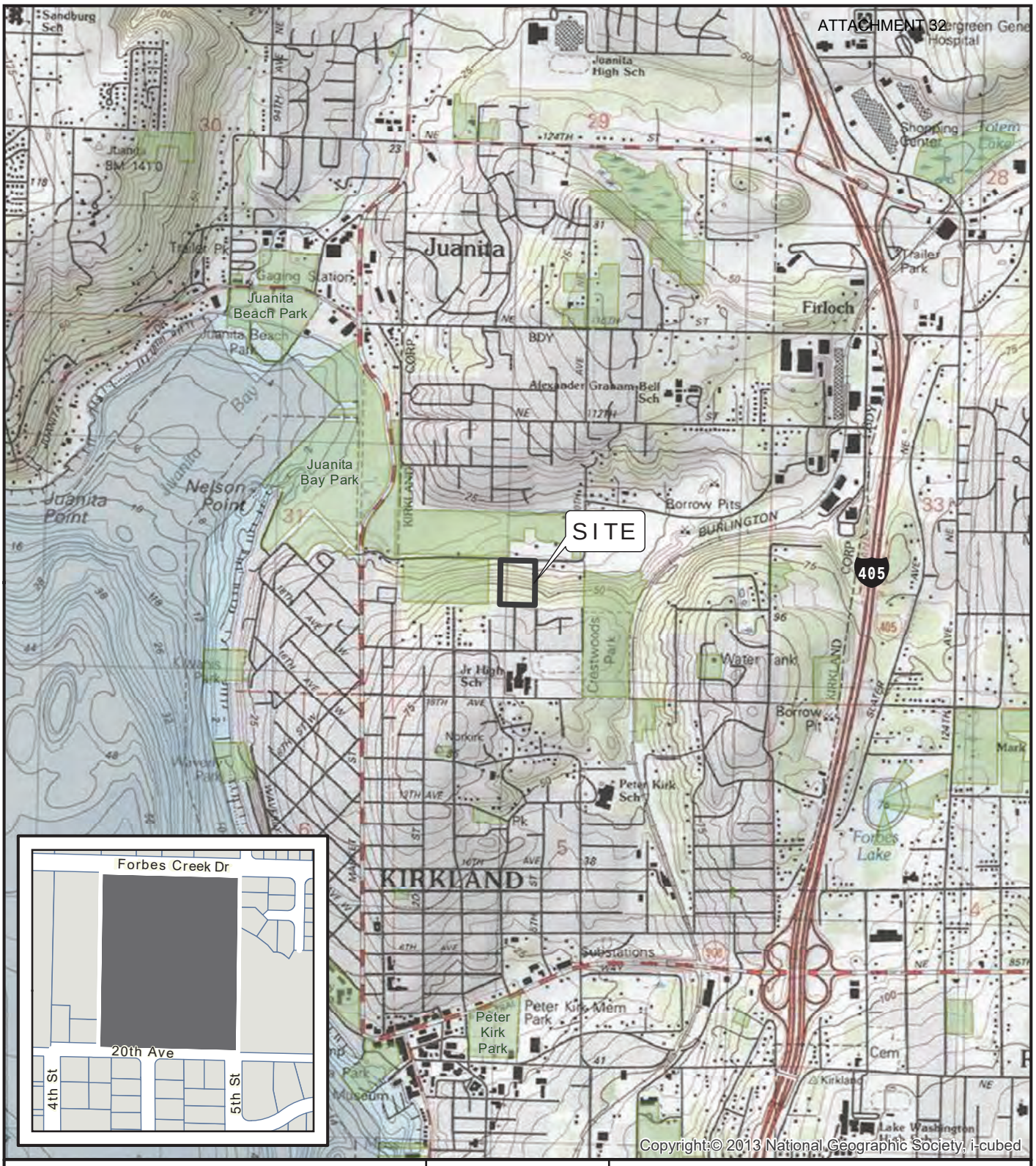
Sincerely,
**ASSOCIATED EARTH SCIENCES, INC.**
**Kirkland, Washington**

BRUCE L. BLYTON
STATE OF WASHINGTON
REGISTERED
PROFESSIONAL ENGINEER
2/20/18

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

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

| | | |
|---|---|---|
| Attachments: | Figure 1: | Vicinity Map |
| | Figure 2: | Site and Exploration Plan |
| | Figure 3: | Slope Stability Analysis - Cross-Section A-A' (static conditions) |
| | Figure 4: | Slope Stability Analysis - Cross-Section A-A' (seismic conditions) |
| | Figure 5: | Slope Stability Analysis - Cross-Section B-B' (static conditions) |
| | Figure 5: | Slope Stability Analysis - Cross-Section B-B' (seismic conditions) |
| | Appendix: | Exploration Logs |
| | | "Site Reconnaissance - Wetland 'A'" letter, dated October 13, 2016 |



DATA SOURCES / REFERENCES:
USGS: 7.5' SERIES TOPOGRAPHIC MAPS, ESRI/I-CUBED/NGS 2013
KING CO: STREETS, PARCELS, CITY LIMITS 1/18

LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

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NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION

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# VICINITY MAP

LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
|---|---|---|
| 160384E001 | 2/18 | 1 |

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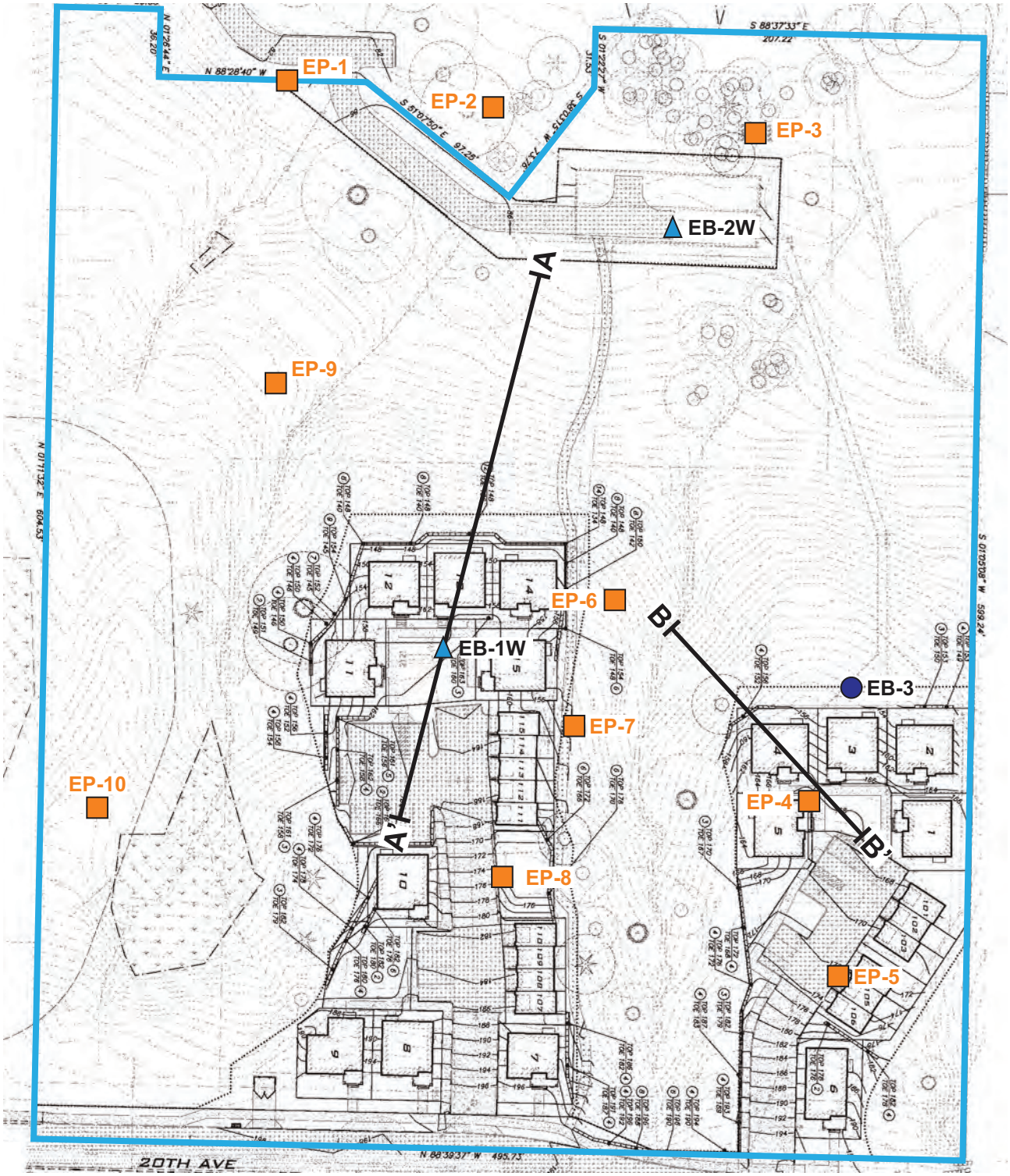


**LEGEND:**

- SITE BOUNDARY
- EP — EXPLORATION PIT
- EB — EXPLORATION BORING
- EB — MONITORING WELL

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE. BASE MAP REFERENCE: BLUELINE; ORCAS MOON COTTAGES; PRELIMINARY GRADING PLAN; SHEET 7 OF 10; DATED 11/21/17

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# SITE AND EXPLORATION PLAN

LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
|---|---|---|
| 160384E001 | 2/18 | 2 |

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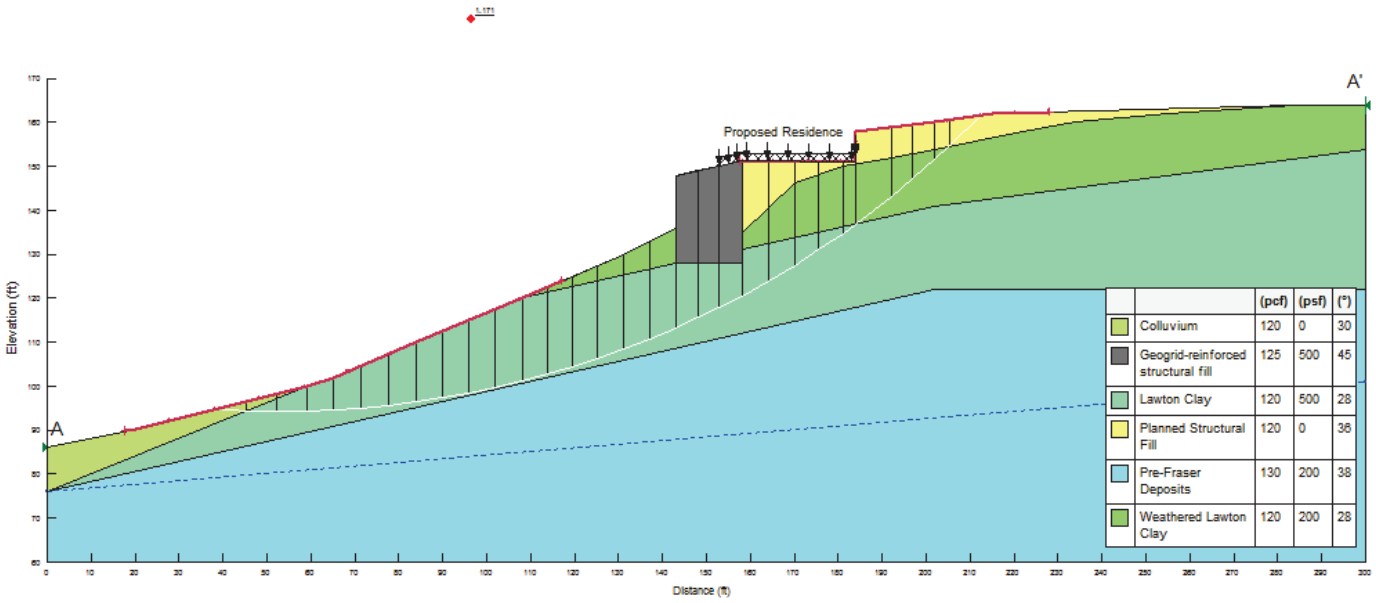


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SLOPE STABILITY ANALYSIS
CROSS-SECTION A - A' SEISMIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
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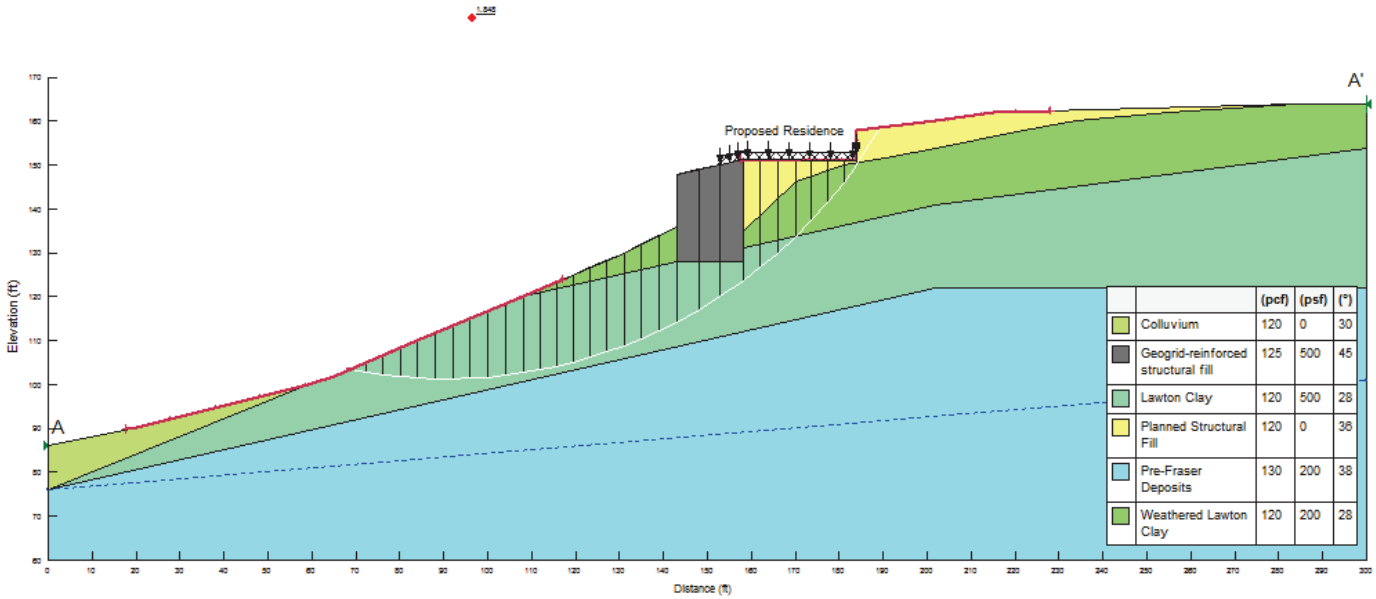


NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

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SLOPE STABILITY ANALYSIS
CROSS-SECTION A - A' STATIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
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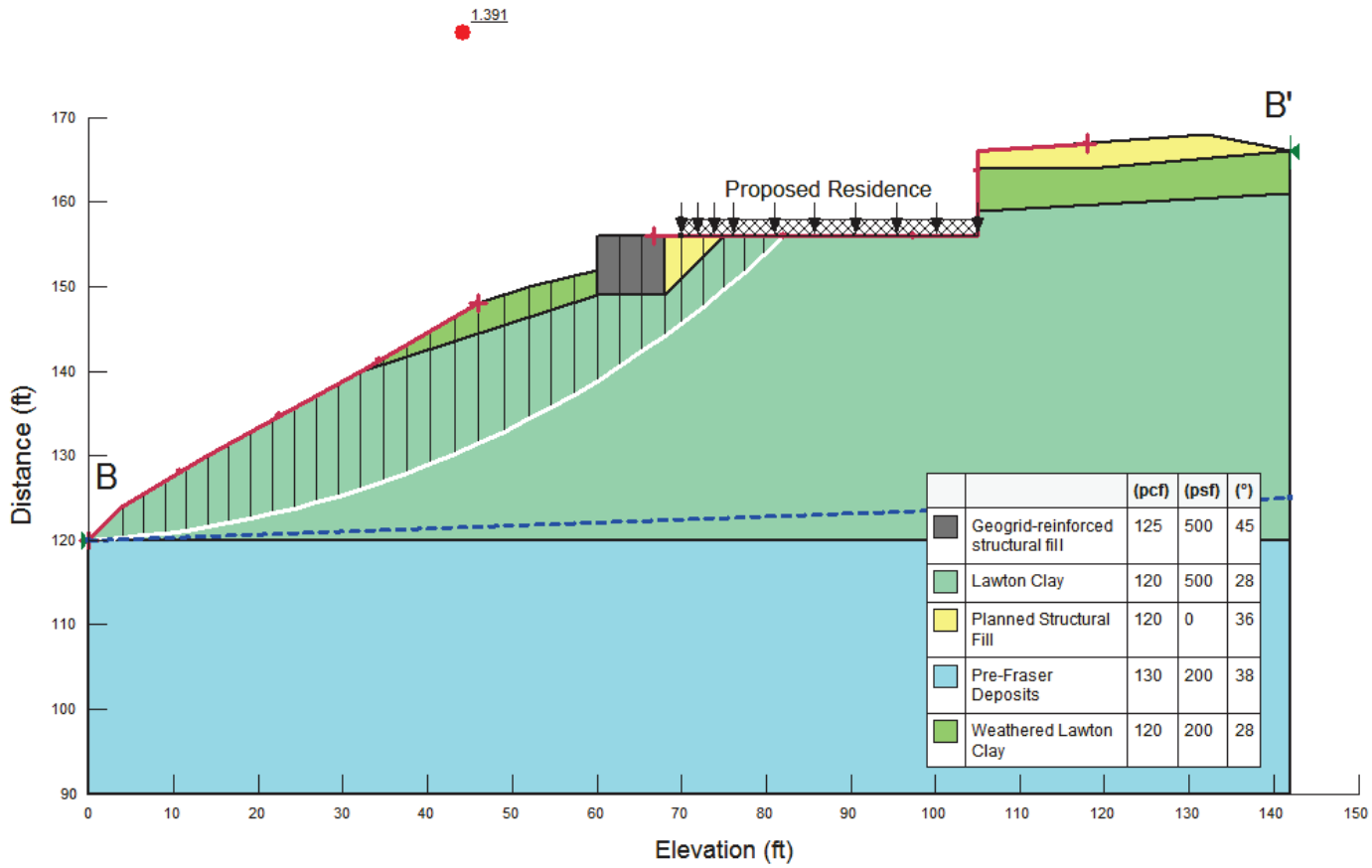


| | | (pcf) | (psf) | (°) |
|---|---|---|---|---|
| | Geogrid-reinforced structural fill | 125 | 500 | 45 |
| | Lawton Clay | 120 | 500 | 28 |
| | Planned Structural Fill | 120 | 0 | 36 |
| | Pre-Fraser Deposits | 130 | 200 | 38 |
| | Weathered Lawton Clay | 120 | 200 | 28 |

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

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SLOPE STABILITY ANALYSIS
CROSS-SECTION B - B' SEISMIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

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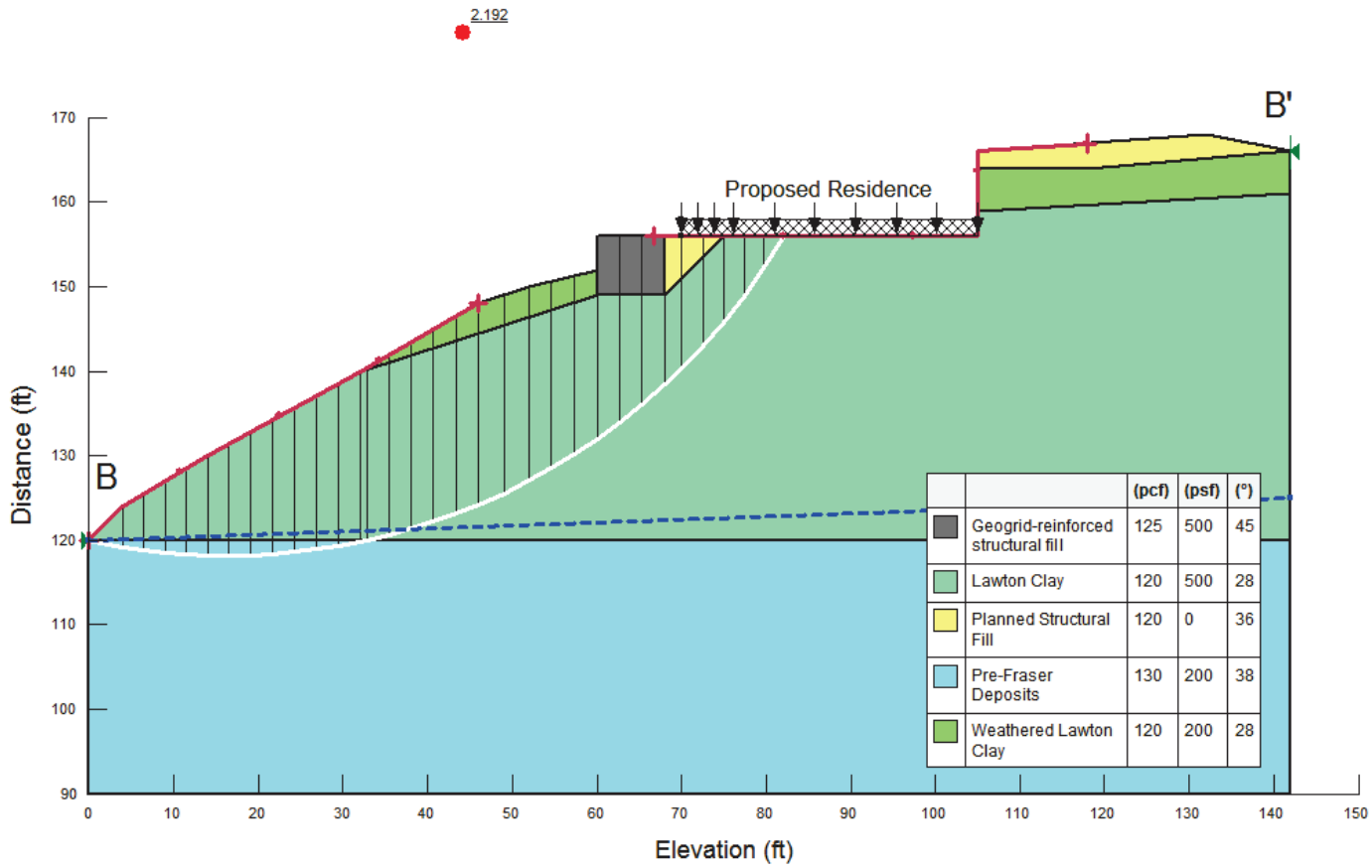


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SLOPE STABILITY ANALYSIS
CROSS-SECTION B - B' STATIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
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# APPENDIX

| | | | | |
|---|---|---|---|---|
| Coarse-Grained Soils - More than 50% (1) Retained on No. 200 Sieve | Gravels - More than 50% (1) of Coarse Fraction Retained on No. 4 Sieve | ≤5% Fines (5) | GW | Well-graded gravel and gravel with sand, little to no fines |
| | | | GP | Poorly-graded gravel and gravel with sand, little to no fines |
| | | ≥12% Fines (5) | GM | Silty gravel and silty gravel with sand |
| | | | GC | Clayey gravel and clayey gravel with sand |
| | Sands - 50% (1) or More of Coarse Fraction Passes No. 4 Sieve | ≤5% Fines (5) | SW | Well-graded sand and sand with gravel, little to no fines |
| | | | SP | Poorly-graded sand and sand with gravel, little to no fines |
| | | ≥12% Fines (5) | SM | Silty sand and silty sand with gravel |
| | | | SC | Clayey sand and clayey sand with gravel |
| Fine-Grained Soils - 50% (1) or More Passes No. 200 Sieve | Silts and Clays Liquid Limit Less than 50 | | ML | Silt, sandy silt, gravelly silt, silt with sand or gravel |
| | | | CL | Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay |
| | | | OL | Organic clay or silt of low plasticity |
| | Silts and Clays Liquid Limit 50 or More | | MH | Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt |
| | | | CH | Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel |
| | | | OH | Organic clay or silt of medium to high plasticity |
| Highly Organic Soils | | | PT | Peat, muck and other highly organic soils |

## Terms Describing Relative Density and Consistency

**Coarse-Grained Soils**

| Density | SPT(2) blows/foot |
|---|---|
| Very Loose | 0 to 4 |
| Loose | 4 to 10 |
| Medium Dense | 10 to 30 |
| Dense | 30 to 50 |
| Very Dense | >50 |

**Fine-Grained Soils**

| Consistency | SPT(2) blows/foot |
|---|---|
| Very Soft | 0 to 2 |
| Soft | 2 to 4 |
| Medium Stiff | 4 to 8 |
| Stiff | 8 to 15 |
| Very Stiff | 15 to 30 |
| Hard | >30 |

### Test Symbols

G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Chemical
DD = Dry Density
K = Permeability

## Component Definitions

| Descriptive Term | Size Range and Sieve Number |
|---|---|
| Boulders | Larger than 12" |
| Cobbles | 3" to 12" |
| Gravel | 3" to No. 4 (4.75 mm) |
| Coarse Gravel | 3" to 3/4" |
| Fine Gravel | 3/4" to No. 4 (4.75 mm) |
| Sand | No. 4 (4.75 mm) to No. 200 (0.075 mm) |
| Coarse Sand | No. 4 (4.75 mm) to No. 10 (2.00 mm) |
| Medium Sand | No. 10 (2.00 mm) to No. 40 (0.425 mm) |
| Fine Sand | No. 40 (0.425 mm) to No. 200 (0.075 mm) |
| Silt and Clay | Smaller than No. 200 (0.075 mm) |

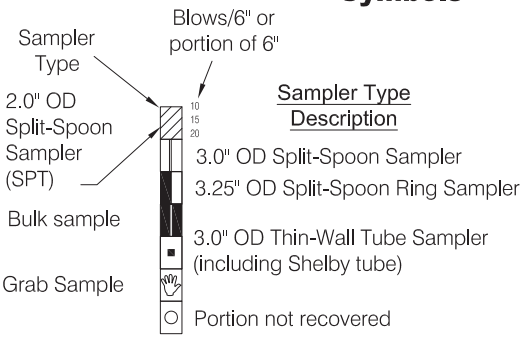
## (3) Estimated Percentage

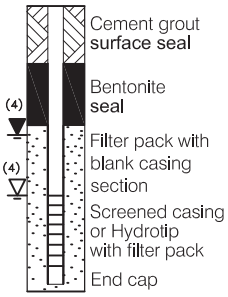
| Component | Percentage by Weight |
|---|---|
| Trace | <5 |
| Some | 5 to <12 |
| *Modifier* (silty, sandy, gravelly) | 12 to <30 |
| Very *modifier* (silty, sandy, gravelly) | 30 to <50 |

## Moisture Content

Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

## Symbols




(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
(4) Depth of ground water
▼ ATD = At time of drilling
▽ Static water level (date)
(5) Combined USCS symbols used for fines between 5% and 12%

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

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# EXPLORATION LOG KEY

FIGURE A1

blocks \ dwg \ log_key.dwg LAYOUT: Layout 4 -2014 Qty Chng

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# Geologic & Monitoring Well Construction Log

ATTACHMENT 2

| Project Number | Well Number | Sheet |
|---|---|---|
| 160384E001 | EB-1W | 1 of 2 |

| | | | |
|---|---|---|---|
| Project Name | Londo Forbes Creek | Location | Kirkland, WA |
| Elevation (Top of Well Casing) | | Surface Elevation (ft) | ~160 |
| Water Level Elevation | | Date Start/Finish | 1/27/18,1/27/18 |
| Drilling/Equipment | Boretec / Track Rig | Hole Diameter (in) | 8 inches |
| Hammer Weight/Drop | 140# / 30" | | |

| Depth (ft) | Water Level | WELL CONSTRUCTION | ST | Blows/ 6" | Graphic Symbol | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | Flush mount monument | | | | **Topsoil** |
| | | | | | | **Lawton Clay** |
| | | Bentonite 0 to 47 feet | | | | |
| 5 | | | | 3 1 1 | | Moist to very moist, light brown, silty, fine SAND, trace gravel; sand is massive (SM). |
| 10 | | 2-inch I.D. PVC casing: 0 to 50 feet | | 5 4 4 | | Very moist, light brown to light gray, SILT; interbed (~1 inch thick) of silty, fine to medium SAND; silt is laminated with iron stained laminations (ML). |
| 15 | | | | 7 10 18 | | Very moist, gray to dark gray, SILT, trace sand; silt is massive with laminated sections; effervesces with HCl (ML). |
| | | | | | | Harder drill action. |
| 20 | | | | 9 17 23 | | Moist to very moist, gray and light gray, SILT; disturbed (ML). |
| 25 | | | | 7 10 14 | | Moist to very moist, dark gray, sandy, SILT; interbed (~6 inches thick) of silty sand; massive (ML). |
| 30 | | | | 8 16 16 | | Very moist to wet, gray to dark gray with some iron staining, sandy, SILT; drill cuttings very wet (ML). |
| | | | | | | **Pre-Fraser Non Glacial Deposits** |
| | | | | | | Harder drilling. |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

Water Level (2/2/18)

Water Level at time of drilling (ATD)

**Logged by:** TG

**Approved by:** JHS

823

NWWELL- B 160384.GPJ BORING.GDT 2/14/18

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# Geologic & Monitoring Well Construction Log

ATTACHMENT 2

| Project Number | Well Number | Sheet |
|---|---|---|
| 160384E001 | EB-1W | 2 of 2 |

| | | | |
|---|---|---|---|
| Project Name | Londo Forbes Creek | Location | Kirkland, WA |
| Elevation (Top of Well Casing) | | Surface Elevation (ft) | ~160 |
| Water Level Elevation | | Date Start/Finish | 1/27/18,1/27/18 |
| Drilling/Equipment | Boretec / Track Rig | Hole Diameter (in) | 8 inches |
| Hammer Weight/Drop | 140# / 30" | | |

| Depth (ft) | Water Level | WELL CONSTRUCTION | ST | Blows/ 6" | Graphic Symbol | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | | 15 31 17 | | Very moist, reddish brown with heavy iron staining, fine to medium SAND, trace to some silt; interbed (~3 inches thick) of gray, sandy, silt (SP-SM). |
| | | | | | | Gravelly drilling. |
| 40 | | | | 50/6" | | Very moist, gray to greenish gray with some areas of heavy iron staining, SILT; ranges to sandy silt; occasional organics (ML). |
| 45 | | | | 50/5" | | Moist, light brown, gravelly, fine to coarse SAND, trace silt; broken gravel in sampler (SP). |
| | | 10/20 sand 47 to 60 feet | | | | Gravelly drill action. |
| 50 | | 2-inch I.D. PVC well screen: 0.010-inch slot width, 50 to 60 feet | | 50/3" | | Moist, light brownish gray, gravelly, fine to coarse SAND, trace silt (SP). |
| 55 | | | | 38 50/6 | | Moist, light brown to reddish brown, fine to medium SAND, some gravel, trace silt; some silt clasts in sampler; iron staining obvious around silt clasts and in sand (SP). |
| | ▽ | | | 50/2" | | Moist, light brown to light gray, gravelly, fine to medium SAND, some silt; gravel is subrounded (SP-SM). |
| 60 | | Screw type end cap with O-ring | | | | Boring terminated at 60 feet. Well completed at 60 feet on 1/27/18. No groundwater encountered. |
| | | Well tag # BKH-179 | | | | |
| 65 | | | | | | |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

▽ Water Level (2/2/18)

▼ Water Level at time of drilling (ATD)

**Logged by:** TG

**Approved by:** JHS

824

NWWELL- B 160384.GPJ BORING.GDT 2/14/18

associated earth sciences incorporated

# Geologic & Monitoring Well Construction Log

ATTACHMENT 2

| Project Number | Well Number | Sheet |
|---|---|---|
| 160384E001 | EB-2W | 1 of 1 |

| | | | |
|---|---|---|---|
| Project Name | Londo Forbes Creek | Location | Kirkland, WA |
| Elevation (Top of Well Casing) | | Surface Elevation (ft) | ~84 |
| Water Level Elevation | | Date Start/Finish | 1/24/18,1/24/18 |
| Drilling/Equipment | Boretec / Track Rig | Hole Diameter (in) | 8 inches |
| Hammer Weight/Drop | 140# / 30" | | |

| Depth (ft) | Water Level | WELL CONSTRUCTION | ST | Blows/ 6" | Graphic Symbol | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | Flush mount monument | | | | **Topsoil - 6 inches** |
| | | | | | | **Colluvium** |
| | | Bentonite 0 to 17 feet | | | | |
| 5 | | | | 1 2 2 | | Moist to very moist, brown, very silty, fine SAND (SM). |
| 10 | ▽ ▼ | 2-inch I.D. PVC casing: 0 to 20 feet | | 2 5 4 | | Very moist, light brown, silty, fine to medium SAND, trace gravel; occasional organics (SM). |
| | | | | | | **Pre-Olympia Glacial Deposits** |
| | | | | | | Driller noted gravelly drilling. |
| 15 | | | | 34 30 24 | | Wet, light grayish brown, gravelly, silty, fine to medium SAND (SM). |
| | | | | | | Very hard drilling observed. |
| | | 10/20 sand 17 to 30 feet | | | | |
| 20 | | 2-inch I.D. PVC well screen: 0.010-inch slot width, 20 to 30 feet | | 27 37 33 | | Wet, light brownish gray, gravelly, fine to medium SAND, some silt (SP-SM). |
| 25 | | | | 50/6" | | Wet, light brown, silty, GRAVEL, some sand; gravel is angular (GM). |
| | | | | | | Less gravelly drilling. |
| | | | | | | Driller noted heaving sands. |
| 30 | | | | 10 19 30 | | Wet, light brownish gray, very silty, fine SAND; ranges to sandy silt; minor mica flakes in sand (SM). |
| | | Screw type end cap with O-ring | | | | Boring terminated at 31.5 feet. |
| | | Well tag # BKH-178 | | | | Well completed at 30 feet on 1/24/18. |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

▽ Water Level (2/2/18)

▼ Water Level at time of drilling (ATD)

**Logged by:** TG

**Approved by:** JHS

825

NWWELL- B 160384.GPJ BORING.GDT 2/14/18

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# Exploration Log

ATTACHMENT 32

| Project Number | Exploration Number | Sheet |
|---|---|---|
| 160384E001 | EB-3 | 1 of 2 |

| | | | |
|---|---|---|---|
| Project Name | Londo Forbes Creek | Ground Surface Elevation (ft) | ~152 |
| Location | Kirkland, WA | Datum | NAVD 88 |
| Driller/Equipment | Boretec / Track Rig | Date Start/Finish | 1/24/18,1/24/18 |
| Hammer Weight/Drop | 140# / 30" | Hole Diameter (in) | 8 inches |

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Well Completion | Water Level | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **Topsoil - 6 inches** | | | | | |
| | | | | **Lawton Clay** | | | | | |
| 5 | | S-1 | | Moist to very moist, light brown to light gray, SILT, trace sand; oxidized laminations in silt (ML). | | | 3 4 5 | ▲9 | |
| 10 | | S-2 | | Moist to very moist, gray to dark gray, SILT, some fine sand; faintly stratified (ML). | | | 9 15 15 | ▲30 | |
| 15 | | S-3 | | Very moist to wet, gray to dark gray, silty, fine SAND (SM). | | | 13 14 16 | ▲30 | |
| 20 | | S-4 | | Very moist, gray to dark gray, SILT; disturbed light and dark gray silt; some minor lamination (ML). | | | 12 22 25 | ▲47 | |
| 25 | | S-5 | | Very moist, gray to dark gray, SILT; some disturbed texture dark gray and light gray silt; shiny fracture angles (ML). | | | 12 18 21 | ▲39 | |
| 30 | | S-6 | | Very moist, gray to light gray, SILT; some minot lamination in silt; angular fracture surfaces; massive (ML). | | | 9 14 16 | ▲30 | |
| | | | | **Pre-Fraser Non Glacial Deposits** | | | | | |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

Water Level ()

Water Level at time of drilling (ATD)

**Logged by:** TG

**Approved by:** JHS

826

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# Exploration Log

ATTACHMENT 32

| Project Number | Exploration Number | Sheet |
|---|---|---|
| 160384E001 | EB-3 | 2 of 2 |

| | | | |
|---|---|---|---|
| Project Name | Londo Forbes Creek | Ground Surface Elevation (ft) | ~152 |
| Location | Kirkland, WA | Datum | NAVD 88 |
| Driller/Equipment | Boretec / Track Rig | Date Start/Finish | 1/24/18,1/24/18 |
| Hammer Weight/Drop | 140# / 30" | Hole Diameter (in) | 8 inches |

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Well Completion | Water Level | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | S-7 | | Very moist, gray to greenish gray, sandy, SILT; some laminated silt; interbed (9 inches thick) of light brown with some oxidation, fine sand (ML). | | | 15 18 18 | ▲36 | |
| 40 | | S-8 | | Very moist to wet, gray, SILT, some sand; occasional organics; 3 inches of oxidized fine sand in sampler tip (ML). | | | 12 50/6" | | ▲50/6" |
| 45 | | S-9 | | Very moist, dark gray to dark brown, SILT; organics; interbed (12 inches thick) of clean, fine to medium sand (ML). | | | 14 24 30 | | ▲54 |
| 50 | | S-10 | | Very moist, dark gray, SILT, trace sand, trace gravel; faint organic odor; interbed (~4 inches thick) of oxidized light brown, fine to medium sand (ML). | | | 34 50/5" | | ▲50/5" |
| | | | | **Pre-Olympia Glacial Deposits** | | | | | |
| 55 | | S-11 | | Very moist, dark grayish brown, gravelly, silty, fine to medium SAND (SM). | | | 50/3" | | ▲50/3" |
| 60 | | S-12 | | Very moist, brownish gray, silty, fine to medium SAND (SM). | | | 50/4" | | ▲50/4" |
| 65 | | | | Bottom of exploration boring at 60.5 feet<br>No groundwater encountered. | | | | | |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

Water Level ()

Water Level at time of drilling (ATD)

**Logged by:** TG

**Approved by:** JHS

827

# LOG OF EXPLORATION PIT NO. EP-1

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

| Depth (ft) | DESCRIPTION |
|---|---|
| | **Topsoil** |
| 1 | Loose, moist, brown, silty SAND, few gravel. |
| | **Recessional Outwash** |
| 2 | Medium dense, moist, brown, medium SAND, trace to few silt, few gravel |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | Medium dense to dense, wet |
| 11 | |
| 12 | |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | Bottom of exploration pit at depth 16 feet<br>No ground water. Slight caving |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by:

Project No. KE05310A

June 2005

KCTP3 05310A.GPJ August 3, 2005

# LOG OF EXPLORATION PIT NO. EP-2

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

| Depth (ft) | DESCRIPTION |
|---|---|
| | **Topsoil** |
| 1 | Loose, moist, brown, silty SAND, few gravel. |
| | **Possible Fill** |
| 2 | Loose, wet, brown, medium SAND, few silt and gravel. |
| 3 | **Transitional Beds** |
| 4 | Soft, wet, blue-gray, sandy SILT, trace gravel. |
| 5 | |
| 6 | Stiff, moist, brown, SILT, trace to few SAND, trace gravel. |
| 7 | |
| 8 | |
| 9 | |
| 10 | Stiff, moist, blue-gray, SILT, trace sand, trace gravel. |
| 11 | |
| 12 | |
| 13 | |
| 14 | Bottom of exploration pit at depth 13 feet<br>No ground water. No caving. |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by:

Project No. KE05310A

June 2005

KCTP3 05310A.GPJ August 1, 2005

# LOG OF EXPLORATION PIT NO. EP-3

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

| Depth (ft) | DESCRIPTION |
|---|---|
| | **Topsoil** |
| | Loose, wet, brown, silty SAND, few gravel. |
| 1 | **Possible Fill** |
| | Medium dense, wet, brown, silty SAND, few gravel. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | **Recessional Outwash** |
| | Medium dense, wet, brown, SAND with gravel, few silt. |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| 11 | |
| 12 | Bottom of exploration pit at depth 11 feet<br>No ground water. Slight caving at 6'. |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by:

Project No. KE05310A

June 2005

KCTP3 05310A.GPJ August 1, 2005

# LOG OF EXPLORATION PIT NO. EP-4

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

| Depth (ft) | DESCRIPTION |
|---|---|
| | **Topsoil** |
| 1 | Loose, moist, dark brown, silty SAND, few gravel, thin fibrous roots. |
| | **Pre-Vashon Lacustrine** |
| 2 | Stiff, moist, brown, sandy SILT, few gravel. |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | Stiff, moist to wet, blue-gray, SILT, trace sand and gravel. |
| 9 | |
| 10 | |
| 11 | Bottom of exploration pit at depth 10 feet<br>No ground water. No caving |
| 12 | |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

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Project No. KE05310A

June 2005



KCTP3 05310A.GPJ August 1, 2005

# LOG OF EXPLORATION PIT NO. EP-5

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

| Depth (ft) | DESCRIPTION |
|---|---|
| | **Topsoil** |
| | Loose, moist, brown, silty SAND, few gravel. |
| 1 | **Recessional Outwash** |
| | Medium dense, moist, brown, SAND, few silt and gravel, frequent thin roots. |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | **Transitional Beds** |
| | Dense, moist, tan, silty SAND, few gravel and weakly cemented. |
| 7 | Dense, moist, blue-gray, SAND, trace silt and gravel with (blue) silt interbeds. |
| 8 | |
| 9 | |
| 10 | |
| 11 | |
| 12 | Bottom of exploration pit at depth 11 feet<br>Slight seepage at 11'. No caving. |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by:

Project No. KE05310A

June 2005



KCTP3 05310A.GPJ August 1, 2005

# LOG OF EXPLORATION PIT NO. EP-6

This log is part of the report prepared by Associated Earth Sciences, Inc (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

| Depth (ft) | DESCRIPTION |
|---|---|
| | **Topsoil** |
| 1 | **Recessional Outwash** |
| | Medium dense, moist, brown, medium SAND, few silt, trace to some gravel. |
| 2 | |
| 3 | |
| 4 | **Advance Outwash** |
| 5 | Dense, wet, brown, sandy GRAVEL, trace to some silt. |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| 11 | |
| 12 | |
| 13 | Bottom of exploration pit at depth 12 feet<br>No ground water No caving. |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by:

Project No. KE05310A

June 2005

KCTP3 05310A.GPJ August 1, 2005

# LOG OF EXPLORATION PIT NO. EP-7

| Depth (ft) | This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. DESCRIPTION |
|---|---|
| | **Topsoil** |
| 1 | Loose, moist, brown, SAND, few silt and gravel. |
| | **Recessional Outwash** |
| 2 | Dense, moist, brown, medium SAND, trace silt and gravel, some fibrous roots |
| 3 | |
| 4 | |
| 5 | |
| | **Transitional Beds** |
| 6 | Very stiff, moist, blue-gray, SILT, few sand, trace gravel |
| 7 | |
| 8 | |
| 9 | Grades to sandy SILT |
| 10 | |
| 11 | |
| 12 | Bottom of exploration pit at depth 11 feet<br>No ground water. No caving. |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by:

Project No. KE05310A

June 2005



KCTP3 05310A.GPJ August 1, 2005

# LOG OF EXPLORATION PIT NO. EP-8

| Depth (ft) | This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. |
|---|---|
| | DESCRIPTION |
| | Topsoil |
| 1 | **Recessional Outwash** |
| | Medium dense, moist, brown, medium SAND, few silt, few gravel, thin, fibrous roots |
| 2 | |
| 3 | |
| 4 | **Transitional Beds** |
| | Stiff, wet, tan, SILT, few sand, trace gravel |
| 5 | |
| 6 | |
| 7 | |
| 8 | Dense, wet, blue-gray, SAND, trace silt and gravel with very stiff (blue) silt interbeds |
| 9 | |
| 10 | |
| 11 | Bottom of exploration pit at depth 10 feet<br>No ground water. No caving. |
| 12 | |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by

Project No. KE05310A

June 2005

KCTP3 05310A.GPJ August 1, 2005

# LOG OF EXPLORATION PIT NO. EP-9

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

| Depth (ft) | DESCRIPTION |
|---|---|
| | **Topsoil** |
| | **Recessional Outwash** |
| 1 | Medium dense, moist, brown, SAND, few silt and gravel, thin, fibrous roots |
| 2 | |
| 3 | |
| 4 | Dense, moist, brown, sandy GRAVEL, trace to some silt. |
| | **Pre-Vashon Lacustrine** |
| 5 | Hard, moist, tan, SILT, few sand, trace gravel. |
| 6 | |
| 7 | |
| 8 | |
| 9 | Very stiff, wet, blue-gray SILT, few sand, trace gravel |
| 10 | |
| | **Advance Outwash** |
| 11 | Dense, wet, brown, gravelly SAND, trace silt. |
| 12 | |
| 13 | Bottom of exploration pit at depth 12 feet<br>No ground water |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by:

Project No. KE05310A

June 2005

KCTP3 05310A.GPJ August 3, 2005

# LOG OF EXPLORATION PIT NO. EP-10

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

| Depth (ft) | DESCRIPTION |
|---|---|
| | **Topsoil** |
| | Loose, moist, dark brown, SAND, few silt and gravel. |
| 1 | **Recessional Outwash** |
| | Medium dense, moist, brown, SAND, few silt and gravel |
| 2 | |
| 3 | |
| | **Transitional Beds** |
| 4 | Stiff, moist, tan, SILT, few sand, trace gravel. |
| 5 | |
| 6 | |
| | Dense, wet, blue-gray, SAND, trace silt and gravel with silt interbeds. |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| 11 | Bottom of exploration pit at depth 10 feet<br>No ground water |
| 12 | |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by:

Project No. KE05310A

June 2005



KCTP3 05310A.GPJ August 3, 2005

associated
earth sciences
incorporated

October 13, 2016
Project No. KE160384A

Orcas Moon, LLC
P.O. Box 2710
Redmond, Washington 98073

Attention: Mr. Robert Londo

Subject: Site Reconnaissance - Wetland "A"
Londo Forbes Creek
20th Avenue and 4th Place
Kirkland, Washington

Dear Mr. Londo:

As requested, Associated Earth Sciences, Inc. (AESI) has observed site conditions at Wetland "A", previously delineated by others, at the southwest portion of the subject site. We have previously prepared a "Subsurface Exploration, Geologic Hazard, and Geotechnical Engineering Report - Londo Forbes Creek," dated July 28, 2016, for the above-referenced project.

We visited the site on October 11, 2016, during a period of dry weather, to observe conditions at and surrounding Wetland "A". The previously-delineated wetland area lies within the relatively gently sloping base of a gully possessing a northerly aspect and generally moderately to steeply sloping sidewalls. Several young (4- to 8-inch-diameter) alders were growing at the base of the gully. We did not observe water flowing through the bottom of the gully during our reconnaissance, although wet soils were observed at the surface of the gully bottom.

A steep headwall extends across the south end of this gully, as well as down the western flank. The western portion of the headwall displays freshly exposed silt, and includes a stepped, recently incised channel between the western flank and southern end of the gully. This morphology suggests active downcutting of the gully and adjacent slopes. Quarry rock has been placed near the head of the gully in apparent attempt to mitigate channel erosion. We also observed fill placed at the top of the south end of the gully, with soil spilling into the gully, suggestive of past dumping activities at the subject site.

Outside of the gully, the vegetation along the site slopes consists of shrubs, ferns, blackberries, small- to medium-sized deciduous and evergreen trees. We did not observe indications of slope instability, such as bowed or tilted trees, naturally occurring terraced topography,

tension cracks, reversed drainage gradients, and large-scale unvegetated soil exposures outside of that described in the gully.

We observed two storm water drains outleting immediately above the gully area. One drain consists of a perforated pipe placed over the aforementioned rock spalls and oriented toward the area of the stepped, eroded channel at the southwest portion of the gully. This drain pipe appears to originate at a catch basin along the north side of 20th Avenue. The second drain pipe outlets upslope of the south end of the gully, discharging in a sheetflow fashion over the headscarp. This pipe, which we understand was installed circa 2005, originates from a catch basin along the south side of 20th Avenue. These drain systems serve to concentrate storm water flow from 20th Avenue and release this flow as two point discharges near the top of the steep headscarp of the gully.

Based on our observations, it is our opinion that the water collected by the drain system along 20th Avenue and point-discharged onto the subject site, through the drain pipes described above, has led to erosion or shallow slide activity within the gully. Deposits placed by this type of earth movement, particularly fine-grained material as observed in the western flank of the headwall, can remain wet well beyond storm events. The apparent age of the alders observed within the base of the gully suggests that slide activity had occurred relatively recently, perhaps in response to the concentrated storm water discharge introduced to the gully circa 2005.

To mitigate the potential for future slope erosion and instability we recommend that uncontrolled discharge from impermeable surfaces should not be allowed to flow towards or onto steep slope areas. We recommend that any drains currently discharging above or onto the slope either be extended downward to a suitable location at the bottom of the steep slope or tied into a suitable storm water system that discharges away from the slope.

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

Sincerely,
**ASSOCIATED EARTH SCIENCES, INC.**
**Kirkland, Washington**

BRUCE L. BLYTON
STATE OF WASHINGTON
6890
REGISTERED
PROFESSIONAL ENGINEER
10/13/16

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

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

JPL/ld
KE160384A3
Projects\20160384\KE\WP

associated earth sciences incorporated

May 1, 2018
Project No. 160384E001

Orcas Moon, LLC
P.O. Box 2710
Redmond, Washington 98073

Attention: Mr. Robert Londo

Subject: Response to Peer Review Comments
Londo Forbes Creek
20th Avenue and 4th Place
Kirkland, Washington

Dear Mr. Londo:

This letter presents our response to peer review comments made on behalf of the City of Kirkland related to the proposed Londo Forbes Creek residential project. Associated Earth Sciences, Inc. (AESI) has previously performed geotechnical explorations and issued a "Subsurface Exploration, Geologic Hazard, and Geotechnical Engineering Report," dated February 20, 2018, for the proposed improvements.

For our use in preparing this letter, we have been provided with "Geotechnical Consultation - Peer Review Services," prepared by GeoDesign, Inc. (GeoDesign) and dated April 3, 2018. Comments presented in the GeoDesign letter, along with our responses, are presented in the paragraphs below.

> ***KZC [Kirkland Zoning Code] 85.15 #1*** *- The code requires a plan that identifies areas with a slope of 15 percent or greater. The existing condition plan, Sheet EC-01, identifies areas with slopes greater than 40%. We recommend revising this to require the applicant to include a site plan identifying the areas meeting the KZC classifications of "High" and "Moderate" Landslide Hazard Areas. The areas should be hatched and clearly marked to assist in the determination of what areas will be impacted by the proposed development. Additionally, these areas should be shown on the proposed preliminary grading and building/retaining wall layout plan. This plan should be included as a figure in the geotechnical investigation report.*

As stated in our February 20, 2018 report: *"Given the predominance of fine-grained 'Lawton Clay' deposits encountered in our recent exploration borings, the portions of the subject site greater than 15 percent would be classified as 'High Landslide Hazard Areas', as defined in the KZC."* We recommend that the portions of the subject site with a slope greater than 15 percent be marked as "High Landslide Hazard Area" per KZC. We will incorporate the updated project plan as the base plan for Figure 2 of our geotechnical report.

> ***KZC 85.15 #4, a*** *- The report indicates that the slope stability analyses provided in Figures 3 through 6 of the report were completed for the proposed construction conditions and before the site grading plans were finalized. The grading plan should be reviewed and the slope stability analyses and geotechnical report revised as necessary to reflect the proposed grading.*

We will review future versions of the grading plan and update our slope stability analyses to reflect changes in the plan, if needed.

> ***KZC 85.15 #4, a*** *- Slope stability analyses of the existing site conditions are also required to verify how the proposed grading will impact existing slope stability.*

Using the soil parameters presented in our February 20, 2018 report, we completed slope stability analyses of existing site conditions along the cross-sections presented in our February 20, 2018 report (Cross-Sections A-A' and B-B'). Soil strength parameters used for our analysis, along with interpretive geologic cross-sections and critical slip surfaces calculated under both static and seismic conditions, are shown on the attached figures. Our previous analyses for the planned conditions Cross-Sections A-A' and B-B' are included for reference. The resulting factors of safety for slope movement for existing conditions along the modeled cross-sections exceeded 1.50 under static conditions and 1.15 under seismic conditions.

> ***KZC 85.15 #4, a*** *- Additonal [sic] slope stability analysis should be completed on the west side of the parking lot between Buildings 10 and 11 as well as from the southwest corner of Building 10 through the proposed tiered wall system.*

Using the soil parameters presented in our February 20, 2018 report, we completed slope stability analyses of existing and proposed site conditions along Cross-Sections C-C' and D-D', shown on the attached "Site and Exploration Plan" (revised from "Figure 2" of our February 20, 2018 report). Soil strength parameters used for our analysis, along with interpretive geologic cross-sections and critical slip surfaces calculated under both static and seismic conditions, are shown on the attached figures. A traffic surcharge of 250 pounds per square foot (psf) was used for our analysis of planned conditions where parking areas are proposed. The resulting factors of safety for slope movement for both existing and proposed conditions along the modeled cross-sections exceeded 1.50 under static conditions and 1.15 under seismic conditions.

***KZC 85.15#4, h*** *- The retaining walls are considered structures and will need a suitable buffer/setback between the structure and the geologic hazard area. Provide recommendations on buffer/setback requirements and/or engineering methods that can be used to achieve them. The buffers and setbacks associated with geologic hazard areas should also be shown on the plan that identifies geologic hazard areas, along with the proposed development and grading.*

Based on our review Chapter 85 of the KZC, we understand that the City of Kirkland does not have a prescriptive buffer requirement for geologic hazard areas. Based on the slope stability analyses presented in our February 20, 2018 report, as well as the analyses presented in this letter, the proposed construction of new residences and mechanically stabilized earth (MSE) walls at the approximate locations shown in Figure 2 of our report, including the embedment of the proposed MSE wall systems into underlying very stiff to hard Lawton Clay deposits, appears feasible from a geotechnical standpoint without additional buffers.

***KZC 85.15#4, h*** *- Provide additional recommendations for building foundations located adjacent to retaining walls or slopes with regard to appropriate embedment depth.*

As stated in our February 20, 2018 report: *"Planned MSE retaining walls will need to be designed and constructed with suitable embedment into very stiff to hard Lawton clay deposits to maintain suitable stability."* Also, building foundations located near retaining walls should be embedded such that the area bounded by lines extending downward at 1H:1V (Horizontal:Vertical) from any footing must not intersect the nearby retaining wall, or the wall be designed to resist the associated surcharge. We understand that these design details will be shown in the final civil engineering drawings.

***KZC 85.15#4, h*** *- Provide recommendations regarding the construction of the proposed walls pertaining to the required embedment and anticipated excavation depths to establish the bottom-of-wall footing elevation. Surficial loose soil conditions are indicated on the explorations and the existing slope stability analyses indicate wall embedments up to about 9 feet to reach suitable bearing. The wall heights shown on the preliminary grading plan do not reflect the embedment depths or the amount of ground disturbance necessary to complete the excavation. Address temporary cut slope inclinations and short-term stability.*

Our February 20, 2018 report provides recommendations for temporary cut slopes. Based on those recommendations, our slope stability analysis, and the current site/wall layout, we anticipate that the area of excavation for the walls will likely extend several feet beyond the toes of the walls. Therefore, we recommend that the anticipated area of excavation/disturbance to achieve wall embedments be shown in the final civil engineering drawings. Although the extent of excavation beyond the toe walls will vary due to soil conditions and slope geometry, we recommend that, for planning and site layout purposes, a disturbance area extending outward 10 feet from the wall alignments be assumed.

***KZC 85.15#4, h*** *- Confirm that the recommended passive pressure resistance for desiging [sic] retaining walls is suitable for the slope face in front of the proposed walls or provide additional recommendations.*

The proposed project is currently in the preliminary plat application phase. Specific engineering design will be determined subsequent to preliminary plat approval and will be based on the conditions of approval stipulated by the City of Kirkland. Specific MSE wall design will be forthcoming, based on engineering design-phase grading plan (currently anticipated to be prepared in approximately 6 months), and will incorporate passive resistance values which reflect the associated toe slopes.

***KZC 85.15#4, h*** *- Stormwater drainage impacts and mitigation measures should be addressed with reference to the proposed grading and utility plan. Recommentions [sic] and information pertaining to the following should be provided:*

- *Subsurface drains behind retaining walls showing discharge paths or locations*
- *Surface water collection along the east, west, and north perimeter of the proposed development as well as between buildings and retaining walls. The proposed ground surface slopes to the retaining wall and away from the buildings toward the surrounding geologically critical areas.*
- *Preventing subsurface flow along proposed utilities.*

Our February 20, 2018 report provides recommendations for subsurface drainage. We recommend that surface and subsurface drainage elements be shown in the final civil engineering drawings. Recommendations regarding subsurface flow along proposed utilities will be situation specific and reflective of final utility locations and grades. However, based on the lack of significant shallow groundwater encountered in our recent subsurface explorations, we do not anticipate significant subsurface flow along pipe bedding material.

***KZC 85.15#4, h*** *- Address the installation of utilities through geologic hazard areas and provide recommendations regarding appropriate embedment depth and anchorage requirements; identify mitigation measures to address slope stability and drainage imacts [sic].*

At this time, we anticipate that conventional trenching and backfill techniques will be used for utility installation. We will review the final engineered civil plans to provide situation-specific recommendations for slope stability mitigations for utility installation, if needed.

***KZC 85.15#4, h*** *- The plans should show the location of the two drain pipes that discharge stormwater onto the property from 20th Avenue. The AESI letter dated October 13, 2016 indicates that the discharge from these pipes has resulted in erosion, ground movement, and regression of the gully that extends north to Wetland "A." Areas impacted by erosion and slide activity should be shown on the plans. Address impacts associated with continued regression of the gully to the proposed construction. Identify suitable mitigation alternatives.*

We understand that the drain pipes discharging onto the property from 20th Avenue are not part of the proposed project, and that the identified erosion or shallow slide activity is not related to the proposed construction. These pipes are located some 100 to 120 feet laterally to the west of the proposed development area, opposite of a planned wetland buffer area. We do not expect direct impacts to the proposed improvements from discharge from these pipes.

> ***KZC 85.15#4, h*** *- The stormwater detention vault at the north end of the property has a base elevation of 67.3. Groundwater in EB-2W is indicated at elevations between 72 and 74. Provide information on dewatering requirements to construct the vault, impacts to adjacent areas, and proposed mitigation measures.*

A data logger installed in monitoring well EB-2W measured a roughly 1.6-foot lowering of groundwater from February 2nd to April 9th. We anticipate that groundwater in the area of the proposed stormwater detention vault will be limited to interflow perched on the very dense pre-Olympia-age deposits encountered in EB-2W. To reduce the likely degree of flow encountered during the vault excavation, we recommend that this excavation be completed during the dry season. It is anticipated that volumes of seepage will be low, particularly during the dry season, and that control of seepage entering the vault excavation, if needed, can be accomplished by pumping from open sumps/ditches within the excavation.

> ***KZC 85.15#4, h*** *- A wet-season reconnaissance should be completed to observe indications of seasonal groundwater seepage. The report references a reconnaissance completed in October 13, 2016, which is at the end of the dry season when groundwater levels are typically at a minimum. We recommend requiring a visit in April, when seasonal groundwater seepage is more likely to be present.*

As stated in our February 20, 2018 report, *"During our site reconnaissance, we did not observe springs emanating from the steeply sloping areas."* To clarify, our site reconnaissance was completed at the time of our explorations in January of 2018.

> ***KZC 85.15#4, h*** *- The geotechnical report should provide a summary list of geotechnical-related items that require geotechnical observation. Many of these items are indicated throughout the report, but it would be helpful to have a complete list in one section that could be shown on the permit plans and that the City could easily reference.*

Geotechnical items for this type of project often include: Verify Fill and Compaction; Observe and Monitor Excavations; Soil Bearing Verification; Subsurface Drainage Installation; Monitor Slope Stability; Temporary Erosion Control; and MSE Retaining Wall Observations. We understand that the City of Kirkland will establish required geotechnical items for the subject project.

***KZC 85.25 #1** - AESI should also provide a letter indicating that they have reviewed the plans and confirm that the plans are consistent with the geotechnical recommendations.*

We recommend that AESI perform a review of the final plans for the preliminary plat application, followed by a geotechnical review of the final engineered civil plans as they are developed. In this way, our earthwork and foundation recommendations may be properly interpreted and implemented in the design.

***KZC 85.25 #3** - If approved, the permit should require geotechnical professional observation throughout construction and submittal of a close-out report prior to occupancy.*

AESI is available to provide geotechnical engineering and monitoring services during construction, as required by the City of Kirkland.

We trust this information meets your current needs. Please do not hesitate to contact us if you require additional information or have any questions.

Sincerely,
**ASSOCIATED EARTH SCIENCES, INC.**
**Kirkland, Washington**

BRUCE L. BLYTON
STATE OF WASHINGTON
REGISTERED
PROFESSIONAL ENGINEER
5/1/18

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

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

Attachments: Site and Exploration Plan (Figure 2, modified from original report)
Slope Stability Analyses Results (16 sheets)

JPL/ms
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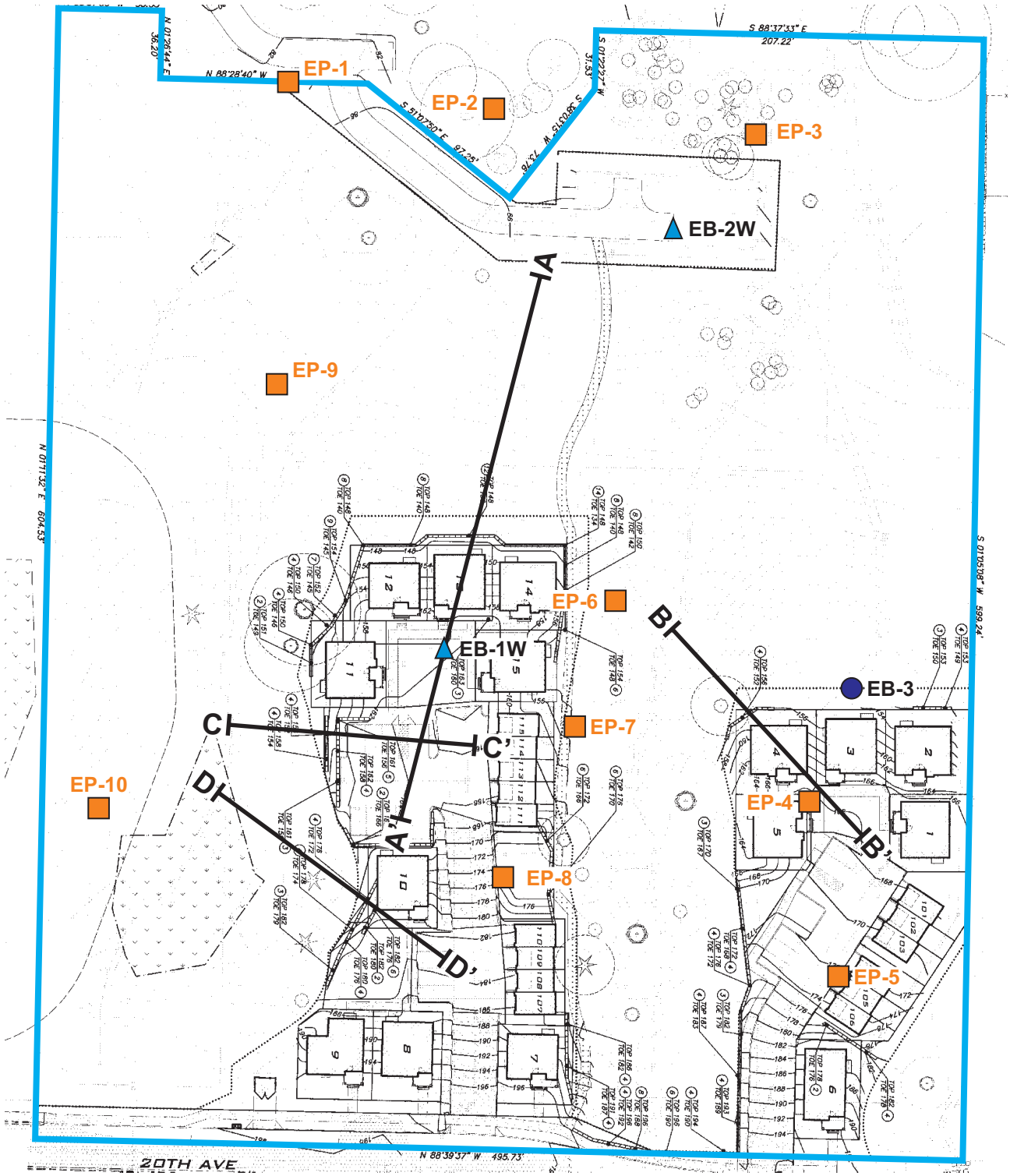


**LEGEND:**

- SITE BOUNDARY
- EP — EXPLORATION PIT
- EB — EXPLORATION BORING
- EB — MONITORING WELL

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE. BASE MAP REFERENCE: BLUELINE, ORCAS MOON COTTAGES, PRELIMINARY GRADING PLAN, SHEET 7 OF 10, 11/21/17

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0 40 80

FEET

NOTE: BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION.

associated earth sciences incorporated

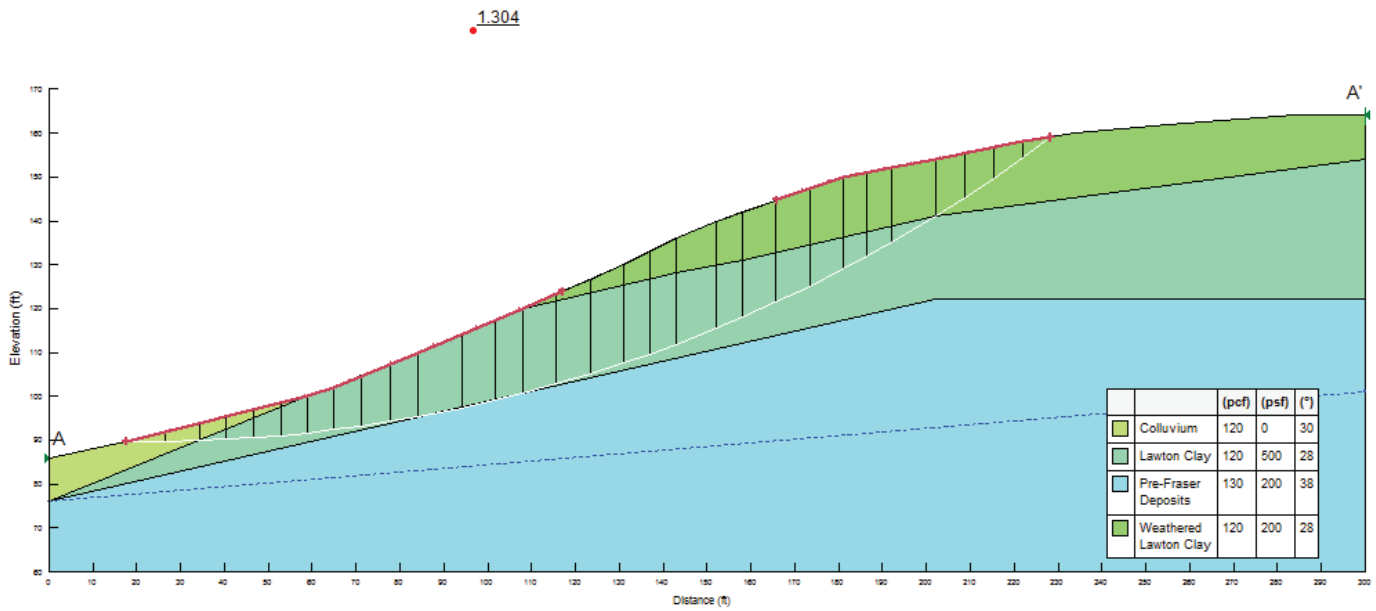
# SITE AND EXPLORATION PLAN

LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
|---|---|---|
| 160384E001 | 4/18 | 2 |

160384 Londo Forbes Ck \ 160384E001 F2 S-E Plan 4-18.cdr

ATTACHMENT 33




NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

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associated earth sciences incorporated

SLOPE STABILITY - EXISTING
CROSS-SECTION A - A' SEISMIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
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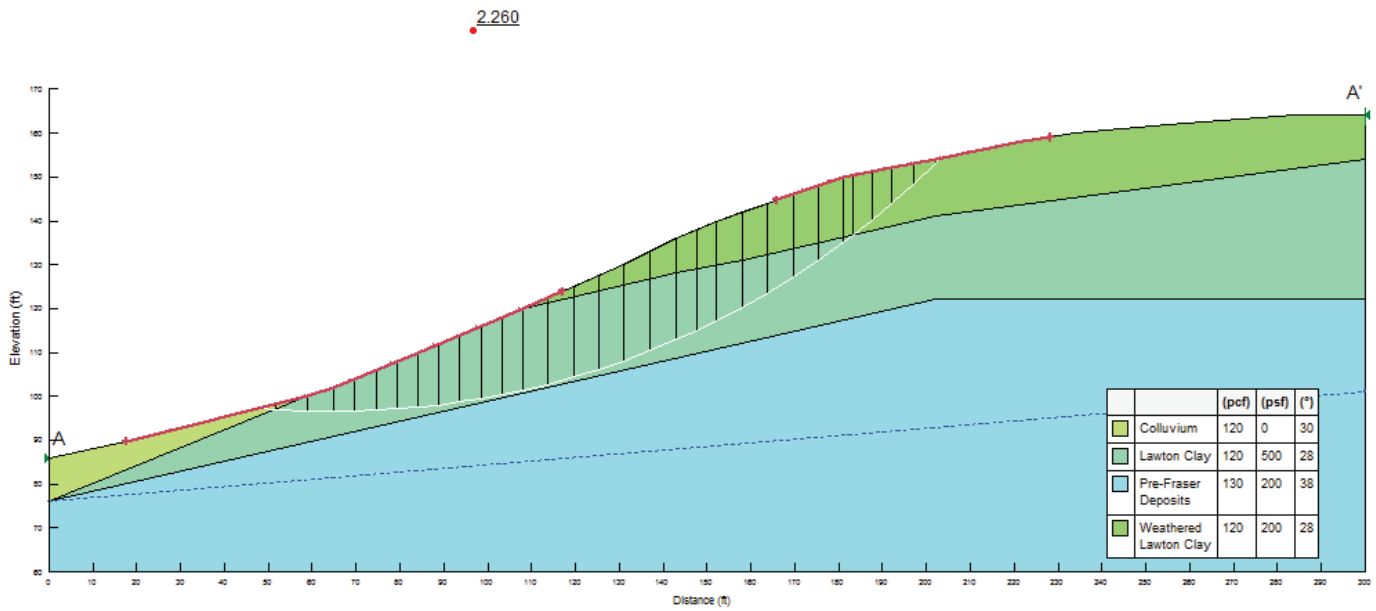
| 160384E001 | 4/18 | . |

160384 Londo Forbes \ 160384E001 F3 SS A-A 4-18.cdr

ATTACHMENT 33




NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

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SLOPE STABILITY - EXISTING CROSS-SECTION A - A' STATIC

LONDO FORBES CREEK

KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
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| 160384E001 | 4/18 | . |

160384 Londo Forbes \ 160384E001 F4 SS A-A 4-18.cdr

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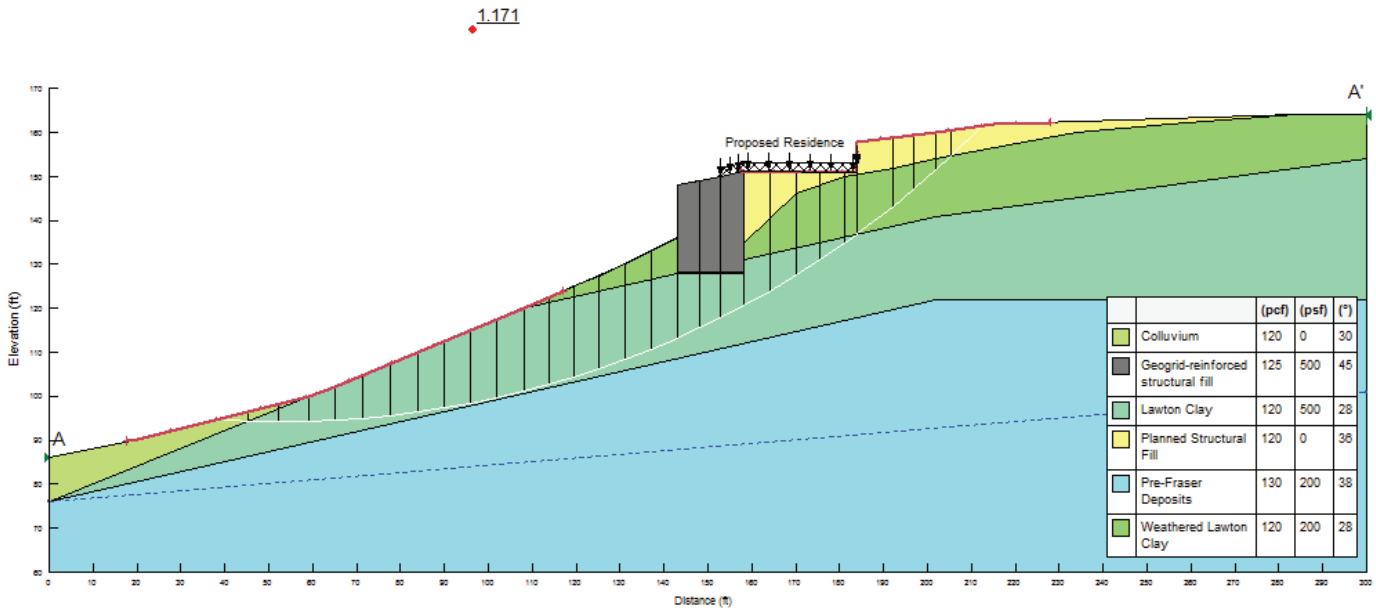


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SLOPE STABILITY - PROPOSED CROSS-SECTION A - A' SEISMIC

LONDO FORBES CREEK

KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
|---|---|---|
| 160384E001 | 4/18 | . |

160384 Londo Forbes \ 160384E001 FS SS A-A 4-18.cdr

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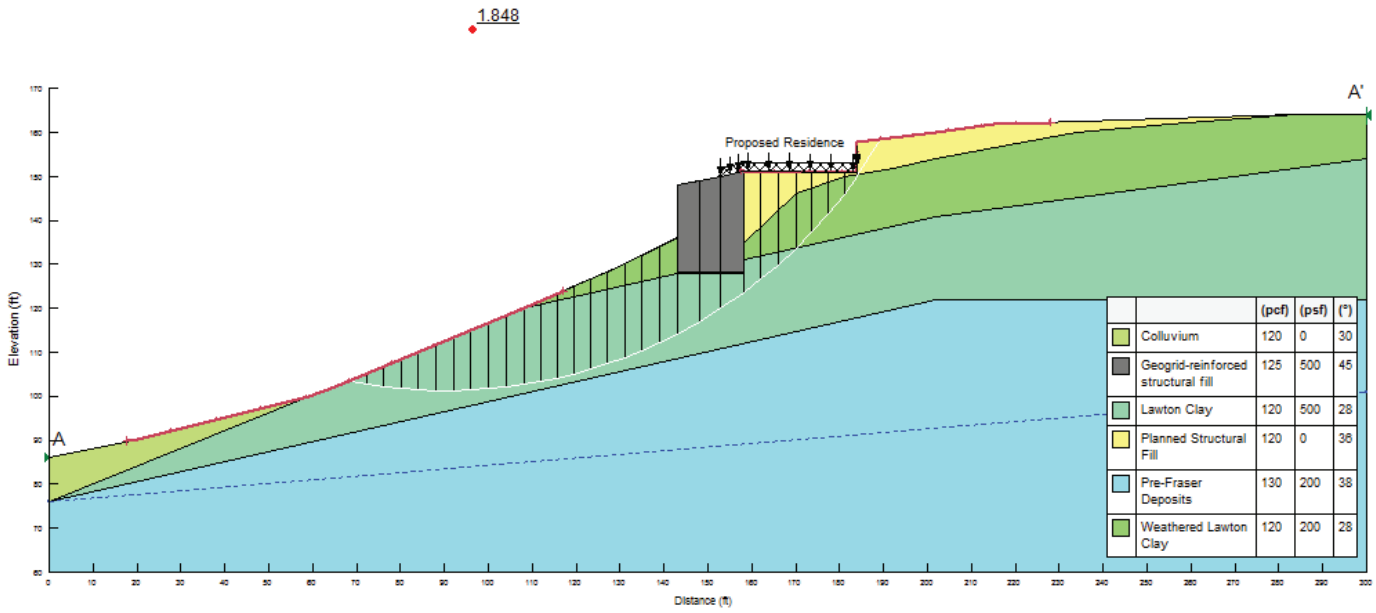


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SLOPE STABILITY - PROPOSED CROSS-SECTION A - A' STATIC

LONDO FORBES CREEK

KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
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| 160384E001 | 4/18 | . |

160384 Londo Forbes \ 160384E001 F6 SS A-A 4-18.cdr

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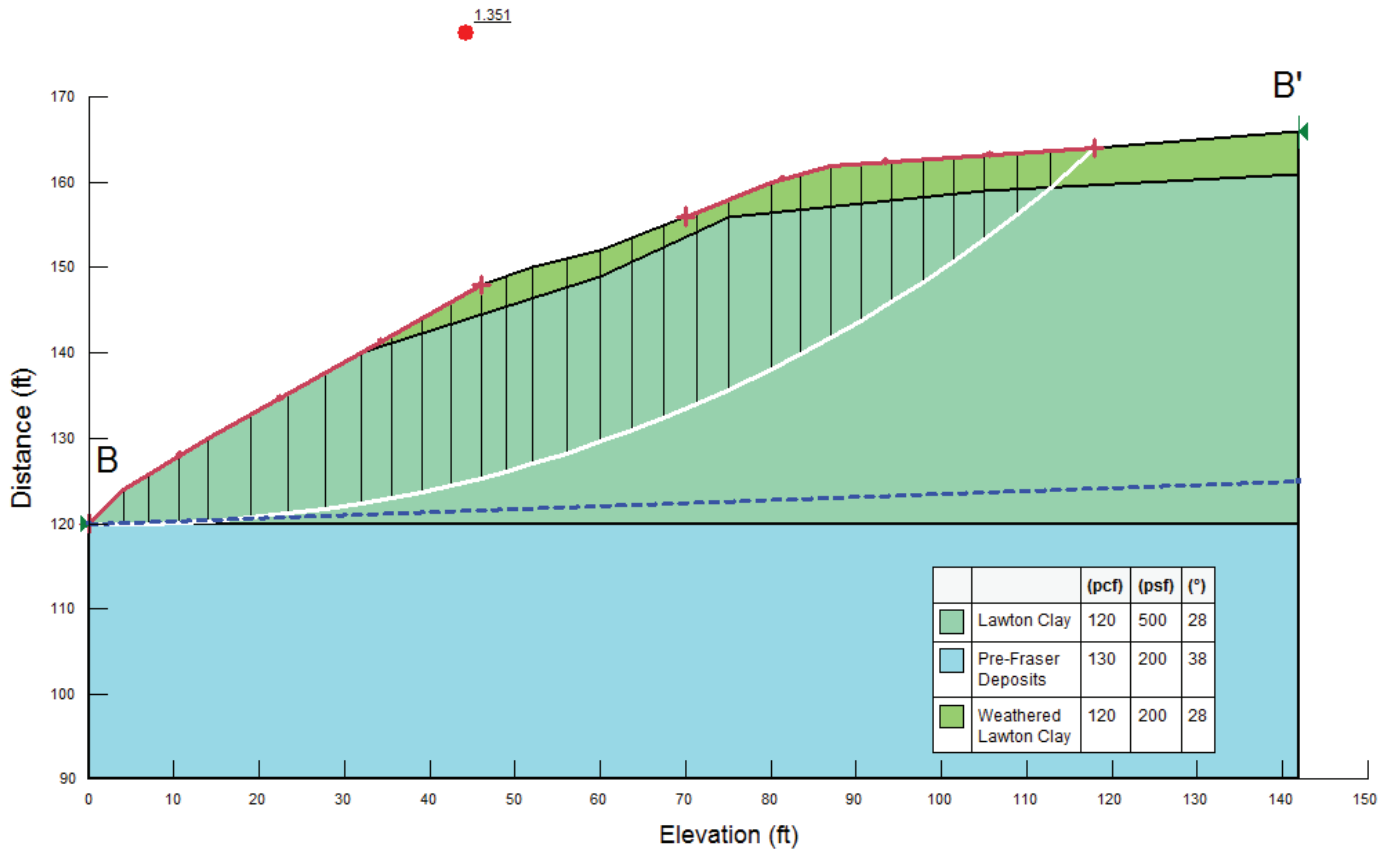


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SLOPE STABILITY - EXISTING
CROSS-SECTION B - B' SEISMIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
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160384 Londo Forbes \ 160384E001 F7 SS B-B' 4-18.cdr

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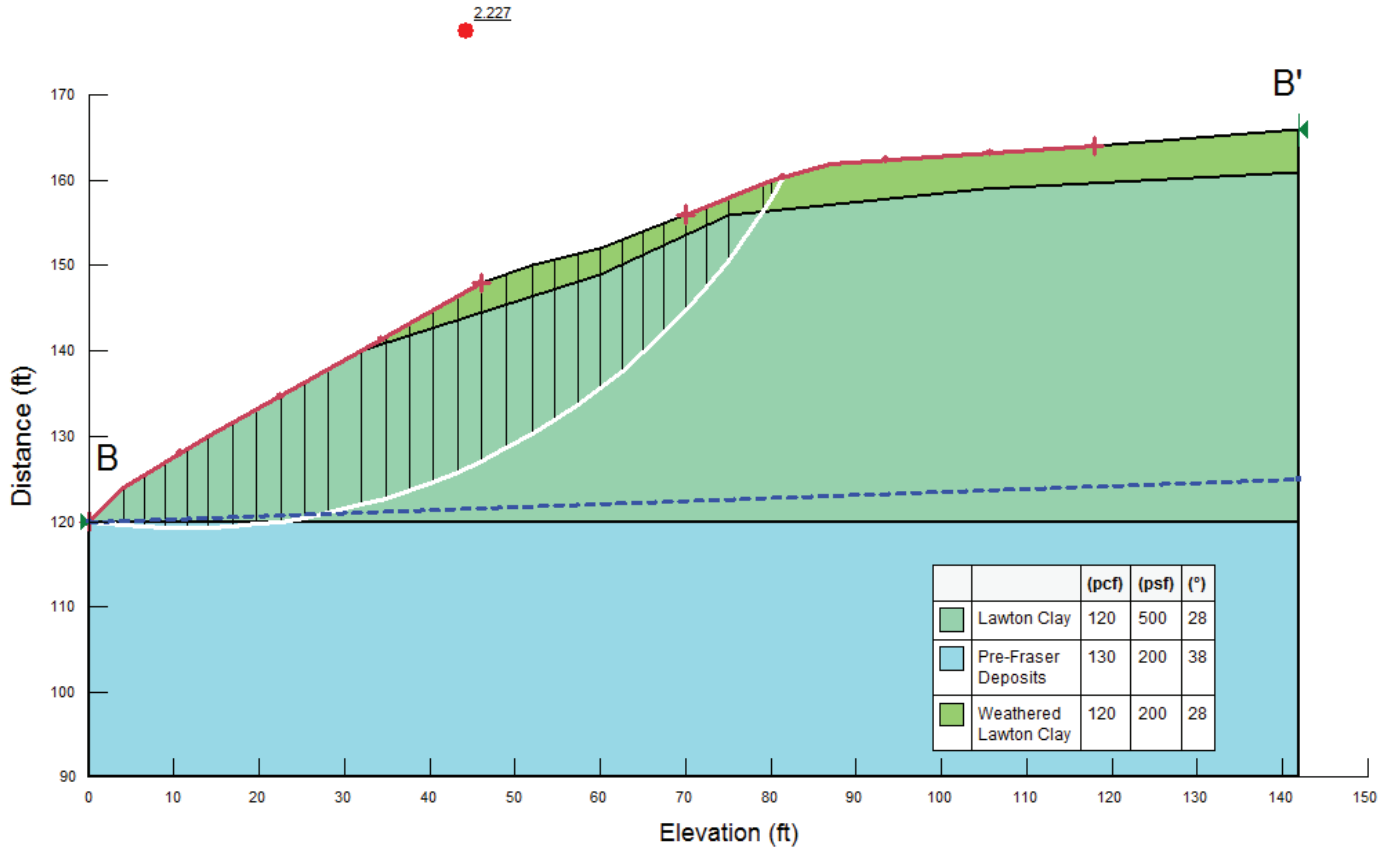


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SLOPE STABILITY - EXISTING CROSS-SECTION B - B' STATIC

LONDO FORBES CREEK

KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
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| 160384E001 | 4/18 | . |

160384 Londo Forbes \ 160384E001 F9 SS B-B 4-18.cdr

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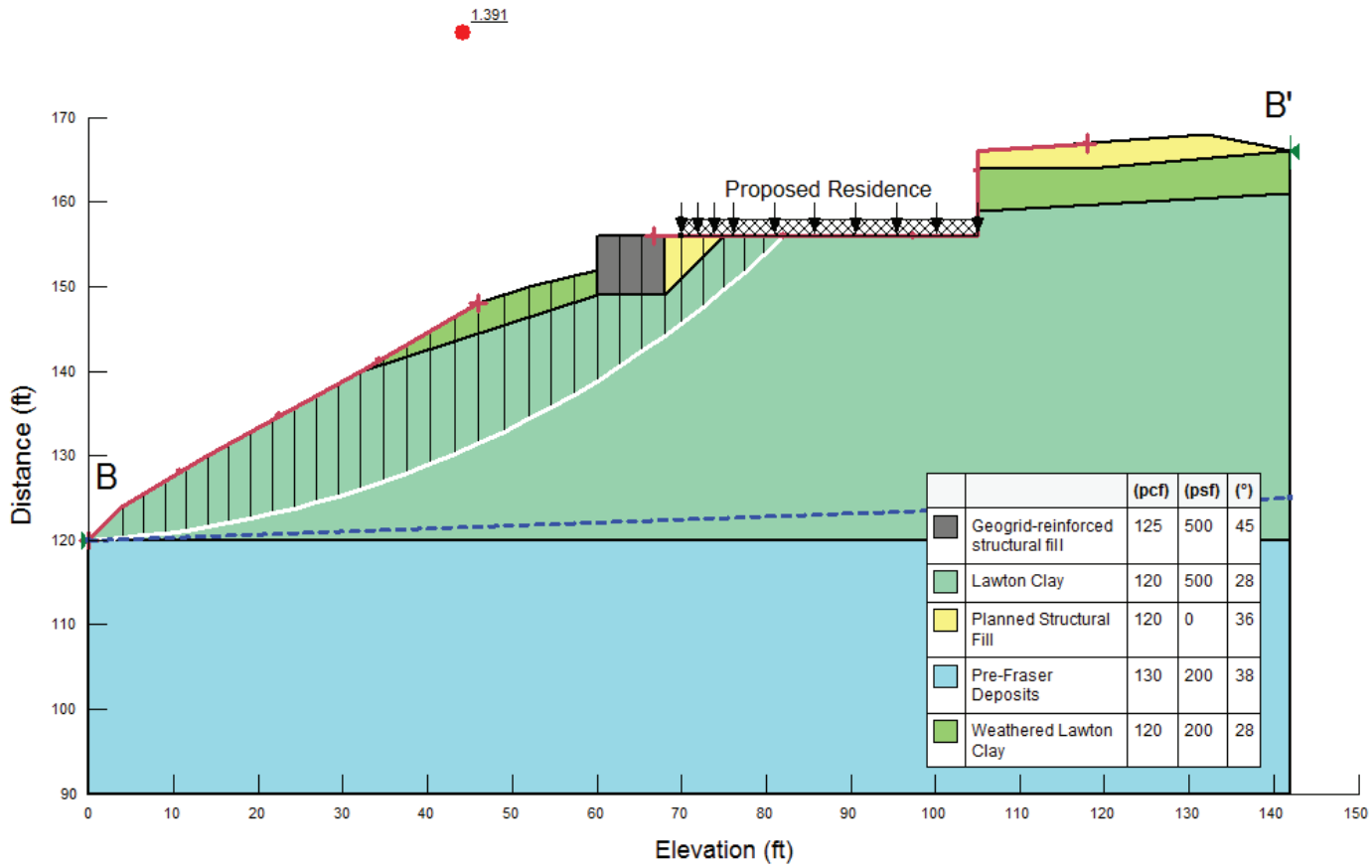


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SLOPE STABILITY - PROPOSED CROSS-SECTION B - B' SEISMIC

LONDO FORBES CREEK

KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
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| 160384E001 | 4/18 | . |

160384 Londo Forbes \ 160384E001 F9 SS B-B' 4-18.cdr

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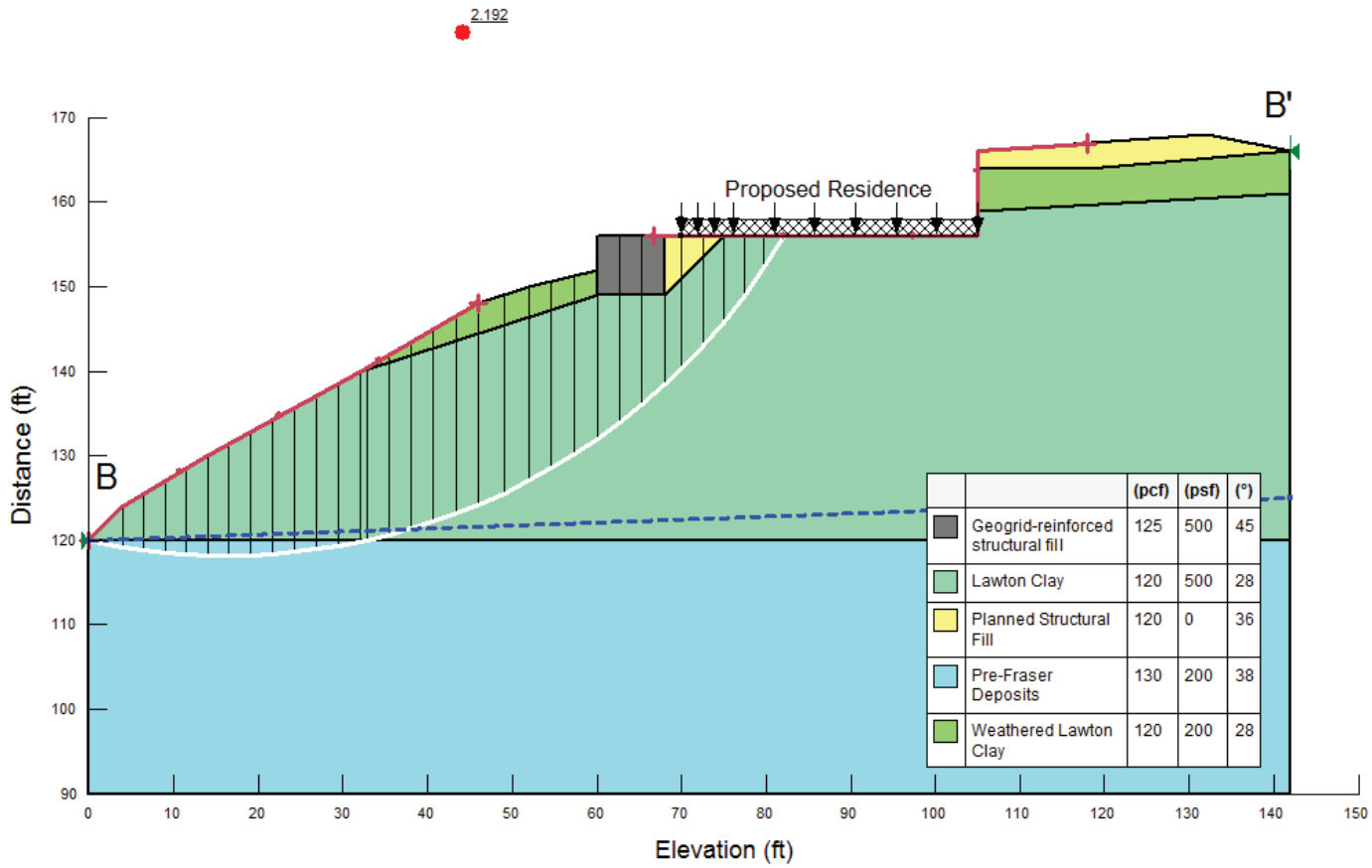


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SLOPE STABILITY - PROPOSED CROSS-SECTION B - B' STATIC

LONDO FORBES CREEK

KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
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| 160384E001 | 4/18 | . |

160384 Londo Forbes \ 160384E001 F10 SS B-B 4-18.cdr

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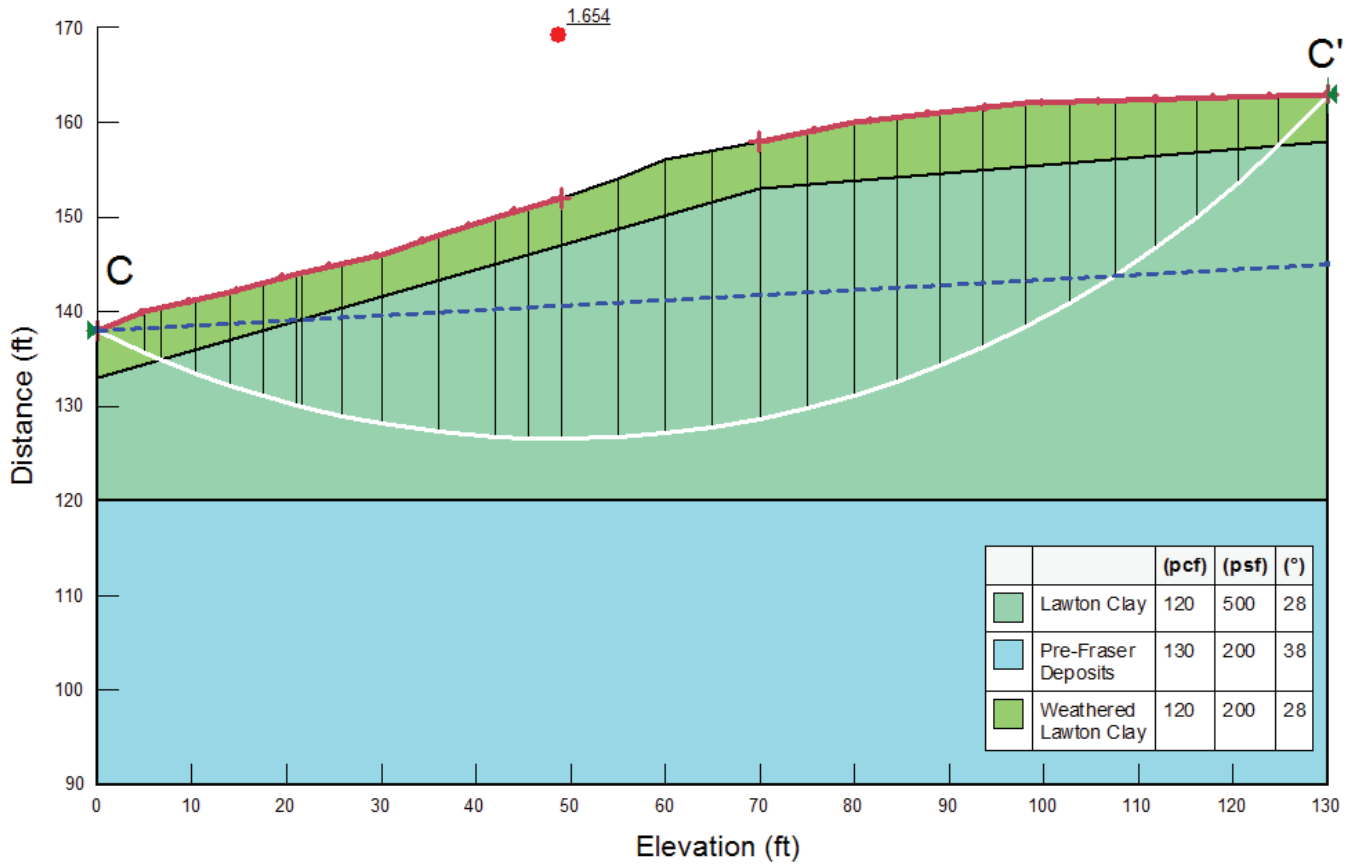


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SLOPE STABILITY - EXISTING
CROSS-SECTION C - C' SEISMIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
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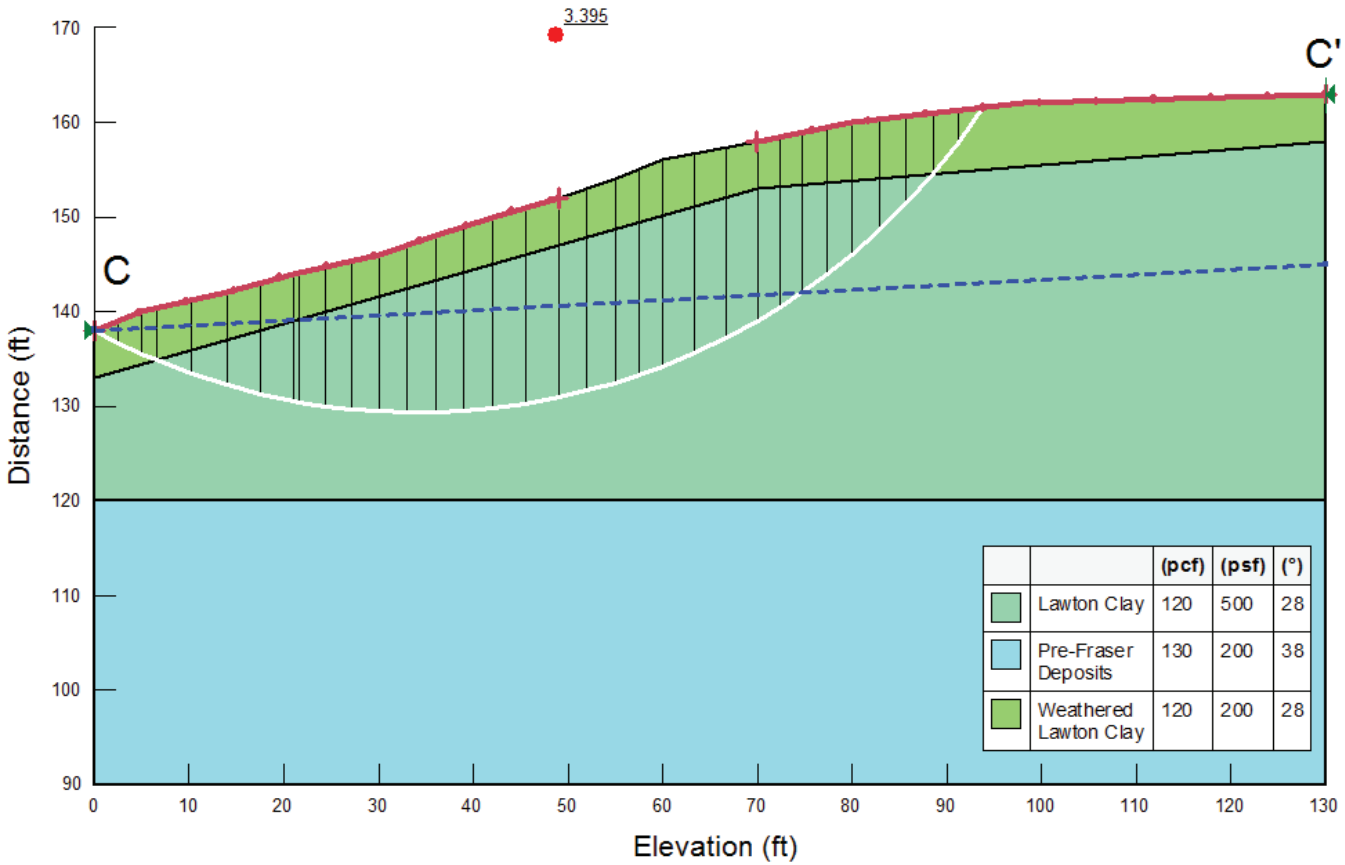


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SLOPE STABILITY - EXISTING CROSS-SECTION C - C' STATIC

LONDO FORBES CREEK

KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
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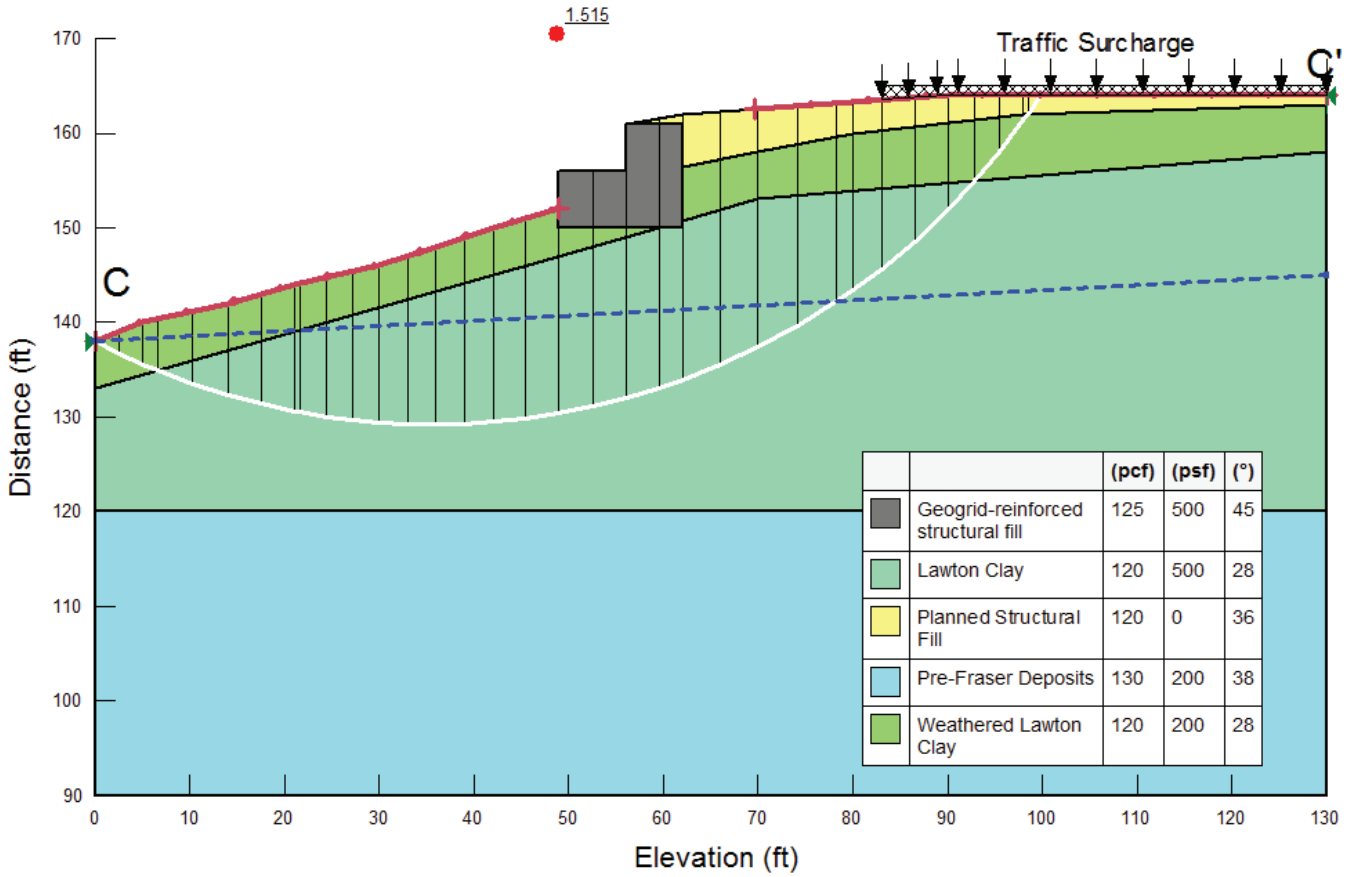


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SLOPE STABILITY - PROPOSED CROSS-SECTION C - C' SEISMIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
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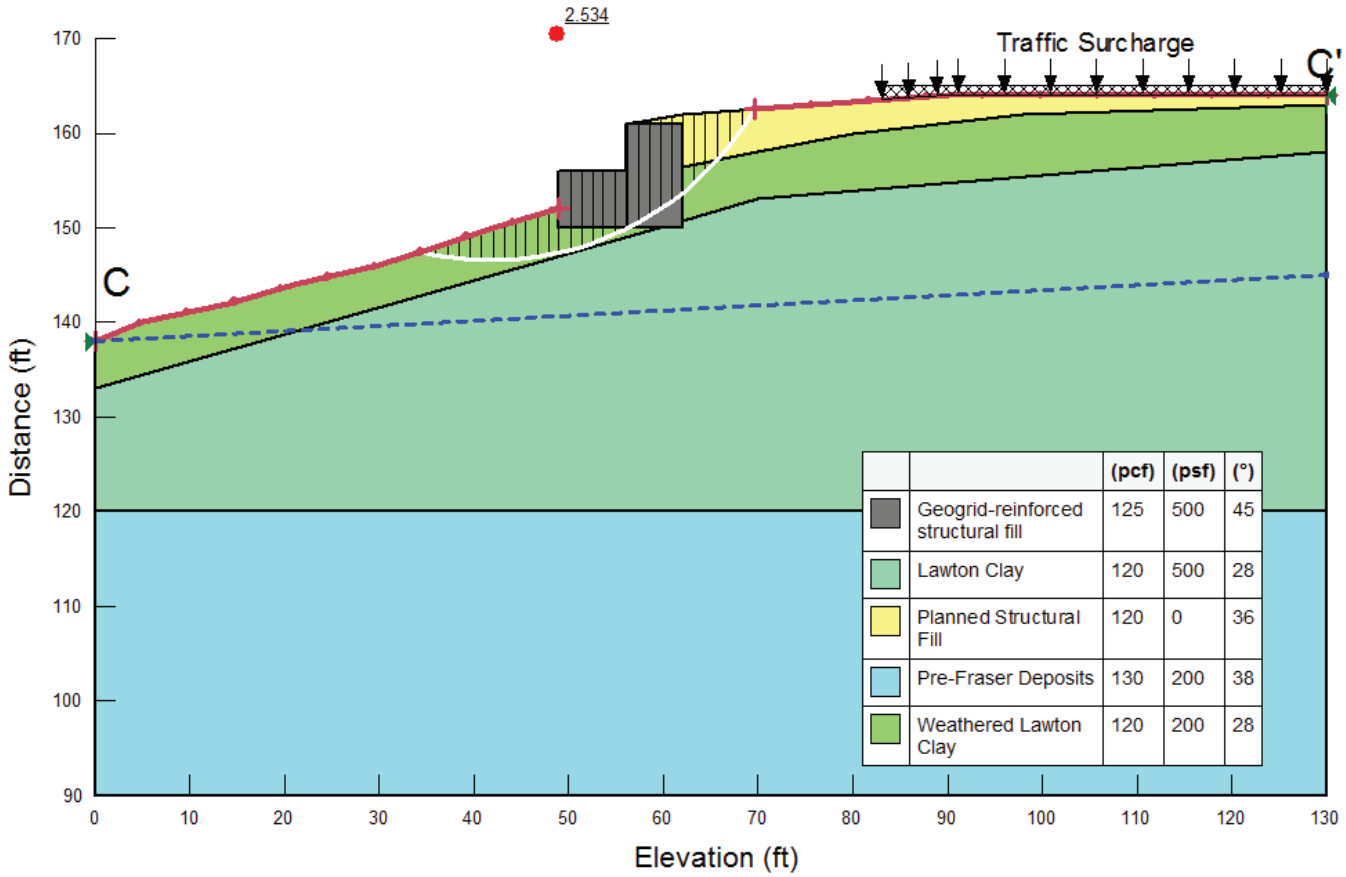


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SLOPE STABILITY - PROPOSED CROSS-SECTION C - C' STATIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
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| 160384E001 | 4/18 | . |

160384 Londo Forbes \ 160384E001 F14 SS C-C 4-18.cdr

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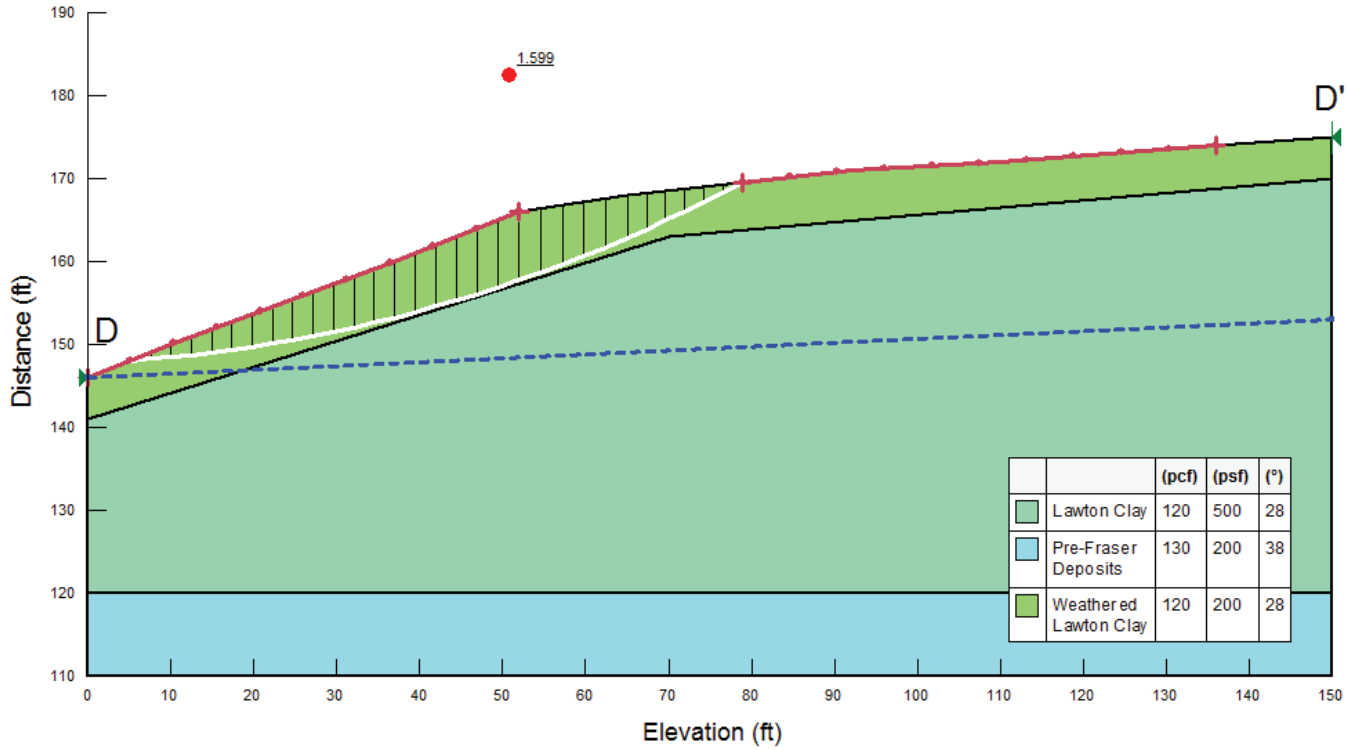


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SLOPE STABILITY - EXISTING
CROSS-SECTION D - D' SEISMIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
|---|---|---|
| 160384E001 | 4/18 | . |

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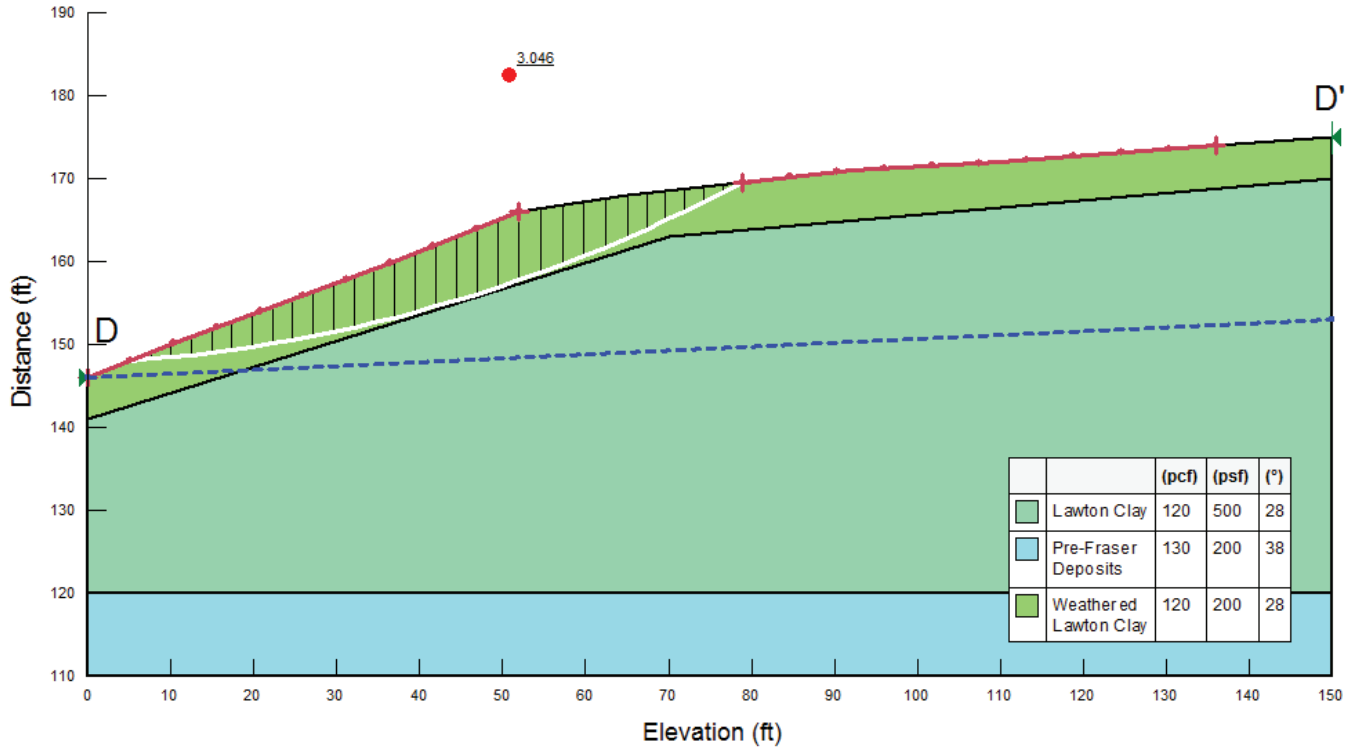
ATTACHMENT 33

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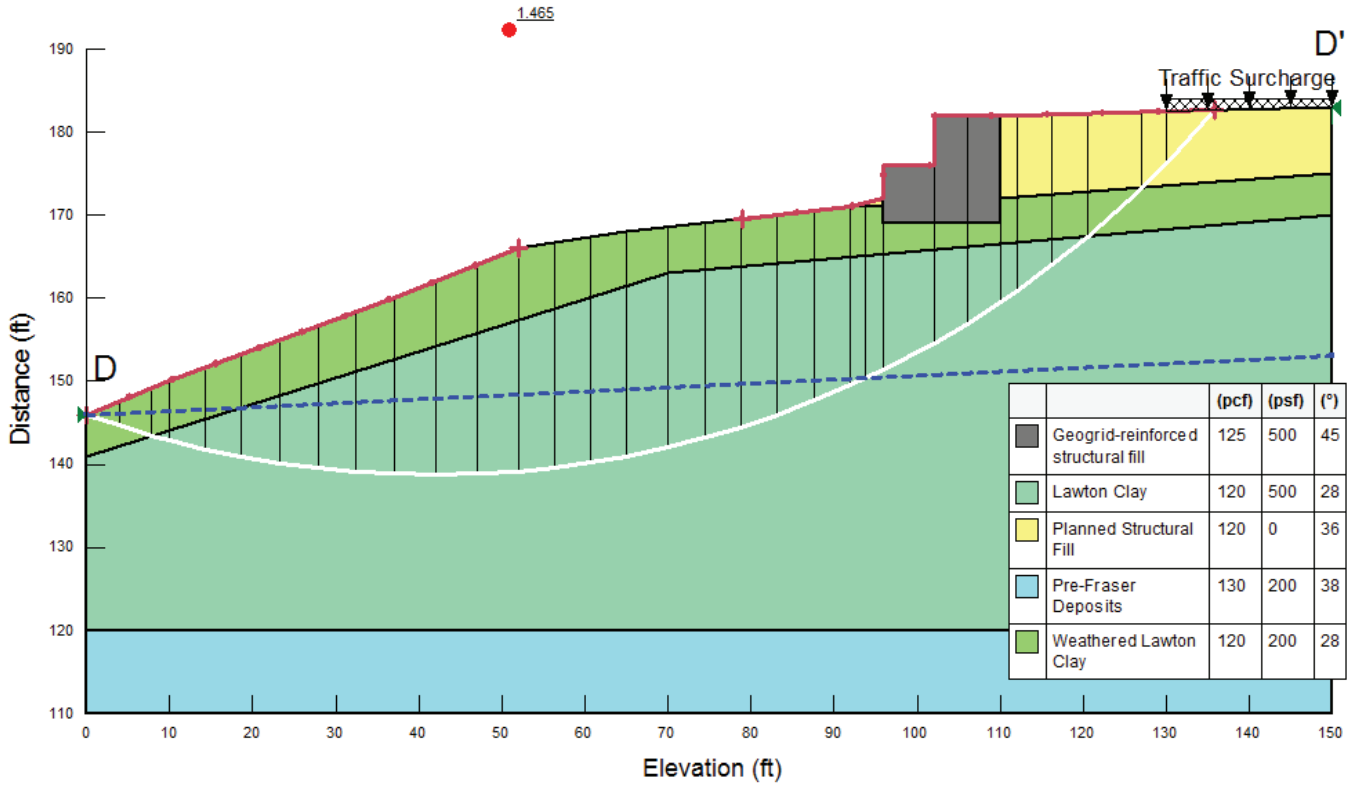
SLOPE STABILITY - EXISTING
CROSS-SECTION D - D' STATIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
|---|---|---|
| 160384E001 | 4/18 | . |

160384 Londo Forbes \ 160384E001 F16 SS D-D 4-18.cdr

ATTACHMENT 33




NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

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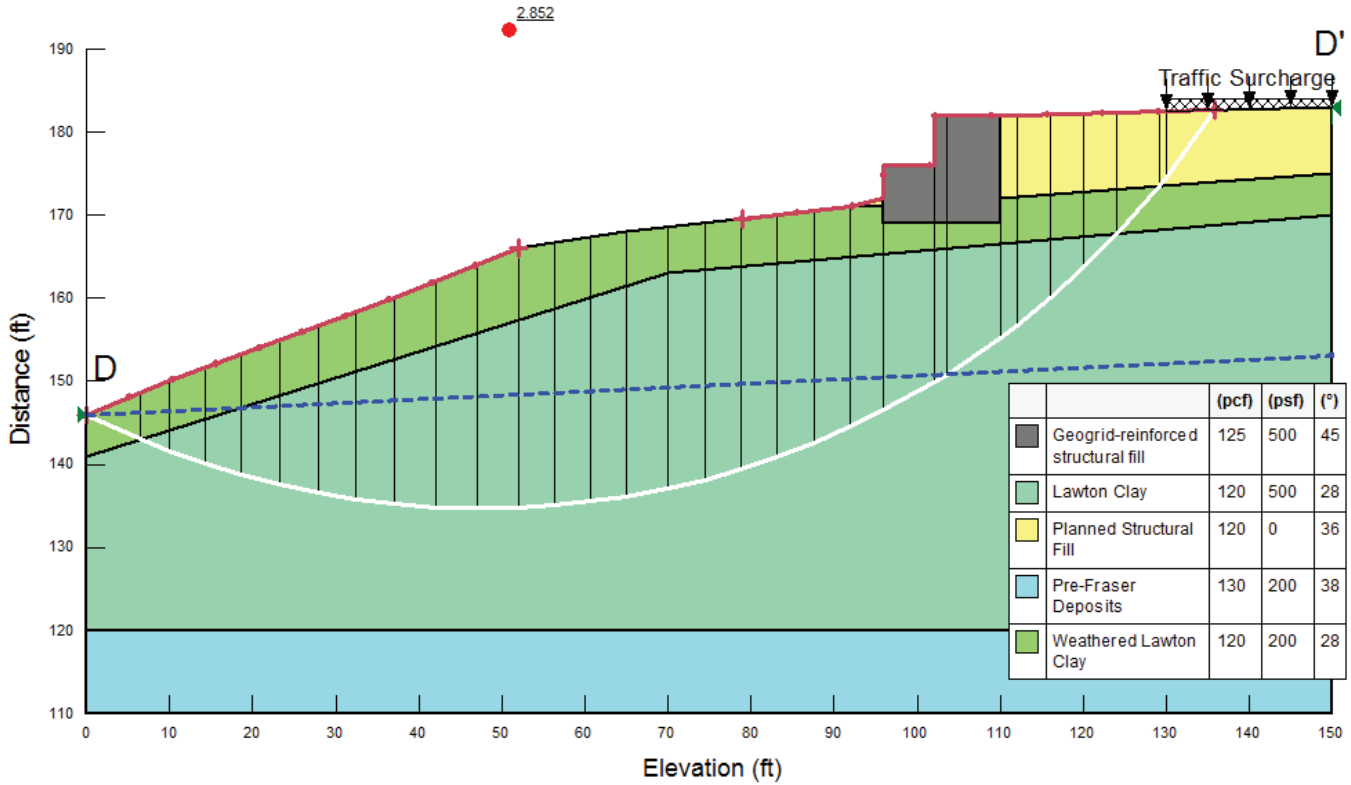
SLOPE STABILITY - PROPOSED CROSS-SECTION D - D' SEISMIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
|---|---|---|
| 160384E001 | 4/18 | . |

160384 Londo Forbes \ 160384E001 F17 SS D-D' 4-18.cdr

ATTACHMENT 33




| | (pcf) | (psf) | (°) |
|---|---|---|---|
| Geogrid-reinforced structural fill | 125 | 500 | 45 |
| Lawton Clay | 120 | 500 | 28 |
| Planned Structural Fill | 120 | 0 | 36 |
| Pre-Fraser Deposits | 130 | 200 | 38 |
| Weathered Lawton Clay | 120 | 200 | 28 |

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

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SLOPE STABILITY - PROPOSED CROSS-SECTION D - D' STATIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
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| 160384E001 | 4/18 | . |

160384 Londo Forbes \ 160384E001 F18 SS D-D 4-18.cdr

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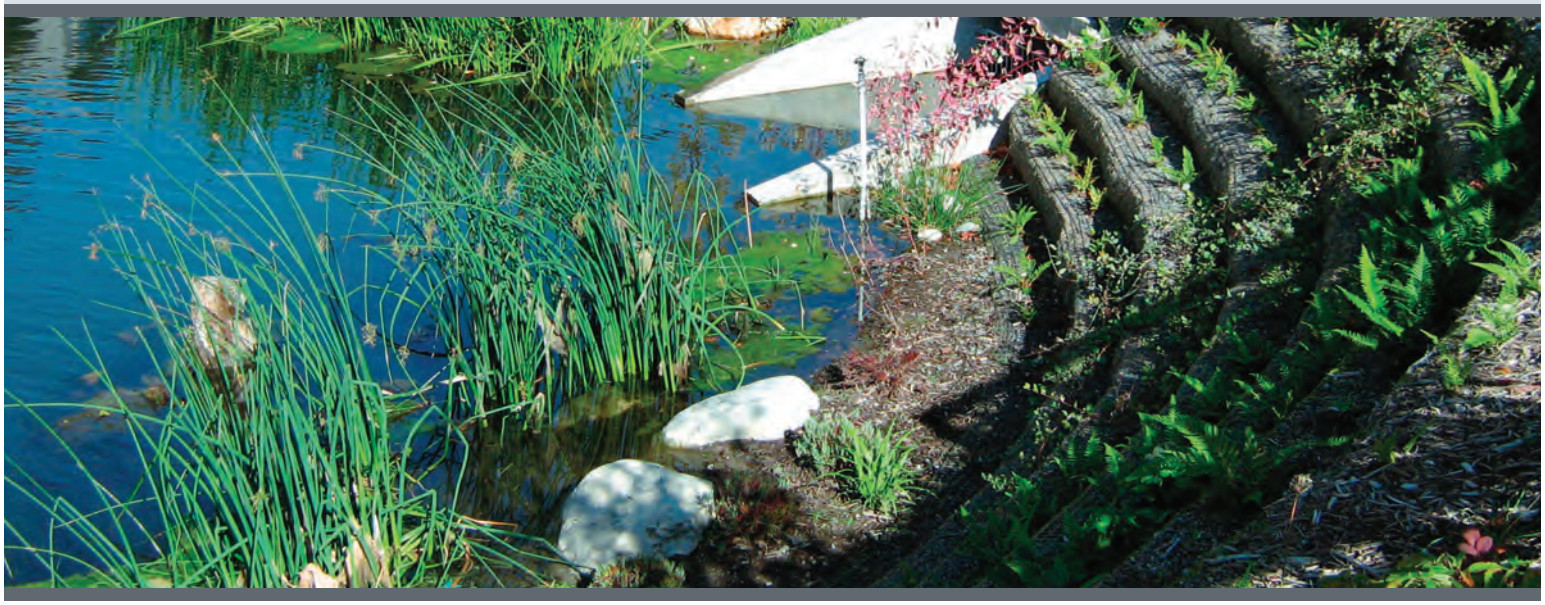
ATTACHMENT 34



*Subsurface Exploration, Geologic Hazard, and Geotechnical Engineering Report*

# LONDO FORBES CREEK

Kirkland, Washington

Prepared For:

**ORCAS MOON, LLC**

Project No. 160384E001
July 28, 2016;
Revised October 29, 2018

Associated Earth Sciences, Inc.
911 5th Avenue
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incorporated

July 28, 2016;
Revised October 29, 2018
Project No. 160384E001

Orcas Moon, LLC
P.O. Box 2710
Redmond, Washington 98073

Attention: Mr. Robert Londo

Subject: Subsurface Exploration, Geologic Hazard, and Geotechnical Engineering Report
Londo Forbes Creek
20th Avenue and 4th Place
Kirkland, Washington

Dear Mr. Londo:

We are pleased to present copies of the above-referenced report. This report summarizes the results of our subsurface exploration, geologic hazard, and geotechnical engineering studies and offers recommendations for the design and development of the proposed project. *This revision is in response to the "Additional Information Letter" prepared by City of Kirkland staff, dated September 21, 2018.*

We have enjoyed working with you on this study and are confident that the recommendations presented in this report will aid in the successful completion of your project. If you should have any questions or if we can be of additional help to you, please do not hesitate to call.

Sincerely,
**ASSOCIATED EARTH SCIENCES, INC.**
**Kirkland, Washington**

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

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# SUBSURFACE EXPLORATION, GEOLOGIC HAZARD, AND GEOTECHNICAL ENGINEERING REPORT

# LONDO FORBES CREEK

## Kirkland, Washington

*Prepared for*:
**Orcas Moon, LLC**
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# I. PROJECT AND SITE CONDITIONS

## 1.0 INTRODUCTION

This report presents the results of our subsurface exploration, geologic hazard, and geotechnical engineering study for the Londo Forbes Creek project, located near the intersection of 20th Avenue and 4th Place in Kirkland, Washington (Figure 1). The approximate locations of explorations completed or referenced for this study are shown on the "Site and Exploration Plan," Figure 2. Interpretive exploration logs are included in the Appendix. At the time of this report, site grading, structural plans, and construction methods have not been finalized. As the nature, design, and locations of the site improvements and lots are planned, the conclusions and recommendations contained in this report should be reviewed and modified, or verified, as necessary.

### 1.1 Purpose and Scope

The purpose of this study was to provide subsurface data to be utilized in design and construction of the site improvements and residences at the above-referenced site. Our study included a review of available geologic literature and exploration logs, completion of three exploration borings, and performing geologic studies to assess the type, thickness, distribution, and physical properties of the subsurface sediments and shallow groundwater conditions. A geologic hazards assessment and a geotechnical engineering study were also completed to determine suitable geologic hazard mitigation techniques, the type of suitable foundations, allowable foundation soil bearing pressures, anticipated foundation settlements, erosion considerations, drainage considerations, and construction recommendations. This report summarizes our fieldwork and offers geologic hazard mitigation and development recommendations based on our present understanding of the project.

*Report Revision – Comment Response*

*This revision to the geotechnical engineering report incorporates responses to the "Additional Information Letter" prepared by City of Kirkland staff, dated September 21, 2018. In their September 21, 2018 letter, City staff requested the following geotechnical information:*

- *Provide a revised site plan identifying slopes that are greater than 15 percent.*
- *Indicate the areas impacted by erosion and slide activity, associated with the existing storm water drainage pipes, on the geotechnical report site plan.*
- *Submit a "final" grading plan and any revisions to the Geotechnical report or slope stability analyses required to reflect the submitted grading plan.*
- *Address the potential of shallow colluvial slope failures below the proposed retaining walls and how the risk of these failure types is mitigated, such as through wall*

*embedment or horizontal benches in front of the walls. Please address this risk in the case of sections C-C' and D-D' where the structures appear to be supported on weather(ed) Lawton Clay.*

*Italicized responses to the above items can be found in the appropriate sections of this report revision.*

## 1.2 Authorization

Written authorization to proceed with this study was granted by Mr. Robert Londo of Orcas Moon, LLC. This report has been prepared for the exclusive use of Orcas Moon, LLC and its agents for specific application to this project. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering and engineering geology practices in effect in this area at the time our report was prepared. No other warranty, express or implied, is made. It must be understood that no recommendations or engineering design can yield a guarantee of stable slopes. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the owner.

# 2.0 PROJECT AND SITE DESCRIPTION

This report was completed with an understanding of the project based on our discussions with you, and review of project plans, prepared by Blueline and dated November 21, 2017. We understand that you are currently planning 14 single-family cottage residences, with associated grading, access, and utilities, at the subject site. Modular block retaining walls, ranging up to approximately 13 feet in exposed height, are planned to face fills placed for roadways and building pads.

The property was situated north of the intersection of 20$^{th}$ Avenue and 4$^{th}$ Place in Kirkland, Washington (King County Parcel Nos. 3890100050 and 3890100055). The approximately 7-acre property generally slopes down to the north and is situated on the south flank of the Forbes Creek valley. The total elevation change across the property was on the order of 120 feet. Incised depressions on the slope appeared to serve as collectors of surface runoff above and for the upper third of the subject property. Locally, the depressions contained slopes on the order of 40 to 50 percent. We were informed that three sections of corrugated metal pipe were laid in the incised depressions and extend down the slope with water exiting the pipes near Forbes Creek Drive. It is our understanding that the pipe was installed to carry runoff water from 20$^{th}$ Avenue to the south of the site.

The property is accessed via a roughly graded road entering from Forbes Creek Drive along the northern property boundary. The site contains remnants of a demolished house and pump

house. The site contains a moderate growth of native vegetation consisting of maple and evergreen trees, blackberry bushes, ferns, and short grass. While on-site, we did not observe bowed trees or similar conditions that would indicate creep or downslope movement of the existing slope. The only significant erosion features we observed were along the previously mentioned incised depressions running north-south on the face of the slope.

## 3.0 SUBSURFACE EXPLORATION

Our previous field study, completed in 2005, included excavating 10 exploration pits to gain information about the site. Our recent study included three exploration borings and installation of two groundwater monitoring wells to supplement previously gathered information. The various types of sediments, as well as the depths where characteristics of the sediments changed, are indicated on the exploration logs presented in the Appendix. The depths indicated on the logs where conditions changed may represent gradational variations between sediment types. Our explorations were approximately located in the field by measuring from known site features.

The conclusions and recommendations presented in this report are based on the subsurface explorations completed for this study. The number, locations, and depths of the explorations were completed within site and budgetary constraints. Because of the nature of exploratory work below ground, extrapolation of subsurface conditions between field explorations is necessary. It should be noted that differing subsurface conditions may sometimes be present due to the random nature of deposition and the alteration of topography by past grading and/or filling. The nature and extent of any variations between the field explorations may not become fully evident until construction. If variations are observed at that time, it may be necessary to re-evaluate specific recommendations in this report and make appropriate changes.

### 3.1 Exploration Pits

Exploration pits were excavated with a trackhoe. The pits permitted direct, visual observation of subsurface conditions. Materials encountered in the exploration pits were studied and classified in the field by a geotechnical engineer from our firm. All exploration pits were backfilled immediately after examination and logging. Selected samples were then transported to our laboratory for further visual classification and testing, as necessary.

### 3.2 Exploration Borings

The borings were completed on the subject site using track-mounted drilling equipment advancing a hollow-stem auger. During the drilling process, samples were obtained at 5-foot intervals. The borings were continuously observed and logged by representatives from our

firm. The exploration logs presented in the Appendix are based on the field logs, drilling action, and inspection of the samples secured.

Disturbed but representative samples were obtained by using the Standard Penetration Test (SPT) procedure in accordance with *American Society for Testing and Materials* (ASTM) D-1586. This test and sampling method consists of driving a standard, 2-inch outside-diameter, split barrel sampler a distance of 18 inches into the soil with a 140-pound hammer free-falling a distance of 30 inches. The number of blows for each 6-inch interval is recorded, and the number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance ("N") or blow count. If a total of 50 blows are recorded at or before the end of one 6-inch interval, the blow count is recorded as the number of blows for the corresponding number of inches of penetration. The resistance, or N-value, provides a measure of the relative density of granular soils or the relative consistency of cohesive soils. These values are plotted on the attached boring logs.

The samples obtained from the split-barrel sampler were classified in the field and representative portions placed in watertight containers. The samples were then transported to our laboratory for further visual classification and geotechnical laboratory testing, as necessary. The various types of soil and groundwater elevations, as well as the depths where soil and groundwater characteristics changed, are indicated on the exploration boring logs presented in the Appendix of this report. Our explorations and reconnaissance were approximately located by measuring from known site features.

### 3.3 Monitoring Wells

Exploration borings EB-1W and EB-2W were completed as 2-inch-diameter monitoring wells, each with 10 feet of machine-slotted Schedule 40 polyvinyl chloride (PVC) well screen and a flush-mount monument. The sand pack materials consisted of 10/20 Colorado Silica Sand. The wells were sealed with a combination of bentonite chips and concrete. Well construction details are presented on the boring logs in the Appendix. Hand water level data was collected after well development was completed, on February 2, 2018, and a pressure transducer with an automatic data logger was installed in EB-2W to collect water levels. A hydrograph illustrating water levels for EB-2W is attached to this letter.

## 4.0 SUBSURFACE CONDITIONS

Subsurface conditions at the subject site were inferred from the field explorations referenced for this study, visual reconnaissance of the site, and review of applicable geologic literature. The approximate locations of the explorations are shown on Figure 2. As shown on the field logs, the exploration pits generally encountered medium dense sand with varying amounts of

silt and gravel or stiff to hard silts, and the exploration borings generally encountered stiff to hard silt overlying very dense pre-Fraser-age deposits, with colluvium encountered at the lower, northern end of the site. Minor amounts of fill may occur at some locations, particularly those in the northern portion of the site, adjacent to the roadway, or within utility trenches across the property and in the vicinity of previous structures. The following section presents more detailed subsurface information.

## 4.1 Stratigraphy

### *Topsoil*

Topsoil consisting of loose, moist, dark brown, silty sand was encountered in most of the explorations. The topsoil ranged in thickness from about 0.5 to 1.5 feet. This material is unsuitable for structure or pavement support.

### *Fill*

We observed fill soils covering buried, approximately 12-inch–diameter, corrugated pipes laid along the steep site slopes. The pipes appeared to be between 1.5 and 2 feet below existing site grades at the locations we observed. Fill may also be encountered around utilities and foundation areas associated with the demolished structure. This material is unsuitable for structure or pavement support.

### *Colluvium*

Colluvial soils were encountered at the location of exploration boring EB-2W to a depth of approximately 12.5 feet below the ground surface. The colluvium generally consisted of loose, silty fine to medium sand with trace gravel. Portions of the colluvium contained organic material. Colluvium is a material derived from upslope and deposited by gravity or through the potential disturbance of upslope activity. Due to their variable density and organic debris content, the existing colluvial soils are not suitable for foundation support.

### *Recessional Outwash*

Sediments encountered below the topsoil layer consisted of medium dense, fine to medium sand with varying quantities of silt. We interpret these sediments to be representative of recessional outwash. The recessional outwash consists of sediments that were deposited by meltwater streams that emanated from the retreating glacial ice during the latter portion of the Vashon Stade of the Fraser Glaciation ending approximately 12,500 years ago. Where glacial sediments are exposed at the ground surface throughout the Puget Sound region, the upper several feet of these sediments typically become weathered. The recessional outwash

sediments generally extended about 4 to 5 feet below existing grades, but in exploration pit EP-1, extended to the bottom of the exploration at 16 feet. When properly prepared, the recessional outwash will be suitable for the support of foundations.

*Advance Outwash*

An advance outwash deposit consisting of medium dense to very dense sand containing variable amounts of disseminated silt, interbeds of clayey silt, and few amounts of scattered gravel was encountered below the topsoil and recessional deposits. The advance outwash deposit was generally encountered between 4 to 6 feet below existing grades in exploration pits EP-6 and EP-9, or approximately the middle third of the slope. The advance outwash was deposited ahead of the advancing Vashon-age glacial ice sheet in meltwater streams and subsequently overridden by several thousand feet of ice. Consequently, these materials are medium dense to very dense, possess high shear strength, and have low compressibility characteristics. The advance outwash deposit is suitable for direct foundation support.

*Transitional Beds/Lawton Clay*

A hard, clayey silt and silty clay deposit containing trace amounts of fine sand interpreted to be transitional beds was generally encountered in the upper portions (south end) of the property, including in exploration borings EB-1W and EB-3. The glaciolacustrine clayey silt and silty clay was deposited in freshwater lakes or slow-moving rivers far ahead of the advancing Vashon-age glacial ice sheet and was also overridden by several thousand feet of ice. These materials are hard, have low compressibility characteristics, and are relatively impermeable. The transitional beds are considered suitable for support of shallow foundations with proper preparation. The transitional beds are typically highly moisture-sensitive and susceptible to disturbance when wet. Care should be taken not to disturb planned load-bearing surfaces that are composed of the transitional beds during periods of wet site or weather conditions.

*Pre-Fraser Non-Glacial Deposits*

Below the Lawton clay deposits, exploration borings EB-1W and EB-3 encountered very stiff to hard sandy silt or very dense sand, which extended to 52 feet below the ground surface at EB-3, and below the maximum depth explored of 60 feet below the ground surface at EB-1W. This soil was interpreted to represent non-glacial deposits placed prior to the Vashon Stade of the Fraser Glaciation and subsequently compacted by the weight of the overlying glacial ice. The very stiff to hard/very dense material is generally considered suitable for support of light to heavily loaded foundations when in an intact, undisturbed condition.

*Pre-Olympia Glacial Deposits*

Underlying the colluvium at exploration boring EB-2W, and below the pre-Fraser-age deposits at exploration boring EB-3, we encountered dense to very dense fine to medium sand, with varying amounts of silt and gravel, and gravel beds in places, which extended below the maximum depths explored of 31.5 feet and 60.5 feet, respectively. This deposit was interpreted to represent sediments placed prior to the Olympia interglaciation and subsequently compacted by the weight of the overlying glacial ice. The dense to very dense material is generally considered suitable for support of light to heavily loaded foundations when in an intact, undisturbed condition. This material is somewhat moisture-sensitive and susceptible to disturbance when wet.

## 4.2 Hydrology

Groundwater seepage was encountered in exploration pit EP-5 at the time of our field study in June 2005, and in exploration boring EB-2W during our January 2018 study. A pressure transducer connected to an automatic data logger was installed in EB-2W on February 2, 2018. The highest recorded groundwater elevation in EB-2W was approximately 115 feet in April 2018, lowering to approximately 108 feet in August 2018. Note that the elevations were estimated from Google Earth. A hydrograph of the data is included in the Appendix.

We expect shallow groundwater seepage across much of the site to be limited to interflow. Interflow occurs when surface water percolates down through the surficial weathered or higher-permeability sediments and becomes perched atop underlying, lower-permeability sediments. It should be noted that fluctuations in the level of the groundwater may occur due to the time of the year, variations in the amount of precipitation, and changes in site development. Seepage may also occur at random depths and locations in unsupervised or non-uniform fills. During our site reconnaissance, we did not observe springs emanating from the steeply sloping areas. As stated in our letter, dated October 13, 2016 (attached), the likely predominant water source leading to the wet conditions observed at previously-delineated Wetland “A” includes the drainage system originating along 20$^{th}$ Avenue and point-discharging onto the subject site.

## II. GEOLOGIC HAZARDS AND MITIGATIONS

The following discussion of potential geologic hazards is based on the geologic, slope, and shallow groundwater conditions, as observed and discussed herein.

### 5.0 LANDSLIDE HAZARDS AND MITIGATION

Kirkland Zoning Code (KZC) 85.13(3)(a) defines "High Landslide Hazard Areas" as *"Areas sloping 40 percent or greater, areas subject to previous landslide activities and areas sloping between 15 percent and 40 percent with zones of emergent groundwater or underlain by or embedded with impermeable silts or clays."* Given the predominance of fine-grained "Lawton Clay" deposits encountered in our recent exploration borings, the portions of the subject site greater than 15 percent would be classified as "High Landslide Hazard Areas", as defined in the KZC. *The portions of the subject site greater than 15 percent are shown in Figure 2.* The following paragraphs discuss the stability of the slopes and recommendations to mitigate risks to the public health, safety, or welfare. It must be understood that no recommendations or engineering design can yield a guarantee of stable slopes. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the owner.

During our site reconnaissance and our subsurface exploration, we found no visual evidence of tension cracks, emergent seepage, hummocky topography, or other indications of recent slope instability at the subject site. We observed that many of the large trees scattered across the site, including those near to or at the top of the steep slopes, were vertically oriented, suggesting that ongoing deep-seated slope movement is not occurring at the subject parcel.

*As stated in our letter, dated October 13, 2016 (attached), we stated our opinion that the water collected by the drain system along 20th Avenue and point-discharged onto the subject site, through the drain pipes described above, has led to erosion or shallow slide activity within the gully. Figure 2 shows the approximate area of this erosion.*

### 5.1 Numerical Slope Stability Analysis

Associated Earth Sciences, Inc. (AESI) used GeoStudio 2016, Version 8.16.3.14580, by Geo-Slope International, Ltd. to perform the analysis of slope stability under both existing and proposed site conditions. The Morgenstern-Price method was used for both static and seismic models. We used the topography presented on *the latest version (dated October 23, 2018) of the grading plan* provided by Blueline (shown in Figure 2) to create four profiles within the subject property. Data from the recent exploration borings were used to model the steep slopes and underlying soil contacts. The soil densities and other soil properties in the model

were estimated based on the subsurface conditions encountered in our explorations, our experience with similar soils, and correlation with published information. Soil strength parameters used for our analysis, along with interpretive geologic cross-sections, are shown on Figures 3 through 18. A surcharge of 500 pounds per square foot (psf) was used for our analysis to represent proposed residences, and the modeled cross-sections include the currently proposed fill placement shown in the Blueline plans, including mechanically stabilized earth (MSE) retaining wall systems placed at the tops of the adjacent slopes. Seismic forces were modeled using a pseudo static acceleration of 0.25g, which is consistent with current local standards of practice for slope stability modeling.

Slope stability is expressed as a factor of safety, which is a ratio between resisting and driving forces for a given slope failure scenario. A factor of safety of 1.0 indicates that resisting and driving forces are equal, and a failure is predicted. Factors of safety greater than 1 indicate that resisting forces exceed driving forces, and a failure is not predicted. A static factor of safety of 1.50 would be considered suitable with respect to generally accepted geotechnical engineering practice. During short-term seismic loading, a dynamic factor of safety of 1.15 is generally considered acceptable. Using the above soil parameters, groundwater conditions, and the geometry shown on Figures 3 through 18, the resulting factors of safety for slope movement for both existing and proposed conditions along the modeled cross-sections exceeded 1.50 under static conditions and 1.15 under seismic conditions.

Based on our analyses, the proposed construction of new residences and MSE walls at the approximate locations shown on Figure 2 appears feasible from a geotechnical standpoint. *The MSE walls shown in the cross-sections (e.g., Cross-Section D-D') include wall embedments either within or at the base of the weathered Lawton Clay unit, reflecting a conservative approach to global slope stability analysis for the modeled sections. In practice, MSE retaining walls should be designed and constructed with suitable embedment into very stiff to hard Lawton clay deposits to maintain suitable internal stability and to mitigate the risk posed to the walls by shallow colluvial slope failures below the proposed wall alignments. Suitable embedment should be visually verified by an AESI representative during wall construction.*

As with all steep slopes, surface drainage should be properly controlled and directed away from sloping areas. At no time should loose fill be pushed over the top of the slope or soil excavated from the toe area without support by an engineered retaining structure. Uncontrolled fill on slopes or toe excavation may promote landslides or debris flow activity. AESI should review grading plans as the project design develops and possibly changes from that upon which this report is based.

## 6.0 SEISMIC HAZARDS AND MITIGATIONS

Earthquakes occur regularly in the Puget Lowland. Most of these events are small and are not felt by humans. However, large earthquakes do occur, as evidenced by the 2001, 6.8-magnitude event; the 1965, 6.5-magnitude event; and the 1949, 7.2-magnitude event. The 1949 earthquake appears to have been the largest in this region during recorded history and was centered in the Olympia area. Evaluation of earthquake return rates indicates that an earthquake of the magnitude between 5.5 and 6.0 is likely within a given 20-year period.

Generally, there are four types of potential geologic hazards associated with large seismic events: 1) surficial ground rupture, 2) seismically induced landslides, 3) liquefaction, and 4) ground motion. The potential for each of these hazards to adversely impact the proposed project is discussed below.

### 6.1 Surficial Ground Rupture

The nearest known fault traces to the project site are the South Whidbey Island-Lake Alice Fault located approximately 4 miles to the north, and the Seattle Fault located approximately 5 miles to the south. Recent studies of both the Seattle Fault and the South Whidbey Island-Lake Alice Fault indicate that they are active faults capable of generating surface ruptures. The recognition of these faults is relatively new, and data pertaining to them are limited, with the studies still ongoing. According to the U.S. Geological Society (USGS) studies, the recurrence interval of movements along these faults is unknown, but is speculated to be on the order of 1,100 years. Due to the distance from the site to the known fault zones, and due to the long recurrence interval that is suspected for these fault systems, the risk for damage to the project during the expected life of the structures due to surface faulting is expected to be low, in our opinion.

### 6.2 Seismically Induced Landslides

Due to the field observations and slope stability analysis noted in Section 5.0, it is our opinion that the risk of seismically induced landslides at the subject site is low. Therefore, as noted previously, this opinion is dependent upon site grading and construction practices being completed in accordance with the geotechnical recommendations presented in this report.

### 6.3 Liquefaction

Liquefaction is a temporary loss in soil shear strength that can occur when loose granular soils below the groundwater table are exposed to cyclic accelerations, such as those that occur during earthquakes. The observed site soils were relatively dense and unsaturated and are not

expected to be prone to liquefaction. A detailed liquefaction hazard analysis was not performed as part of this study, and none is warranted, in our opinion.

### 6.4 Seismic Site Class

In our opinion the subsurface conditions at the site are consistent with seismic Site Class D in accordance with the 2015 *International Building Code* (IBC), and the publication ASCE 7 referenced therein, the most recent version of which is ASCE 7-10.

## 7.0 EROSION HAZARDS AND MITIGATION

The on-site sediments contain a high percentage of silt and fine sand and are sensitive to erosion. In order to control erosion and reduce the amount of sediment transport off the site during construction, the following recommendations should be followed.

1. Construction activity should be scheduled or phased as much as possible to reduce the amount of earthwork activity that is performed during the winter months.

2. The winter performance of a site is dependent on a well-conceived plan for control of site erosion and stormwater runoff. The project temporary erosion and sediment control (TESC) plan should include ground-cover measures, access roads, and staging areas. The contractor must implement and maintain the required measures. A site maintenance plan should be in place in the event stormwater turbidity measurements are greater than the Washington State Department of Ecology (Ecology) standards.

3. TESC measures for a given area to be graded or otherwise worked should be installed soon after ground clearing. The recommended sequence of construction within a given area after clearing would be to install sediment traps and/or ponds and establish perimeter flow control prior to starting mass grading.

4. During the wetter months of the year, or when large storm events are predicted during the summer months, each work area should be stabilized so that if showers occur, the work area can receive the rainfall without excessive erosion or sediment transport. The required measures for an area to be “buttoned-up” will depend on the time of year and the duration the area will be left unworked. During the winter months, areas that are to be left unworked for more than 2 days should be mulched or covered with plastic. During the summer months, stabilization will usually consist of seal-rolling the subgrade. Such measures will aid in the contractor’s ability to get back into a work area after a storm event. The stabilization process also includes establishing temporary stormwater conveyance channels through work areas to route runoff to the approved treatment facilities.

5. All disturbed areas should be revegetated as soon as possible. If it is outside of the growing season, the disturbed areas should be covered with mulch, as recommended in the erosion control plan. Straw mulch provides a cost-effective cover measure and can be made wind-resistant with the application of a tackifier after it is placed.

6. Surface runoff and discharge should be controlled during and following development. Uncontrolled discharge may promote erosion and sediment transport.

7. Soils that are to be reused around the site should be stored in such a manner as to reduce erosion from the stockpile. Protective measures may include, but are not limited to, covering with plastic sheeting, the use of low stockpiles in flat areas, or the use of silt fences around pile perimeters.

8. On-site erosion control inspections and turbidity monitoring (when required) should be performed in accordance with Ecology requirements. Weekly and monthly reporting to Ecology should be performed on a regularly scheduled basis. Temporary and permanent erosion control and drainage measures should be adjusted and maintained, as necessary, for the duration of project construction.

It is our opinion that with the proper implementation of the TESC plans and by field-adjusting appropriate mitigation elements (best management practices [BMPs]) throughout construction, as recommended by the erosion control inspector, the potential adverse impacts from erosion hazards on the project may be mitigated.

# III. DESIGN RECOMMENDATIONS

## 8.0 INTRODUCTION

Our explorations indicate that, from a geotechnical standpoint, the subject site is suitable for the proposed development provided the recommendations contained herein are properly followed. The bearing stratum is relatively shallow and spread-footing foundations may be utilized. We understand that the distribution of foundations loads of the proposed residences will be typical; concentrated loads on the order of 2 kips per lineal foot of foundation can be expected. Consequently, the native dense outwash soils, hard transitional bed silts, or structural fills bearing on the native soils are capable of providing suitable building support. Planned MSE retaining walls will need to be designed and constructed with suitable embedment into very stiff to hard Lawton clay deposits to maintain suitable stability.

## 9.0 SITE PREPARATION

Site preparation of planned building, road, and structural fill areas should include removal of all trees, brush, debris and any other deleterious material. Additionally, the upper organic topsoil should be removed and the remaining roots grubbed. Areas where loose surficial soils exist due to grubbing operations should be considered as fill to the depth of disturbance and treated as subsequently recommended for structural fill placement.

Loose topsoil should be stripped down to the underlying, medium dense to dense outwash soils and hard transitional bed silts. Since the density of the soil is variable, random soft pockets may exist and the depth and extent of stripping can best be determined in the field by the geotechnical engineer or his representative. We recommend that road areas be proof-rolled with a loaded dump truck to identify soft spots; soft areas should be overexcavated and backfilled with structural fill.

### 9.1 Temporary Slopes

In our opinion, stable construction slopes should be the responsibility of the contractor and should be determined during construction. For estimating purposes, we anticipate that temporary, unsupported cut slopes in the unsaturated, medium dense recessional outwash soils and stiff silts can be made at a maximum slope of 1.5H:1V, and in the unsaturated native advance outwash sands and gravels and the very stiff to hard silts at 1H:1V. As is typical with earthwork operations, some sloughing and raveling may occur and cut slopes may have to be adjusted in the field. In addition, WISHA/OSHA regulations should be followed at all times.

## 9.2 Moisture-Sensitive Soils

The on-site soils contain a high percentage of fine-grained material, which makes them moisture-sensitive and subject to disturbance when wet. The contractor must use care during site preparation and excavation operations so that the underlying soils are not softened. If disturbance occurs, the softened soils should be removed and the area brought to grade with structural fill. Consideration should be given to protecting access and staging areas with an appropriate section of crushed rock or asphalt treated base (ATB).

If crushed rock is considered for the access and staging areas, it should be underlain by engineering stabilization fabric to reduce the potential of fine-grained materials pumping up through the rock and turning the area to mud. The fabric will also aid in supporting construction equipment, thus reducing the amount of crushed rock required. We recommend that at least 10 inches of rock be placed over the fabric; however, due to the variable nature of the near-surface soils and differences in wheel loads, this thickness may have to be adjusted by the contractor in the field.

# 10.0 STRUCTURAL FILL

Due to the slopes on the site, structural fill will be necessary to establish desired grades. All references to structural fill in this report refer to subgrade preparation, fill type, placement, and compaction of materials as discussed in this section. If a percentage of compaction is specified under another section of this report, the value given in that section should be used.

## 10.1 Subgrade Keying and Benching

If fill is to be placed on slopes steeper than 5H:1V, the base of the fill should be tied to firm, stable subsoil by appropriate keying and benching, which would be established in the field to suit the particular soil conditions at the time of grading. The keyway will act as a shear key to embed the toe of the new fill into the hillside, including the embedment of the proposed MSE wall systems into underlying very stiff to hard Lawton Clay deposits. Generally, the keyway for hillside fills should be at least 8 feet wide and cut into the lower, dense sand or stiff silt. Level benches would then be cut horizontally across the hill following the contours of the slope. No specific width is required for the benches, although they are usually a few feet wider than the dozer being used to cut them. All fills proposed over a slope should be reviewed by our office prior to construction.

We recommend that AESI observe exposed subgrades prior to fill placement. Should wet subgrade conditions be present, we recommend that the wet subgrade areas for fills planned along the slopes be equipped with subfill drains. Subfill drains may consist of a 1- to 2-foot-thick section of free-draining aggregate placed below the fill and covered with a

geotextile fabric. The aggregate should be compacted to 95 percent of the modified Proctor maximum density using *American Society for Testing and Materials* (ASTM) D-1557 as the standard or to a firm and unyielding condition as determined by the geotechnical engineer or his representative. The subfill drains will allow hydrostatic forces, if present, to disperse.

## 10.2 Fill Subgrade Preparation

After overexcavation/stripping has been performed to the satisfaction of the geotechnical engineer/engineering geologist, the upper 12 inches of exposed ground should be recompacted to 90 percent of the modified Proctor maximum density using ASTM D-1557 as the standard or to a firm and unyielding condition as determined by the geotechnical engineer or his representative. If the subgrade contains too much moisture, adequate recompaction may be difficult or impossible to obtain and should probably not be attempted. In lieu of recompaction, the area to receive fill should be blanketed with washed rock or quarry spalls to act as a capillary break between the new fill and the wet subgrade. Where the exposed ground remains soft and further overexcavation is impractical, placement of an engineering stabilization fabric may be necessary to prevent contamination of the free-draining layer by silt migration from below.

## 10.3 Structural Fill Placement and Compaction

After the recompacted ground is tested and approved or a free-draining rock course is laid, structural fill may be placed to attain desired grades. Structural fill is defined as non-organic soil, acceptable to the geotechnical engineer, placed in maximum 10-inch loose lifts with each lift being compacted to at least 95 percent of the modified Proctor maximum density using ASTM D-1557 as the standard. In the case of roadway and utility trench filling, the backfill should be placed and compacted in accordance with current local or county codes and standards. The top of the compacted fill should extend horizontally outward a minimum distance of 3 feet beyond the location of the perimeter footings or roadway edge before sloping down at an angle of 2H:1V.

## 10.4 Moisture-Sensitive Fill Materials

Soils in which the amount of fine-grained material (smaller than the No. 200 sieve) is greater than approximately 5 percent (measured on the minus No. 4 sieve size) should be considered moisture-sensitive. Use of moisture-sensitive soil in structural fills should be limited to favorable dry weather conditions. The on-site soils generally contained significant amounts of silt and are considered moisture-sensitive. In addition, construction equipment traversing the site when the soils are wet can cause considerable disturbance. Due to the sloping, potentially wet conditions at the subject site, and the proposed structures, roadways, utilities, and rockeries planned for these slope conditions, a select import material consisting of a clean,

free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil with the amount of fine-grained material limited to 5 percent by weight when measured on the minus No. 4 sieve fraction. We recommend that imported structural fill conform to Washington State Department of Transportation (WSDOT) Specification 9-03.14(1) (gravel borrow) or similar as determined by the geotechnical engineer.

### 10.5 Structural Fill Testing

The contractor should note that any proposed fill soils must be evaluated by AESI prior to their use in fills. This would require that we have a sample of the material 48 hours in advance of filling activities to perform a Proctor test and determine its field compaction standard. A representative from our firm should inspect the stripped subgrade and be present during placement of structural fill to observe the work and perform a representative number of in-place density tests. In this way, the adequacy of the earthwork may be evaluated as filling progresses and problem areas may be corrected at that time. It is important to understand that taking random compaction tests on a part-time basis will not assure uniformity or acceptable performance of a fill. As such, we are available to aid the owner in developing a suitable monitoring and testing frequency.

## 11.0 FOUNDATIONS

Spread footings may be used for building support when founded on medium dense recessional outwash soils, dense to very dense advance outwash soils, stiff to hard transitional beds, or structural fill placed as previously discussed. We recommend that an allowable bearing pressure of 2,000 psf be utilized for design purposes, including both dead and live loads. An increase of one-third may be used for short-term wind or seismic loading. Perimeter footings should be buried at least 18 inches into the surrounding soil for frost protection. However, all footings must penetrate to the prescribed bearing stratum and no footing should be founded in or above loose, organic, or existing fill soils.

It should be noted that the area bounded by lines extending downward at 1H:1V from any footing must not intersect another footing or intersect a filled area, which has not been compacted to at least 95 percent of ASTM D-1557. In addition, a 1.5H:1V line extending down from any footing must not daylight because sloughing or raveling may eventually undermine the footing. Thus, footings should not be placed near the edge of steps or cuts in the bearing soils.

Anticipated settlement of footings founded on medium dense to very dense outwash soils, stiff to hard transitional bed silts, or approved structural fill should be on the order of 1 inch. However, disturbed soil not removed from footing excavations prior to footing placement

could result in increased settlements. All footing areas should be inspected by AESI prior to placing concrete to verify that the design bearing capacity of the soils has been attained and that construction conforms to the recommendations contained in this report. Such inspections may be required by the City of Kirkland. Perimeter footing drains should be provided as discussed under the section on "Drainage Considerations."

## 12.0 LATERAL WALL PRESSURES

All backfill behind walls or around foundations should be placed following our recommendations for structural fill and as described in this section of the report. Horizontally backfilled walls, which are free to yield laterally at least 0.1 percent of their height, may be designed using an equivalent fluid equal to 35 pounds per cubic foot (pcf). Fully restrained, horizontally backfilled, rigid walls that cannot yield should be designed for an equivalent fluid of 50 pcf. Walls that retain sloping backfill at a maximum angle of 2H:1V should be designed for 55 pcf for yielding conditions and 75 pcf for restrained conditions. If parking areas are adjacent to walls, a surcharge equivalent to 2 feet of soil should be added to the wall height in determining lateral design forces. Undrained walls/structures must be designed for combined soil and hydrostatic pressures (85 pcf for yielding walls, 100 pcf for unyielding walls with horizontal backfill) and for buoyant/uplift forces.

In accordance with the 2015 IBC, retaining wall design should include seismic design parameters. Based on the site soils and assumed wall backfill materials, we recommend a seismic surcharge pressure in addition to the equivalent fluid pressures presented above. A rectangular pressure distribution of 4H and 8H psf (where H is the height of the wall in feet) should be included in design for "active" and "at-rest" loading conditions, respectively. The resultant of the rectangular seismic surcharge should be applied at the midpoint of the walls.

### 12.1 Wall Backfill

The lateral pressures presented above are based on the conditions of a uniform backfill consisting of either the on-site glacial sediments, or imported sand and gravel compacted to 92 percent of ASTM D-1557. A higher degree of compaction is not recommended, as this will increase the pressure acting on the walls. A lower compaction may result in unacceptable settlement behind the walls. Thus, the compaction level is critical and must be tested by our firm during placement. The recommended compaction of 92 percent of ASTM D-1557 applies to any structural fill placed behind the wall within a distance equal to the wall height and up to the elevation of the top of the wall. Structural fill used to construct slopes behind retaining walls should be compacted to at least 95 percent of ASTM D-1557 if the fill is placed above the elevation of the top of the wall. Surcharges from adjacent footings, heavy construction equipment, or sloping ground must be added to the above-recommended lateral pressures.

Footing drains should be provided for all retaining walls, as discussed under the "Drainage Considerations" section of this report.

### 12.2 Wall Drainage

It is imperative that proper drainage be provided so that hydrostatic pressures do not develop against the walls. This would involve installation of a minimum, 1-foot-wide blanket drain for the full wall height (excluding the uppermost 1 foot of backfill) using imported washed gravel against the walls. The wall drain material must be hydraulically connected to the footing drain pipe. Wall foundation drains are discussed in Section 15.0 of this report.

### 12.3 Passive Resistance and Friction Factor

Lateral loads can be resisted by friction between the foundation and the natural, medium dense to very dense sediments or supporting structural fill soils, or by passive earth pressure acting on the buried portions of the foundations. The foundations must be backfilled with compacted structural fill to achieve the passive resistance provided below. We recommend the following allowable design parameters.

- Passive equivalent fluid = 250 pcf
- Coefficient of friction = 0.30

## 13.0 FLOOR SUPPORT

Slab-on-grade floors may be constructed either directly on the medium dense to very dense natural sediments, or on structural fill placed over these materials. Areas of the slab subgrade that are disturbed (loosened) during construction should be recompacted to an unyielding condition prior to placing the pea gravel, as described below.

If moisture intrusion through slab-on-grade floors is to be limited, the floors should be constructed atop a capillary break consisting of a minimum thickness of 4 inches of washed pea gravel. The pea gravel should be overlain by a 10-mil (minimum thickness) plastic vapor retarder.

## 14.0 DRAINAGE CONSIDERATIONS

The underlying, glacially compacted soils are relatively impermeable and water will tend to perch atop this stratum. Additionally, traffic across these soils when they are damp or wet will result in disturbance of the otherwise firm stratum. Therefore, prior to site work and

construction, the contractor should be prepared to provide temporary drainage and subgrade protection, as necessary.

All retaining and perimeter footing walls should be provided with a drain at the footing elevation. The drains should consist of rigid, perforated, PVC pipe surrounded by washed pea gravel. The level of the perforations in the pipe should be set approximately 2 inches below the bottom of the footing, and the drains should be constructed with sufficient gradient to allow gravity discharge away from the buildings. All retaining walls should be lined with a minimum, 12-inch-thick, washed gravel blanket provided to within 1 foot of finish grade, and which ties into the footing drain. Roof and surface runoff should not discharge into the footing drain system, but should be handled by a separate, rigid, tightline drain.

Exterior grades adjacent to walls should be sloped downward away from the structures to achieve surface drainage. Final exterior grades should promote free and positive drainage away from the buildings at all times. Water must not be allowed to pond or to collect adjacent to foundations or within the immediate building areas. It is recommended that a gradient of at least 3 percent for a minimum distance of 10 feet from the building perimeters be provided, except in paved locations. In paved locations, a minimum gradient of 1 percent should be provided unless provisions are included for collection and disposal of surface water adjacent to the structures. Additionally, pavement subgrades should be crowned to provide drainage toward catch basins and pavement edges. Crawl space areas should be provided with drains at low points to prevent water from accumulating.

## 15.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

At the time of this report, site grading, structural plans, and construction methods have not been finalized. We are available to provide additional geotechnical consultation, including MSE wall design services, as the project design develops and possibly changes from that upon which this report is based. We recommend that AESI perform a geotechnical review of the plans prior to final design completion. In this way, our earthwork and foundation recommendations may be properly interpreted and implemented in the design. This plan review is not included in the current scope of work and budget.

We are also available to provide geotechnical engineering and monitoring services during construction. The integrity of the foundations depends on proper site preparation and construction procedures. In addition, engineering decisions may have to be made in the field in the event that variations in subsurface conditions become apparent. Construction monitoring services are not part of this current scope of work. If these services are desired, please let us know and we will prepare a cost proposal.

We have enjoyed working with you on this study and are confident these recommendations will aid in the successful completion of your project. If you should have any questions or require further assistance, please do not hesitate to call.

Sincerely,
**ASSOCIATED EARTH SCIENCES, INC.**
**Kirkland, Washington**

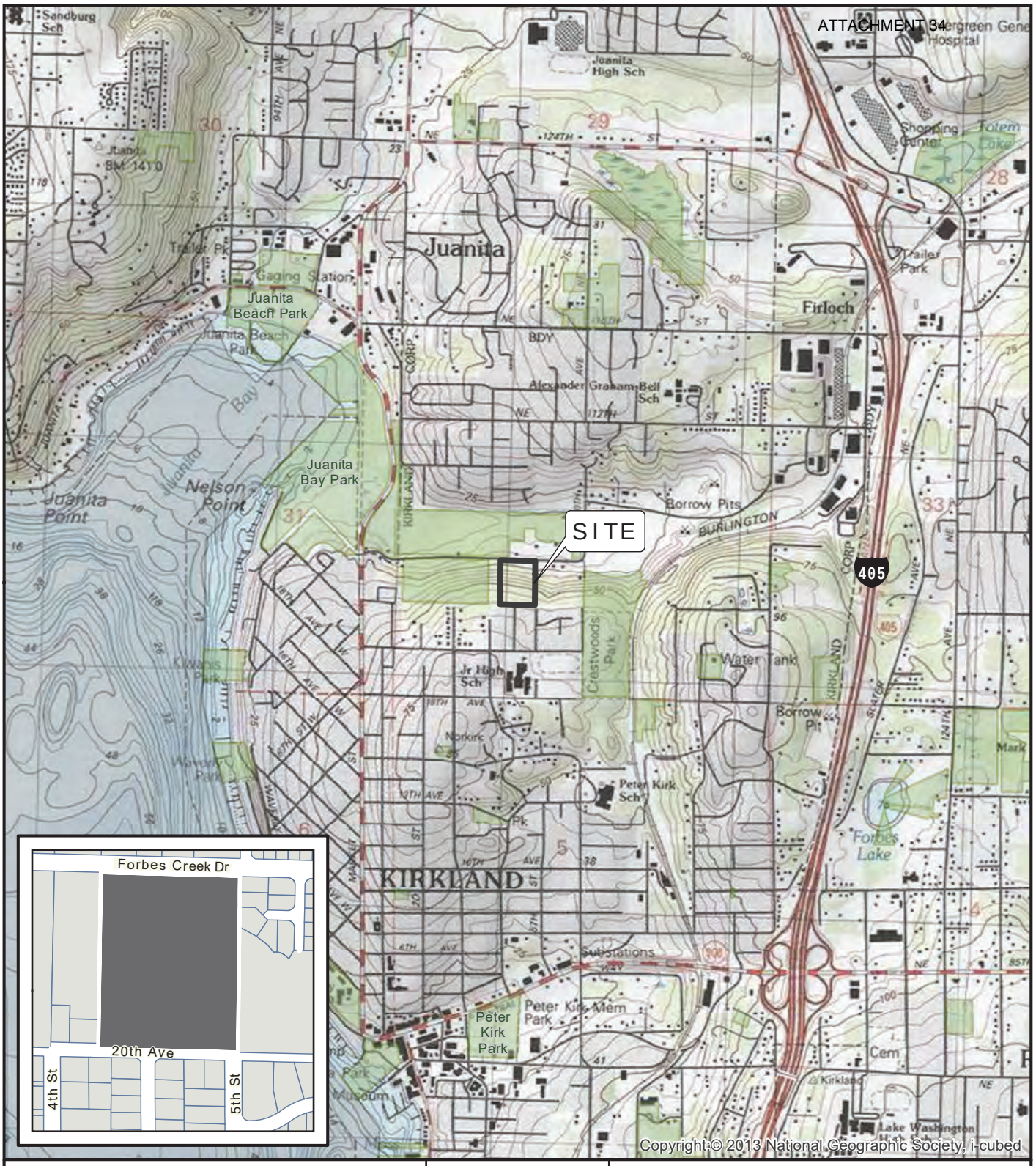
- FOR -

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

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

Attachments:

| | |
|---|---|
| Figure 1: | Vicinity Map |
| Figure 2: | Site and Exploration Plan |
| Figure 3: | Slope Stability - Existing - Cross-Section A-A' (seismic) |
| Figure 4: | Slope Stability - Existing - Cross-Section A-A' (static) |
| Figure 5: | Slope Stability - Proposed - Cross-Section A-A' (seismic) |
| Figure 6: | Slope Stability -Proposed - Cross-Section A-A' (static) |
| Figure 7: | Slope Stability - Existing - Cross-Section B-B' (seismic) |
| Figure 8: | Slope Stability - Existing - Cross-Section B-B' (static) |
| Figure 9: | Slope Stability - Proposed - Cross-Section B-B' (seismic) |
| Figure 10: | Slope Stability - Proposed - Cross-Section B-B' (static) |
| Figure 11: | Slope Stability - Existing - Cross-Section C-C' (seismic) |
| Figure 12: | Slope Stability- Existing - Cross-Section C-C' (static) |
| Figure 13: | Slope Stability - Proposed - Cross-Section C-C' (seismic) |
| Figure 14: | Slope Stability - Proposed - Cross-Section C-C' (static) |
| Figure 15: | Slope Stability - Existing - Cross-Section D-D' (seismic) |
| Figure 16: | Slope Stability - Existing - Cross-Section D-D' (static) |
| Figure 17: | Slope Stability - Proposed - Cross-Section D-D' (seismic) |
| Figure 18: | Slope Stability - Proposed - Cross-Section D-D' (static) |
| Appendix: | Exploration Logs |
| | "Site Reconnaissance - Wetland 'A'" letter, dated October 13, 2016 |
| | Ground Water Elevation and Daily Rainfall vs Time |



DATA SOURCES / REFERENCES:
USGS: 7.5' SERIES TOPOGRAPHIC MAPS, ESRI/I-CUBED/NGS 2013
KING CO: STREETS, PARCELS, CITY LIMITS 1/18

LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

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# VICINITY MAP

LONDO FORBES CREEK
KIRKLAND, WASHINGTON

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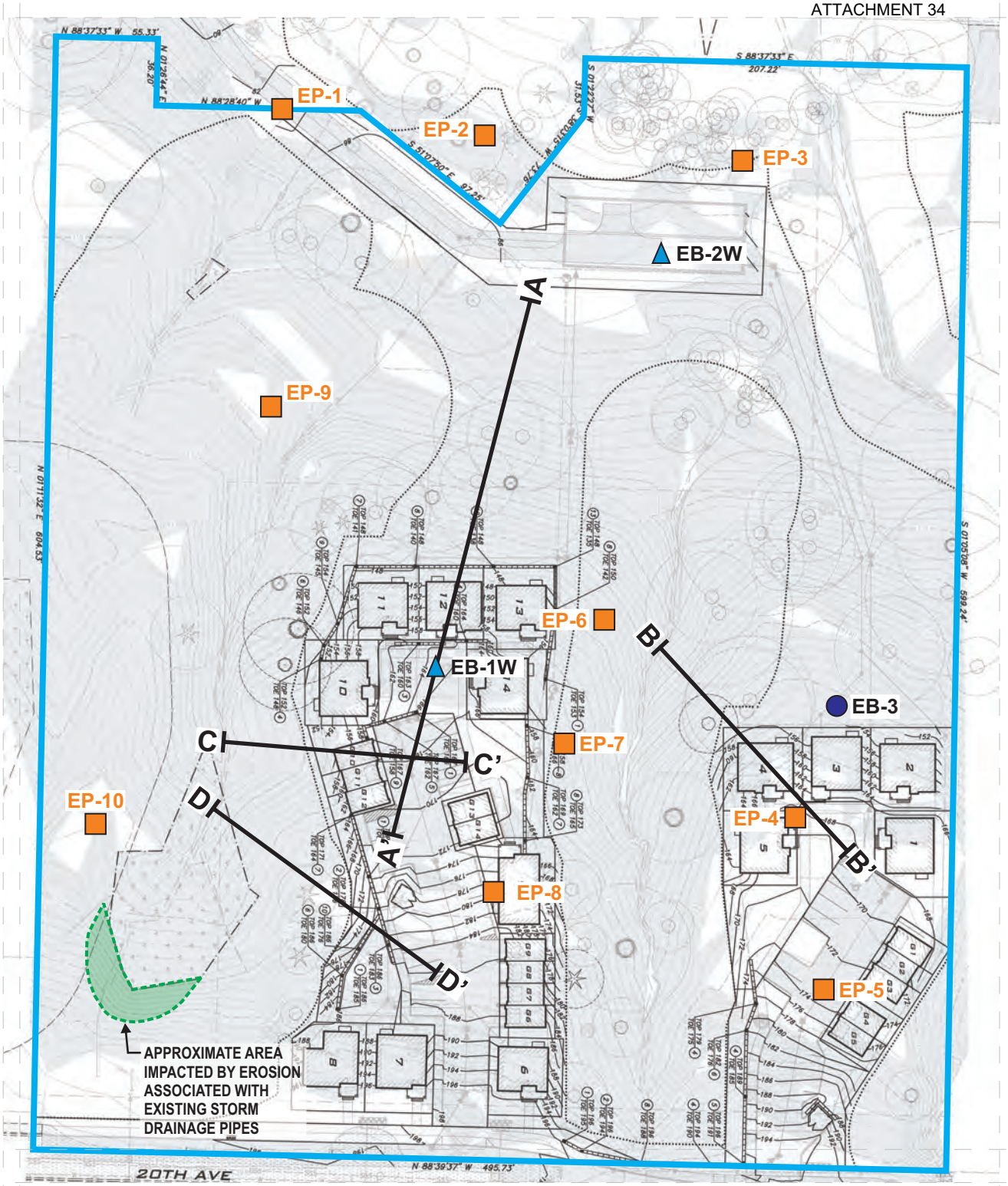


**LEGEND:**

- SITE BOUNDARY
- EP — EXPLORATION PIT
- EB — EXPLORATION BORING
- EB — MONITORING WELL
- >15% SLOPES
- EROSION IMPACT AREA

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.
BASE MAP REFERENCE: BLUELINE, ORCAS MOON COTTAGES, PRELIMINARY GRADING PLAN, SHEET 7 OF 11, 10/23/18

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# SITE AND EXPLORATION PLAN

LONDO FORBES CREEK
KIRKLAND, WASHINGTON

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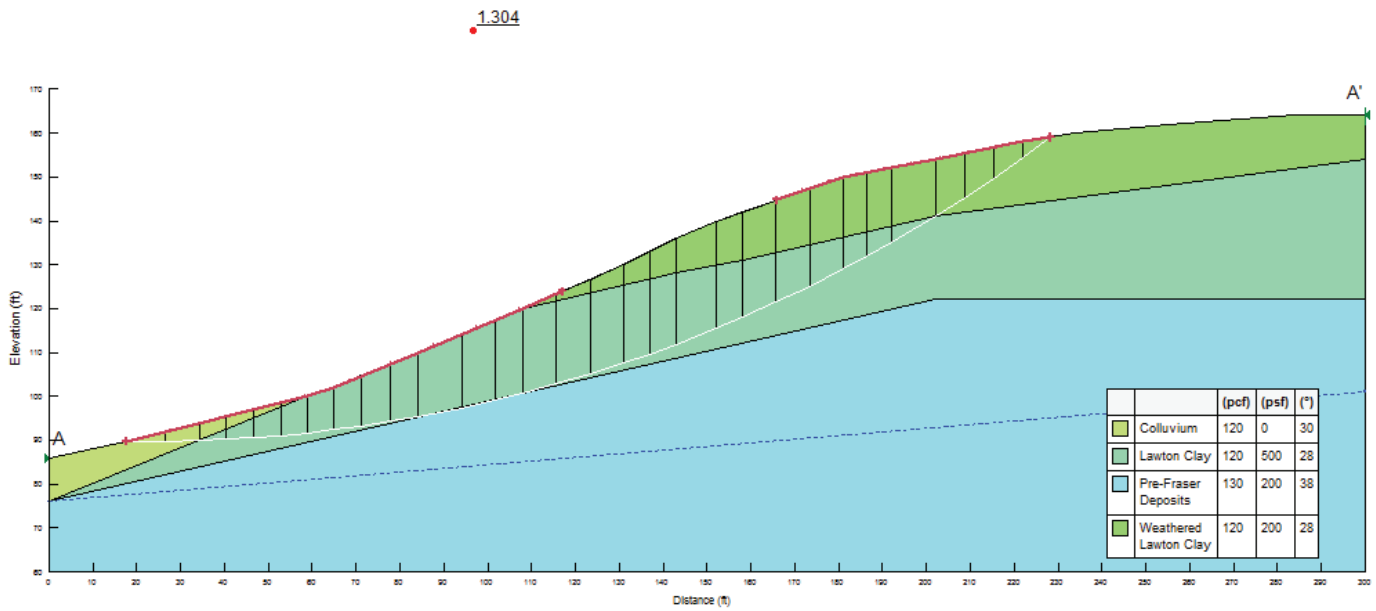


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SLOPE STABILITY - EXISTING
CROSS-SECTION A - A' SEISMIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

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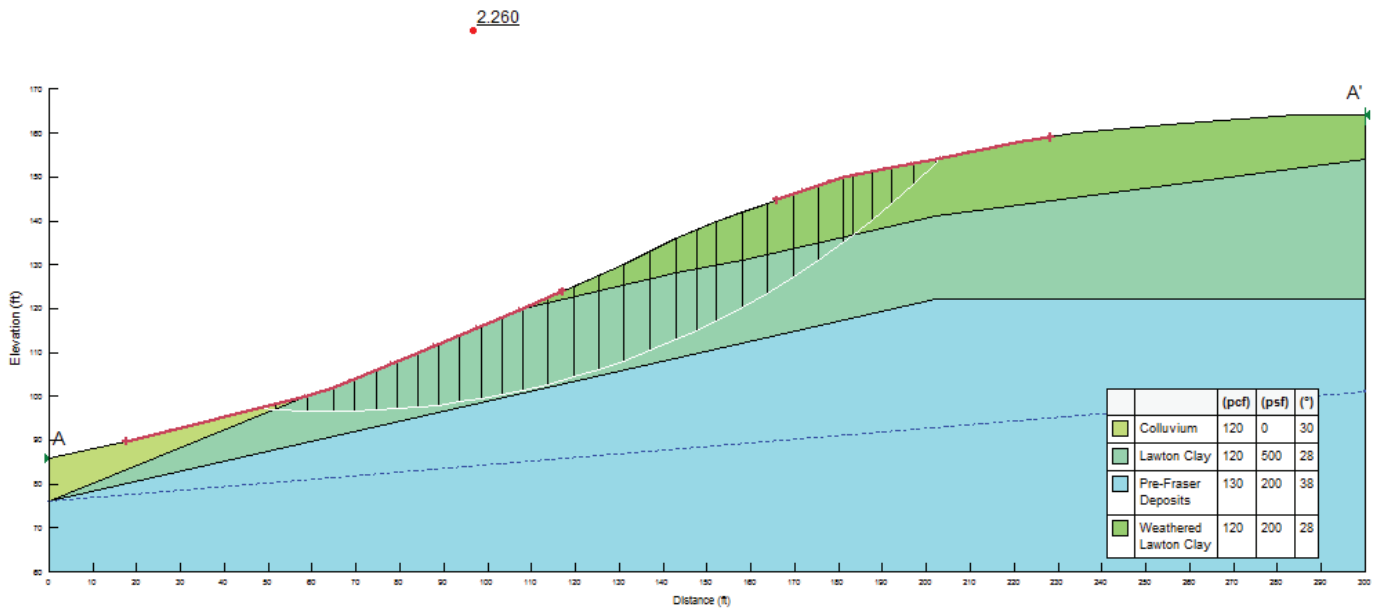


NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

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SLOPE STABILITY - EXISTING CROSS-SECTION A - A' STATIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

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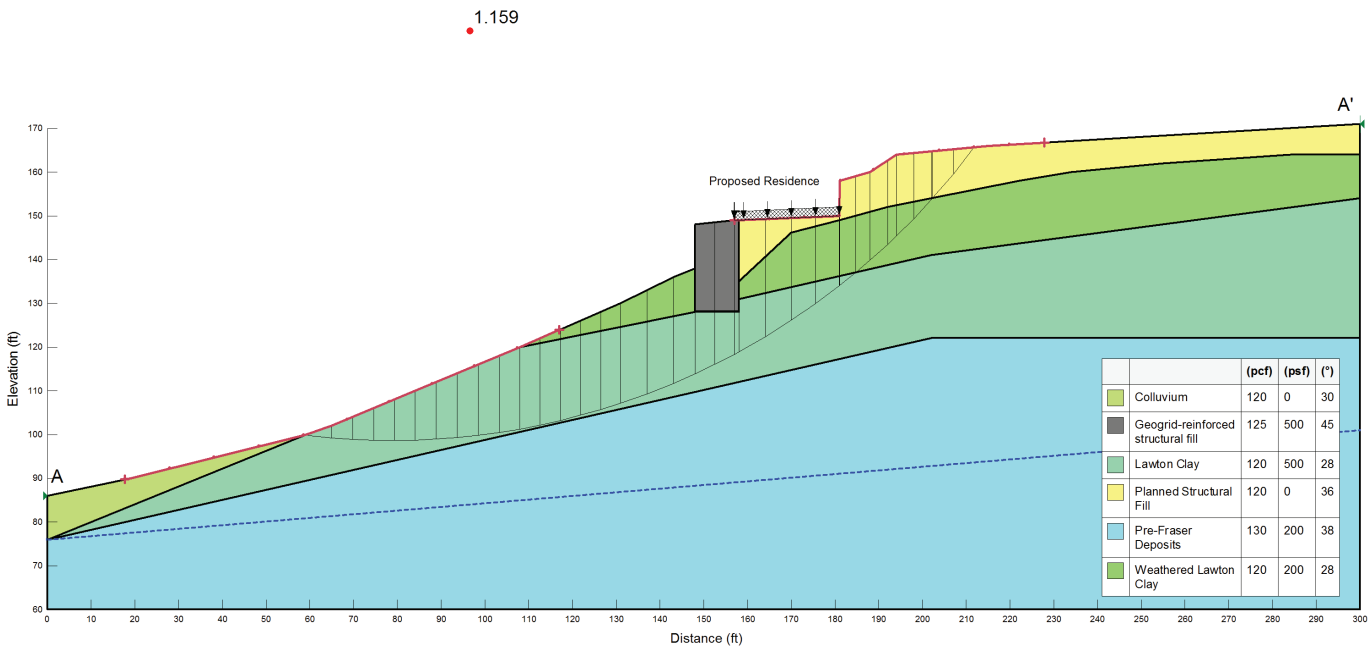


| | | (pcf) | (psf) | (°) |
|---|---|---|---|---|
| | Colluvium | 120 | 0 | 30 |
| | Geogrid-reinforced structural fill | 125 | 500 | 45 |
| | Lawton Clay | 120 | 500 | 28 |
| | Planned Structural Fill | 120 | 0 | 36 |
| | Pre-Fraser Deposits | 130 | 200 | 38 |
| | Weathered Lawton Clay | 120 | 200 | 28 |

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

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SLOPE STABILITY - PROPOSED CROSS-SECTION A - A' SEISMIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

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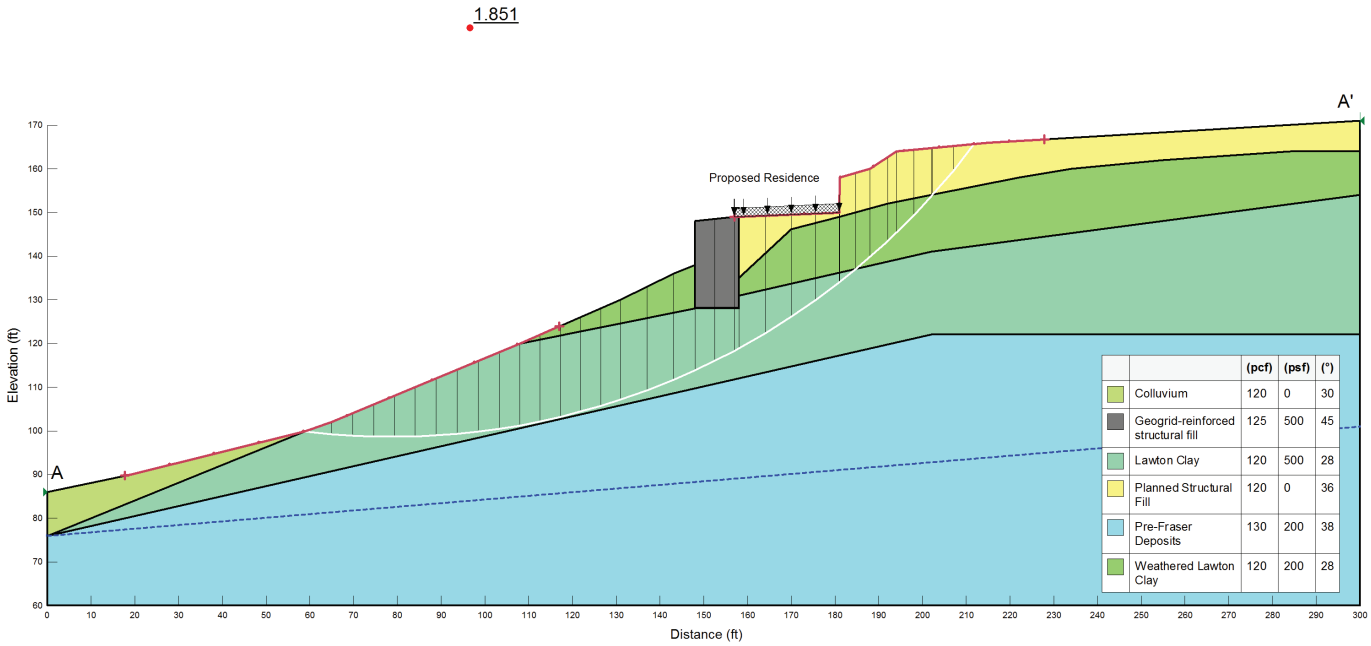


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|---|---|---|---|---|
| | Colluvium | 120 | 0 | 30 |
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SLOPE STABILITY - PROPOSED CROSS-SECTION A - A' STATIC

LONDO FORBES CREEK

KIRKLAND, WASHINGTON

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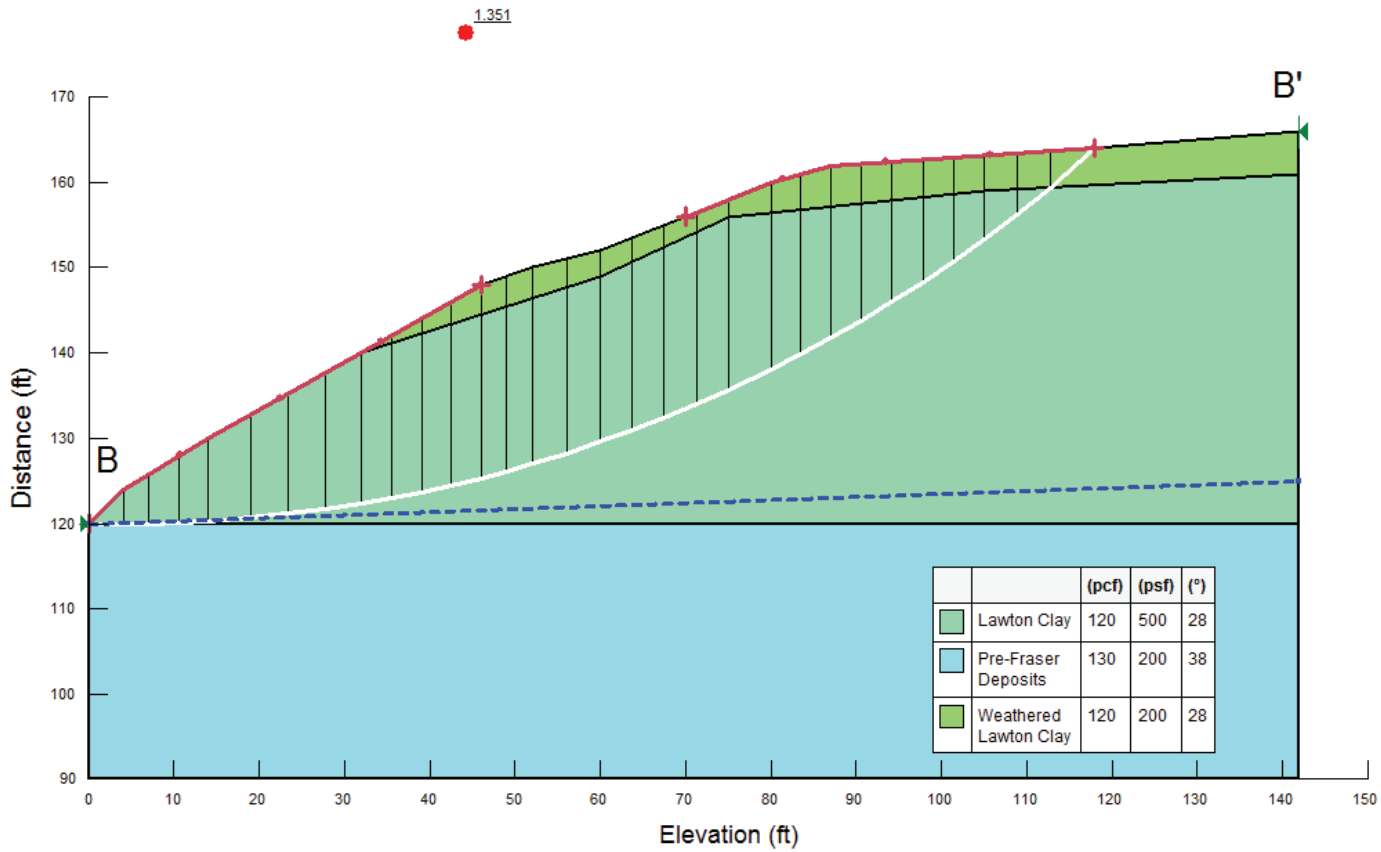


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SLOPE STABILITY - EXISTING
CROSS-SECTION B - B' SEISMIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

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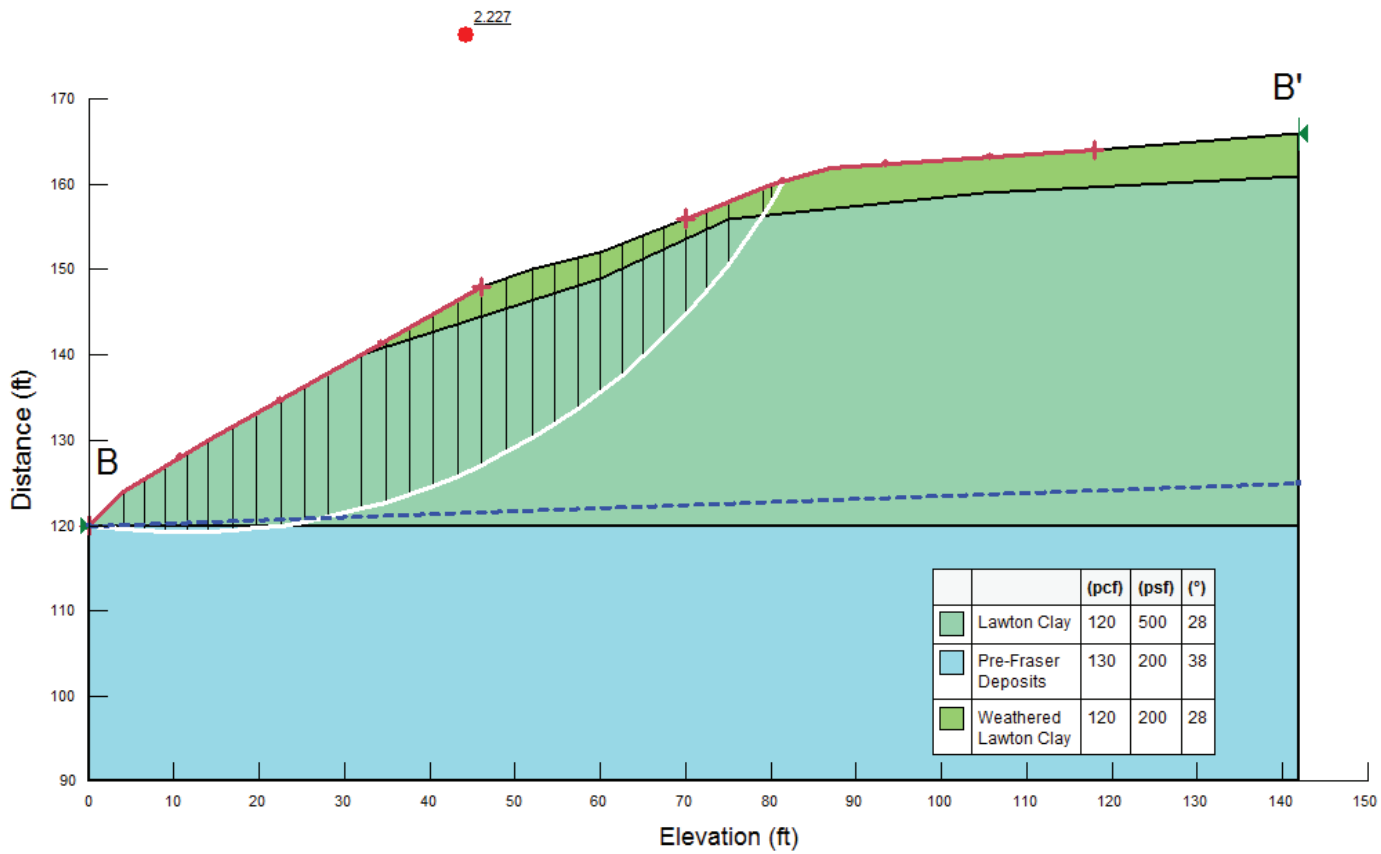


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SLOPE STABILITY - EXISTING
CROSS-SECTION B - B' STATIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

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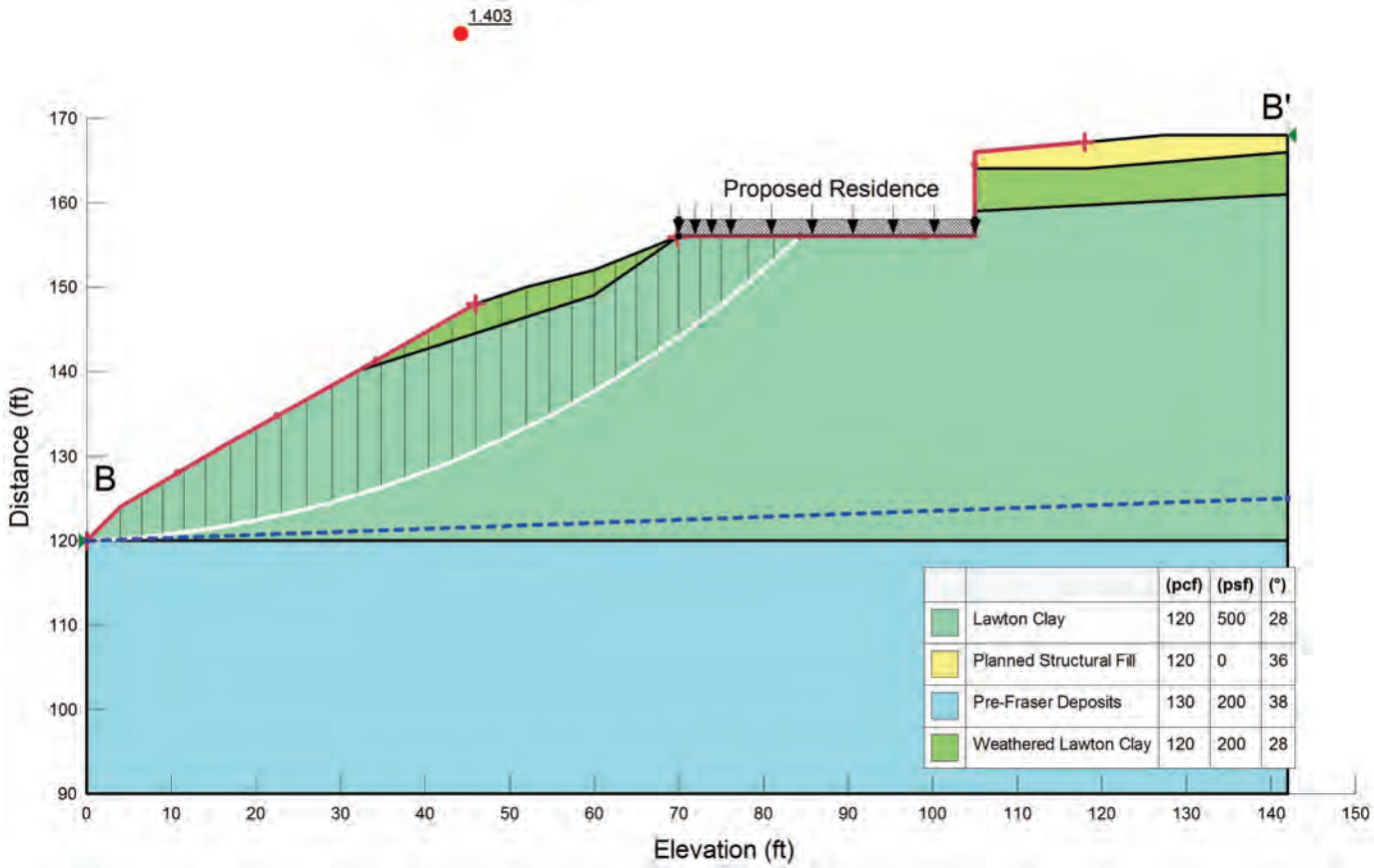


| | (pcf) | (psf) | (°) |
|---|---|---|---|
| Lawton Clay | 120 | 500 | 28 |
| Planned Structural Fill | 120 | 0 | 36 |
| Pre-Fraser Deposits | 130 | 200 | 38 |
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SLOPE STABILITY - PROPOSED CROSS-SECTION B - B' SEISMIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

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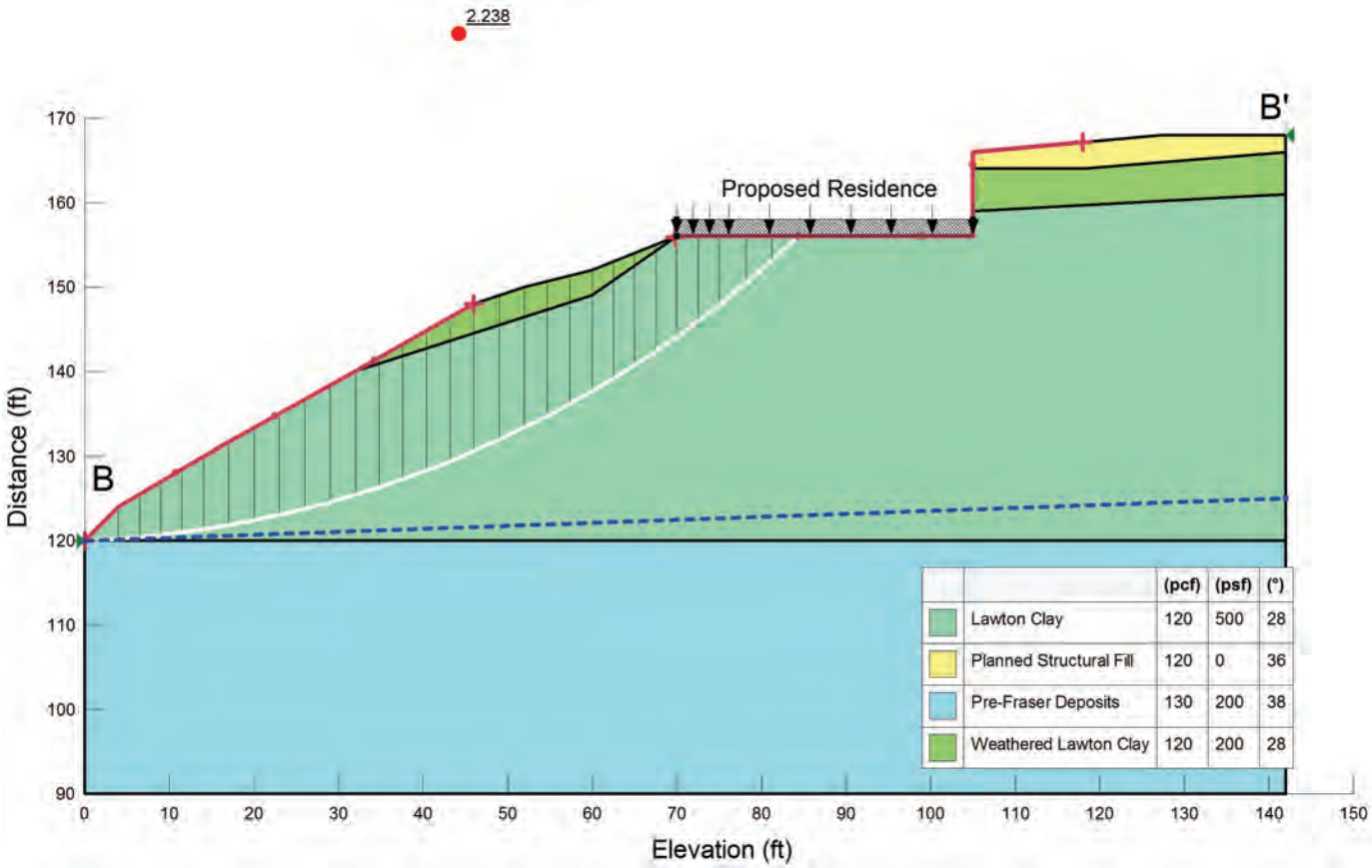


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SLOPE STABILITY - PROPOSED CROSS-SECTION B - B' STATIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

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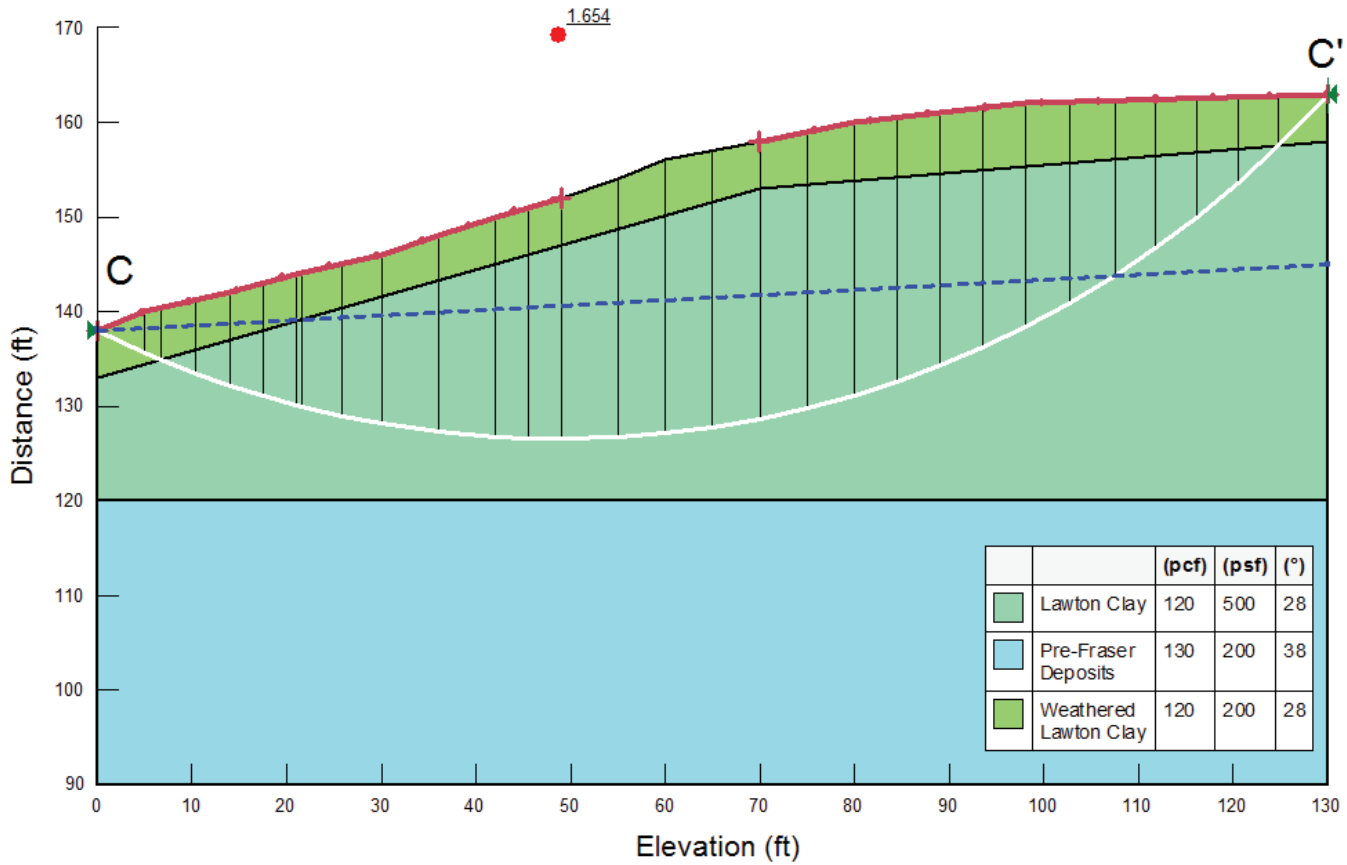


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SLOPE STABILITY - EXISTING
CROSS-SECTION C - C' SEISMIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

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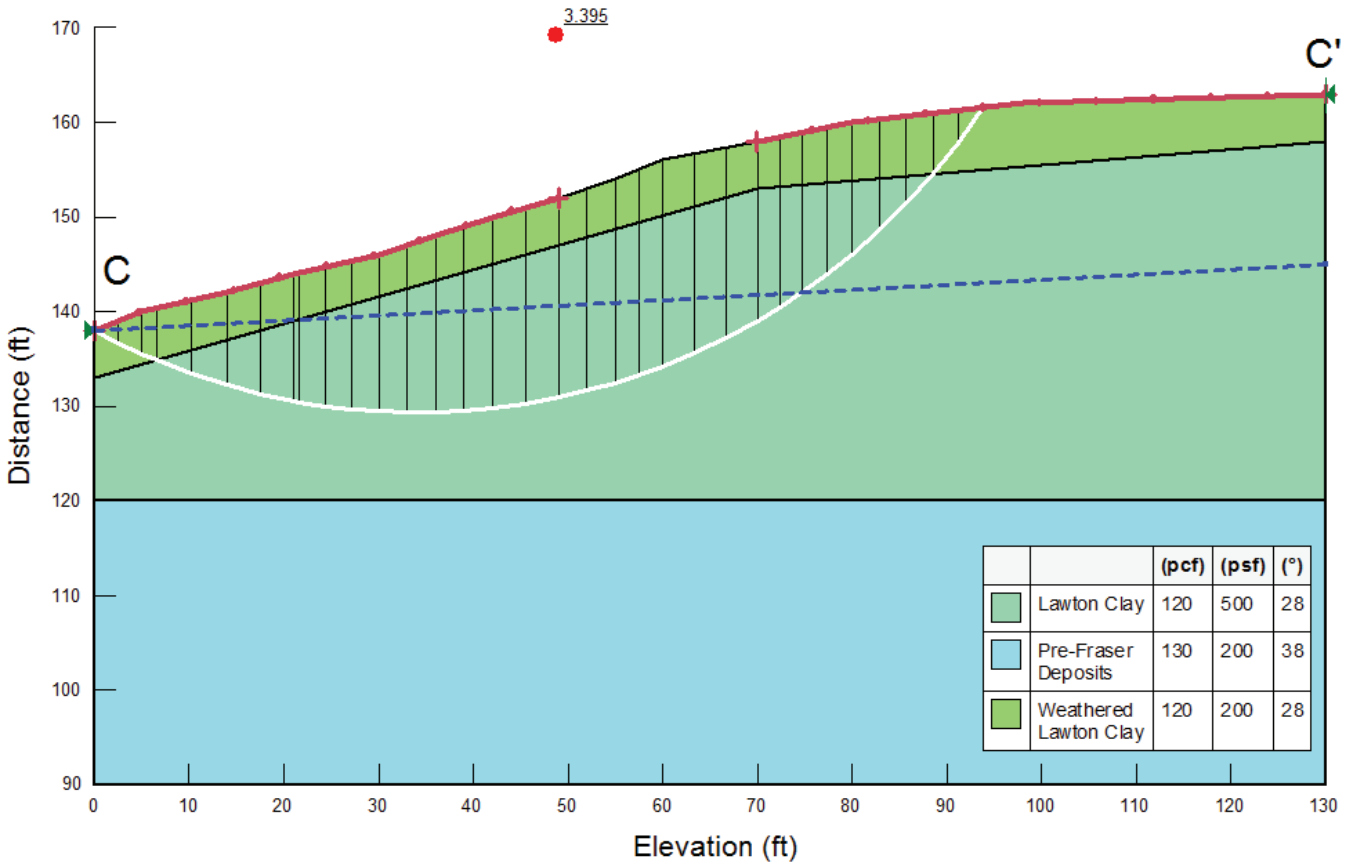


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SLOPE STABILITY - EXISTING
CROSS-SECTION C - C' STATIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

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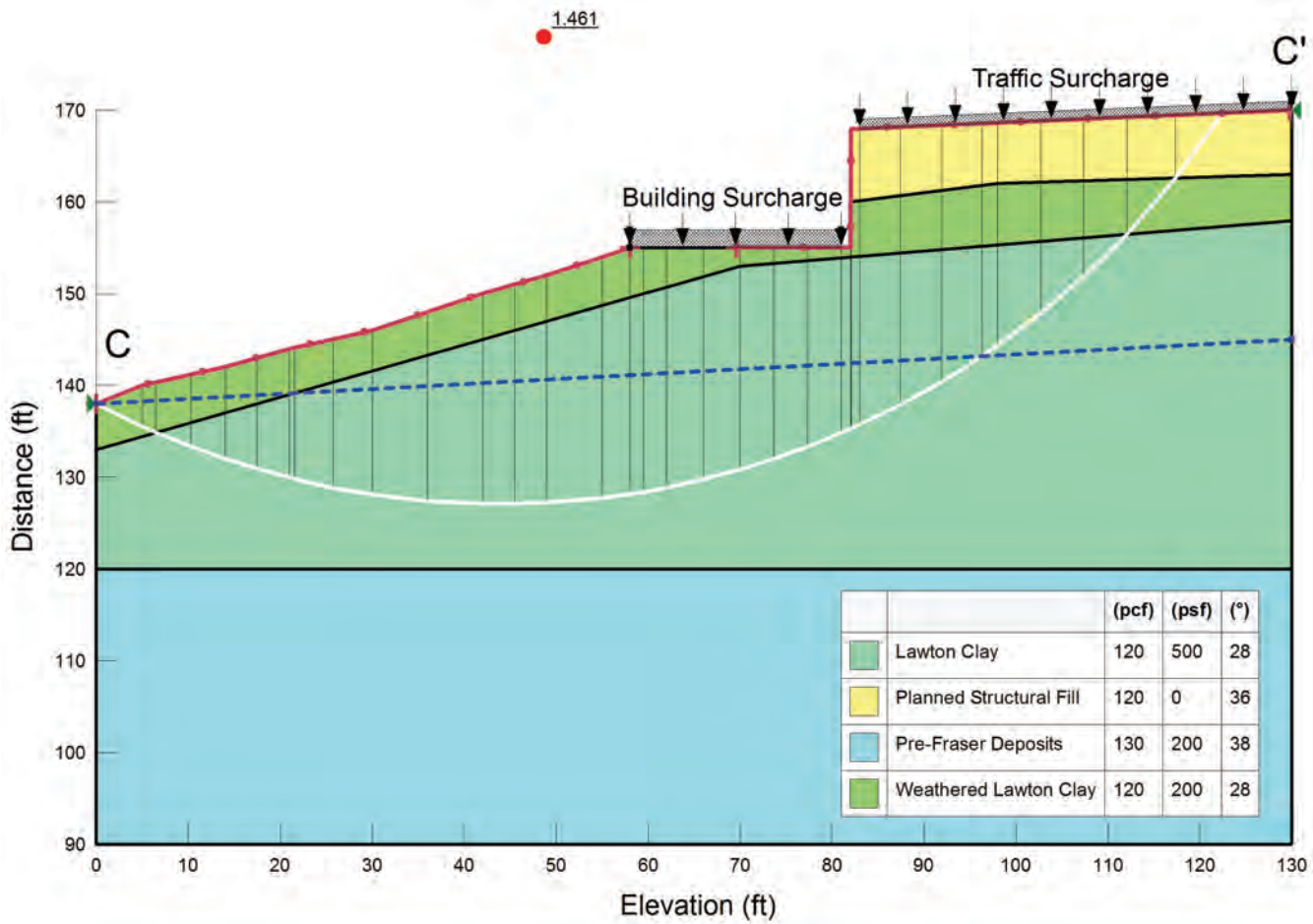


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SLOPE STABILITY - PROPOSED CROSS-SECTION C - C' SEISMIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

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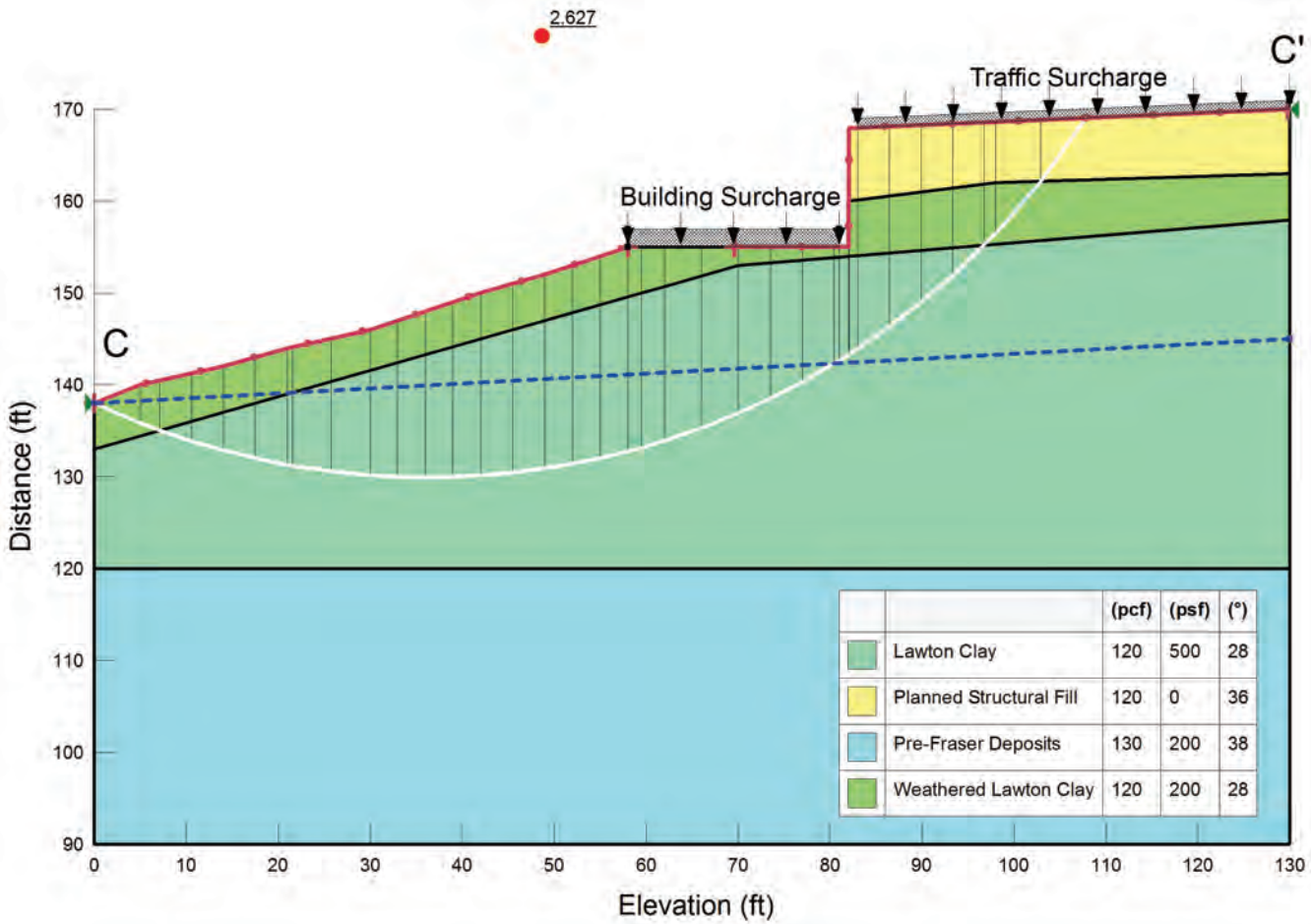


NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

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SLOPE STABILITY - PROPOSED CROSS-SECTION C - C' STATIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

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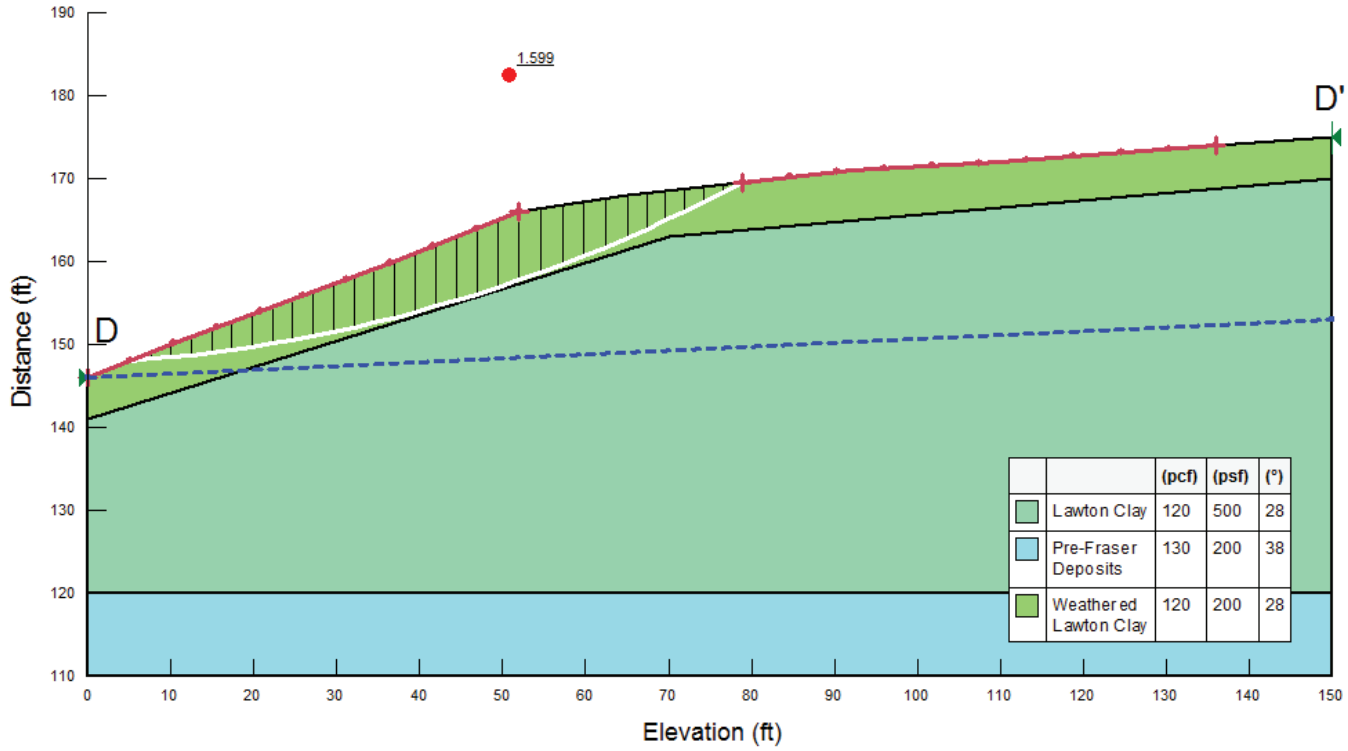
| 160384E001 | 10/18 | 14 |

160384 Londo Forbes \ 160384E001 F14 SS C-C 10-18.cdr




NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

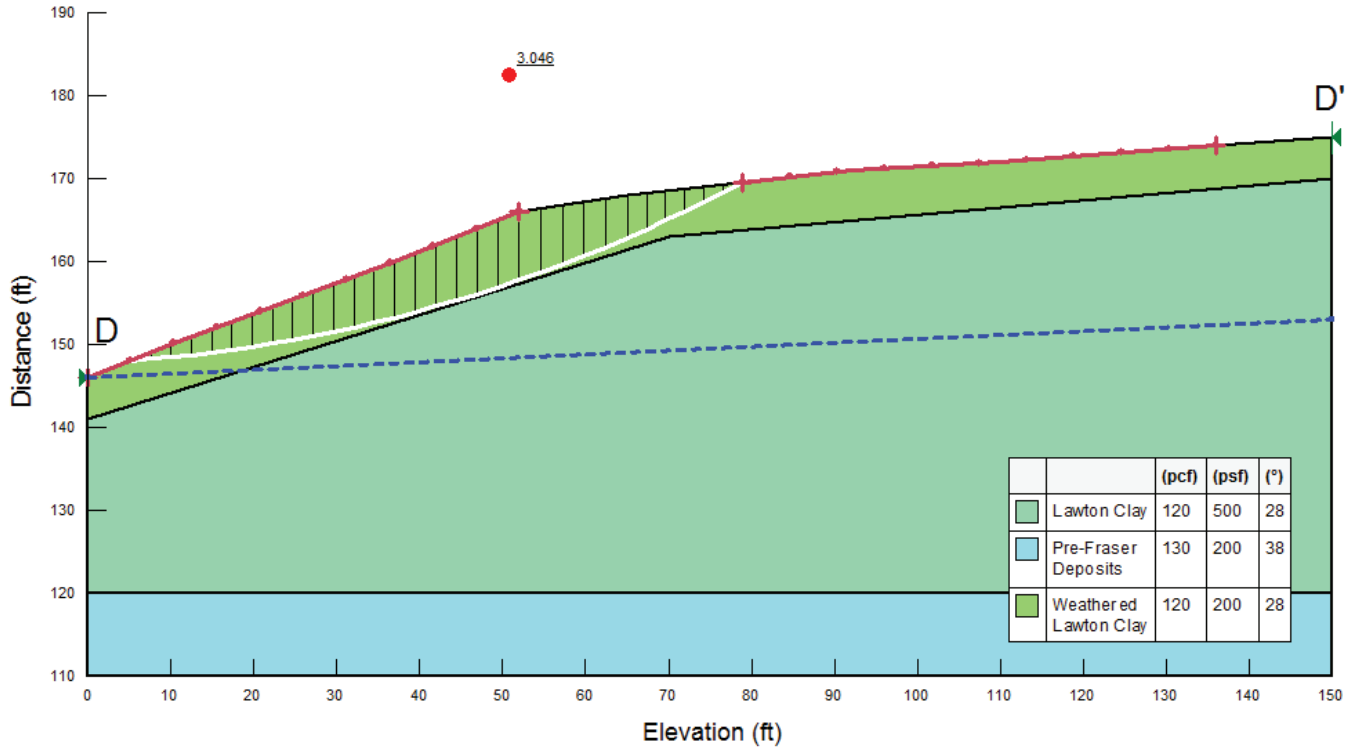
BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION.

associated earth sciences incorporated

SLOPE STABILITY - EXISTING
CROSS-SECTION D - D' SEISMIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
|---|---|---|
| 160384E001 | 10/18 | 15 |

160384 Londo Forbes \ 160384E001 F15 SS D-D 10-18.cdr




NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION.

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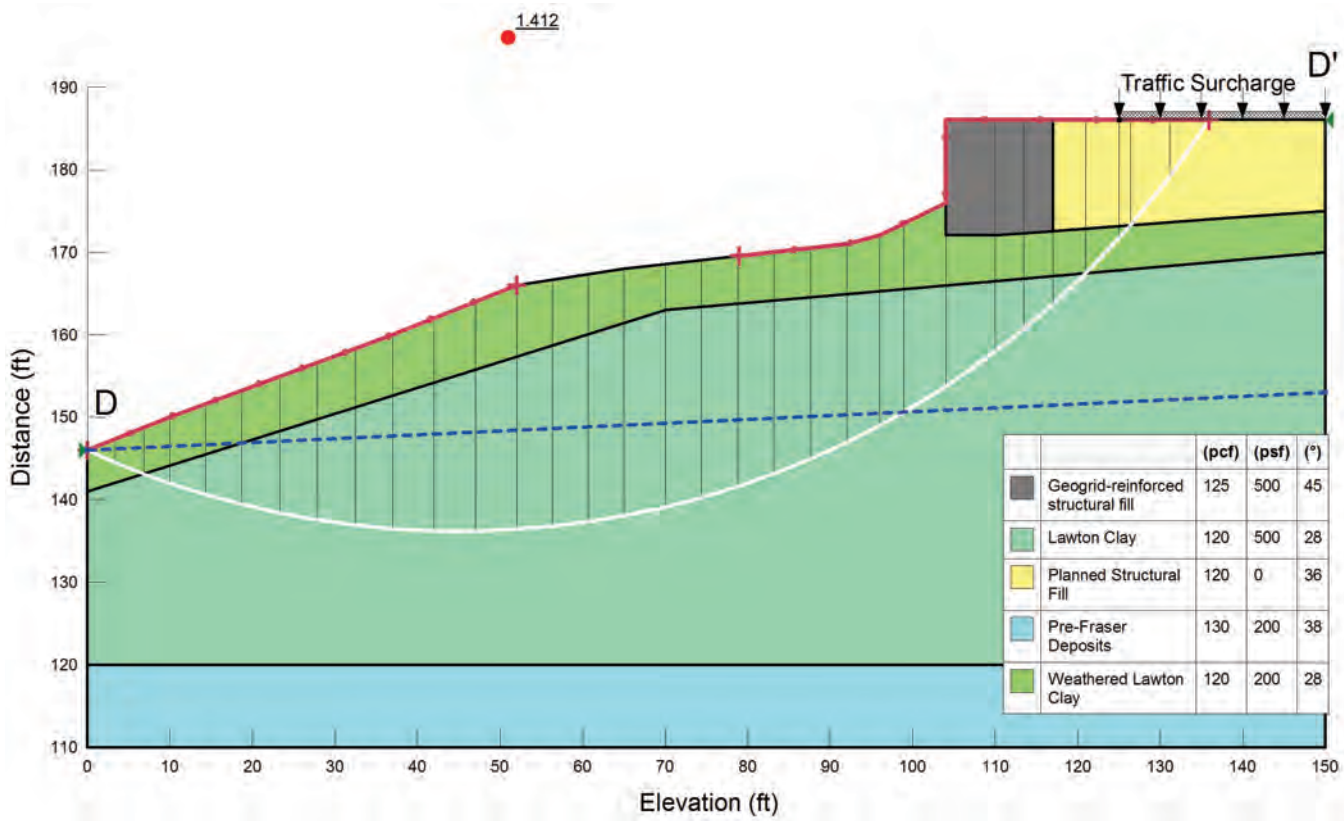
SLOPE STABILITY - EXISTING
CROSS-SECTION D - D' STATIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
|---|---|---|
| 160384E001 | 10/18 | 16 |

160384 Londo Forbes \ 160384E001 F16 SS D-D 10-18.cdr




NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION.

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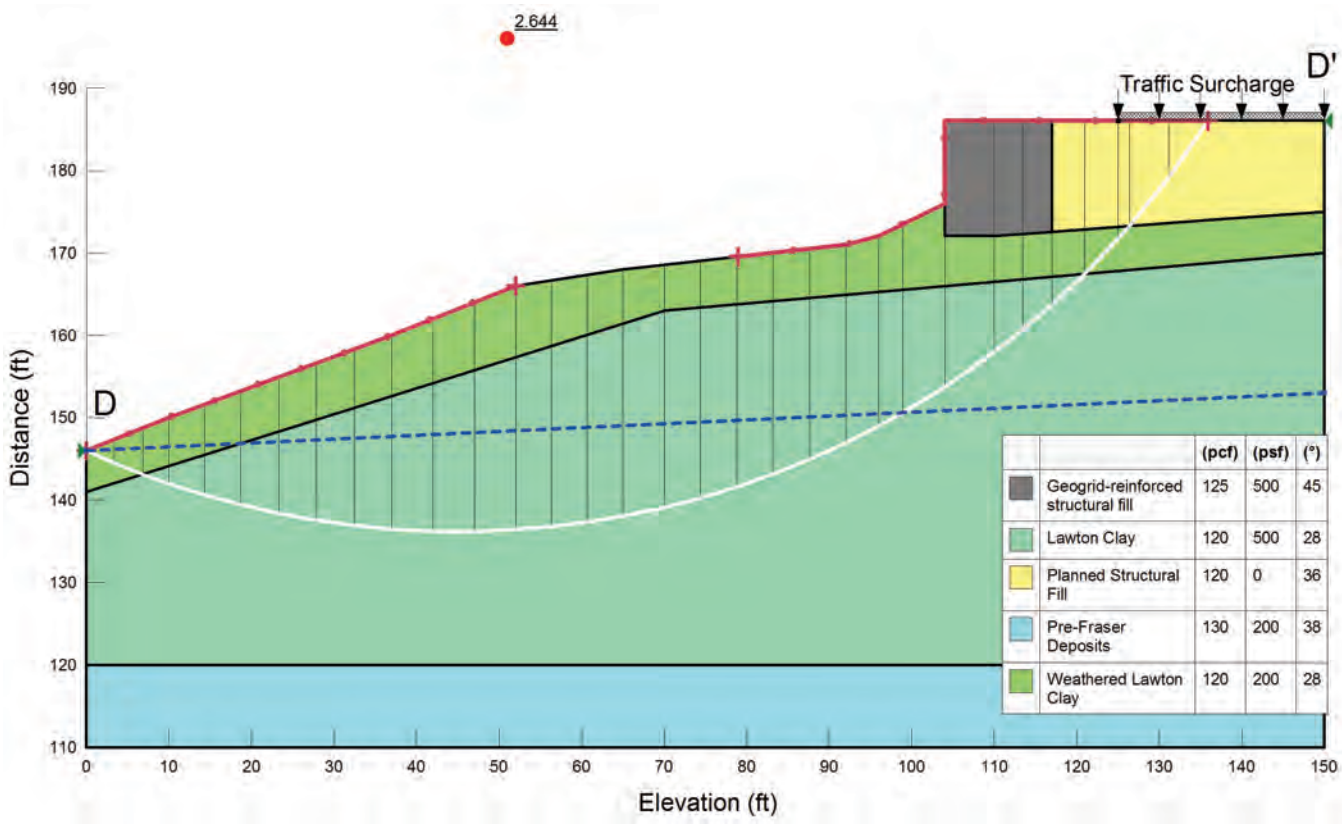
SLOPE STABILITY - PROPOSED CROSS-SECTION D - D' SEISMIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
|---|---|---|
| 160384E001 | 10/18 | 17 |

160384 Londo Forbes \ 160384E001 F17 SS D-D 10-18.cdr




NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

BLACK AND WHITE REPRODUCTION OF THIS COLOR ORIGINAL MAY REDUCE ITS EFFECTIVENESS AND LEAD TO INCORRECT INTERPRETATION.

associated earth sciences incorporated

SLOPE STABILITY - PROPOSED CROSS-SECTION D - D' STATIC
LONDO FORBES CREEK
KIRKLAND, WASHINGTON

| PROJ NO. | DATE: | FIGURE: |
|---|---|---|
| 160384E001 | 10/18 | 18 |

160384 Londo Forbes \ 160384E001 F18 SS D-D 10-18.cdr

# APPENDIX

| | | | | |
|---|---|---|---|---|
| Coarse-Grained Soils - More than 50% (1) Retained on No. 200 Sieve | Gravels - More than 50% (1) of Coarse Fraction Retained on No. 4 Sieve | ≤5% Fines (5) | GW | Well-graded gravel and gravel with sand, little to no fines |
| | | | GP | Poorly-graded gravel and gravel with sand, little to no fines |
| | | ≥12% Fines (5) | GM | Silty gravel and silty gravel with sand |
| | | | GC | Clayey gravel and clayey gravel with sand |
| | Sands - 50% (1) or More of Coarse Fraction Passes No. 4 Sieve | ≤5% Fines (5) | SW | Well-graded sand and sand with gravel, little to no fines |
| | | | SP | Poorly-graded sand and sand with gravel, little to no fines |
| | | ≥12% Fines (5) | SM | Silty sand and silty sand with gravel |
| | | | SC | Clayey sand and clayey sand with gravel |
| Fine-Grained Soils - 50% (1) or More Passes No. 200 Sieve | Silts and Clays Liquid Limit Less than 50 | | ML | Silt, sandy silt, gravelly silt, silt with sand or gravel |
| | | | CL | Clay of low to medium plasticity; silty, sandy, or gravelly clay, lean clay |
| | | | OL | Organic clay or silt of low plasticity |
| | Silts and Clays Liquid Limit 50 or More | | MH | Elastic silt, clayey silt, silt with micaceous or diatomaceous fine sand or silt |
| | | | CH | Clay of high plasticity, sandy or gravelly clay, fat clay with sand or gravel |
| | | | OH | Organic clay or silt of medium to high plasticity |
| Highly Organic Soils | | | PT | Peat, muck and other highly organic soils |

## Terms Describing Relative Density and Consistency

**Coarse-Grained Soils**

| Density | SPT(2) blows/foot |
|---|---|
| Very Loose | 0 to 4 |
| Loose | 4 to 10 |
| Medium Dense | 10 to 30 |
| Dense | 30 to 50 |
| Very Dense | >50 |

**Fine-Grained Soils**

| Consistency | SPT(2) blows/foot |
|---|---|
| Very Soft | 0 to 2 |
| Soft | 2 to 4 |
| Medium Stiff | 4 to 8 |
| Stiff | 8 to 15 |
| Very Stiff | 15 to 30 |
| Hard | >30 |

### Test Symbols

G = Grain Size
M = Moisture Content
A = Atterberg Limits
C = Chemical
DD = Dry Density
K = Permeability

## Component Definitions

| Descriptive Term | Size Range and Sieve Number |
|---|---|
| Boulders | Larger than 12" |
| Cobbles | 3" to 12" |
| Gravel | 3" to No. 4 (4.75 mm) |
| Coarse Gravel | 3" to 3/4" |
| Fine Gravel | 3/4" to No. 4 (4.75 mm) |
| Sand | No. 4 (4.75 mm) to No. 200 (0.075 mm) |
| Coarse Sand | No. 4 (4.75 mm) to No. 10 (2.00 mm) |
| Medium Sand | No. 10 (2.00 mm) to No. 40 (0.425 mm) |
| Fine Sand | No. 40 (0.425 mm) to No. 200 (0.075 mm) |
| Silt and Clay | Smaller than No. 200 (0.075 mm) |

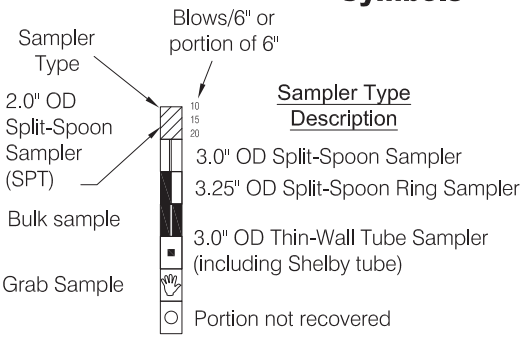
## (3) Estimated Percentage

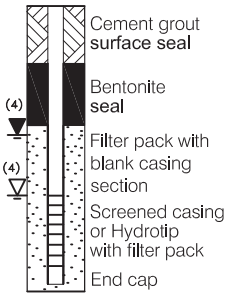
| Component | Percentage by Weight |
|---|---|
| Trace | <5 |
| Some | 5 to <12 |
| *Modifier* (silty, sandy, gravelly) | 12 to <30 |
| Very *modifier* (silty, sandy, gravelly) | 30 to <50 |

## Moisture Content

Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

## Symbols




(1) Percentage by dry weight
(2) (SPT) Standard Penetration Test (ASTM D-1586)
(3) In General Accordance with Standard Practice for Description and Identification of Soils (ASTM D-2488)
(4) Depth of ground water
▼ ATD = At time of drilling
▽ Static water level (date)
(5) Combined USCS symbols used for fines between 5% and 12%

Classifications of soils in this report are based on visual field and/or laboratory observations, which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field or laboratory testing unless presented herein. Visual-manual and/or laboratory classification methods of ASTM D-2487 and D-2488 were used as an identification guide for the Unified Soil Classification System.

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# EXPLORATION LOG KEY

FIGURE A1

blocks \ dwg \ log_key.dwg LAYOUT: Layout 4 -2014 Qty Chng

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# Geologic & Monitoring Well Construction Log

ATTACHMENT 34

| Project Number | Well Number | Sheet |
|---|---|---|
| 160384E001 | EB-1W | 1 of 2 |

| | | | |
|---|---|---|---|
| Project Name | Londo Forbes Creek | Location | Kirkland, WA |
| Elevation (Top of Well Casing) | | Surface Elevation (ft) | ~160 |
| Water Level Elevation | | Date Start/Finish | 1/27/18,1/27/18 |
| Drilling/Equipment | Boretec / Track Rig | Hole Diameter (in) | 8 inches |
| Hammer Weight/Drop | 140# / 30" | | |

| Depth (ft) | Water Level | WELL CONSTRUCTION | ST | Blows/ 6" | Graphic Symbol | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | Flush mount monument | | | | **Topsoil** |
| | | | | | | **Lawton Clay** |
| | | Bentonite 0 to 47 feet | | | | |
| 5 | | | | 3 1 1 | | Moist to very moist, light brown, silty, fine SAND, trace gravel; sand is massive (SM). |
| 10 | | 2-inch I.D. PVC casing: 0 to 50 feet | | 5 4 4 | | Very moist, light brown to light gray, SILT; interbed (~1 inch thick) of silty, fine to medium SAND; silt is laminated with iron stained laminations (ML). |
| 15 | | | | 7 10 18 | | Very moist, gray to dark gray, SILT, trace sand; silt is massive with laminated sections; effervesces with HCl (ML). |
| | | | | | | Harder drill action. |
| 20 | | | | 9 17 23 | | Moist to very moist, gray and light gray, SILT; disturbed (ML). |
| 25 | | | | 7 10 14 | | Moist to very moist, dark gray, sandy, SILT; interbed (~6 inches thick) of silty sand; massive (ML). |
| 30 | | | | 8 16 16 | | Very moist to wet, gray to dark gray with some iron staining, sandy, SILT; drill cuttings very wet (ML). |
| | | | | | | **Pre-Fraser Non Glacial Deposits** |
| | | | | | | Harder drilling. |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

Water Level (2/2/18)

Water Level at time of drilling (ATD)

**Logged by:** TG

**Approved by:** JHS

909

NWWELL- B 160384.GPJ BORING.GDT 2/14/18

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# Geologic & Monitoring Well Construction Log

ATTACHMENT 34

| Project Number | Well Number | Sheet |
|---|---|---|
| 160384E001 | EB-1W | 2 of 2 |

| | | | |
|---|---|---|---|
| Project Name | Londo Forbes Creek | Location | Kirkland, WA |
| Elevation (Top of Well Casing) | | Surface Elevation (ft) | ~160 |
| Water Level Elevation | | Date Start/Finish | 1/27/18,1/27/18 |
| Drilling/Equipment | Boretec / Track Rig | Hole Diameter (in) | 8 inches |
| Hammer Weight/Drop | 140# / 30" | | |

| Depth (ft) | Water Level | WELL CONSTRUCTION | ST | Blows/ 6" | Graphic Symbol | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | | | 15 31 17 | | Very moist, reddish brown with heavy iron staining, fine to medium SAND, trace to some silt; interbed (~3 inches thick) of gray, sandy, silt (SP-SM). |
| | | | | | | Gravelly drilling. |
| 40 | | | | 50/6" | | Very moist, gray to greenish gray with some areas of heavy iron staining, SILT; ranges to sandy silt; occasional organics (ML). |
| 45 | | | | 50/5" | | Moist, light brown, gravelly, fine to coarse SAND, trace silt; broken gravel in sampler (SP). |
| | | 10/20 sand 47 to 60 feet | | | | Gravelly drill action. |
| 50 | | 2-inch I.D. PVC well screen: 0.010-inch slot width, 50 to 60 feet | | 50/3" | | Moist, light brownish gray, gravelly, fine to coarse SAND, trace silt (SP). |
| 55 | | | | 38 50/6 | | Moist, light brown to reddish brown, fine to medium SAND, some gravel, trace silt; some silt clasts in sampler; iron staining obvious around silt clasts and in sand (SP). |
| 60 | ▽ | Screw type end cap with O-ring<br>Well tag # BKH-179 | | 50/2" | | Moist, light brown to light gray, gravelly, fine to medium SAND, some silt; gravel is subrounded (SP-SM).<br>Boring terminated at 60 feet.<br>Well completed at 60 feet on 1/27/18.<br>No groundwater encountered. |
| 65 | | | | | | |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

▽ Water Level (2/2/18)

▼ Water Level at time of drilling (ATD)

**Logged by:** TG

**Approved by:** JHS

910

NWWELL- B 160384.GPJ BORING.GDT 2/14/18

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# Geologic & Monitoring Well Construction Log

ATTACHMENT 34

| Project Number | Well Number | Sheet |
|---|---|---|
| 160384E001 | EB-2W | 1 of 1 |

| | | | |
|---|---|---|---|
| Project Name | Londo Forbes Creek | Location | Kirkland, WA |
| Elevation (Top of Well Casing) | | Surface Elevation (ft) | ~84 |
| Water Level Elevation | | Date Start/Finish | 1/24/18,1/24/18 |
| Drilling/Equipment | Boretec / Track Rig | Hole Diameter (in) | 8 inches |
| Hammer Weight/Drop | 140# / 30" | | |

| Depth (ft) | Water Level | WELL CONSTRUCTION | ST | Blows/ 6" | Graphic Symbol | DESCRIPTION |
|---|---|---|---|---|---|---|
| | | Flush mount monument | | | | **Topsoil - 6 inches** |
| | | | | | | **Colluvium** |
| | | Bentonite 0 to 17 feet | | | | |
| 5 | | | | 1 2 2 | | Moist to very moist, brown, very silty, fine SAND (SM). |
| 10 | ▽ ▼ | 2-inch I.D. PVC casing: 0 to 20 feet | | 2 5 4 | | Very moist, light brown, silty, fine to medium SAND, trace gravel; occasional organics (SM). |
| | | | | | | **Pre-Olympia Glacial Deposits** |
| | | | | | | Driller noted gravelly drilling. |
| 15 | | | | 34 30 24 | | Wet, light grayish brown, gravelly, silty, fine to medium SAND (SM). |
| | | | | | | Very hard drilling observed. |
| | | 10/20 sand 17 to 30 feet | | | | |
| 20 | | 2-inch I.D. PVC well screen: 0.010-inch slot width, 20 to 30 feet | | 27 37 33 | | Wet, light brownish gray, gravelly, fine to medium SAND, some silt (SP-SM). |
| 25 | | | | 50/6" | | Wet, light brown, silty, GRAVEL, some sand; gravel is angular (GM). |
| | | | | | | Less gravelly drilling. |
| | | | | | | Driller noted heaving sands. |
| 30 | | | | 10 19 30 | | Wet, light brownish gray, very silty, fine SAND; ranges to sandy silt; minor mica flakes in sand (SM). |
| | | Screw type end cap with O-ring | | | | Boring terminated at 31.5 feet. |
| | | Well tag # BKH-178 | | | | Well completed at 30 feet on 1/24/18. |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

▽ Water Level (2/2/18)

▼ Water Level at time of drilling (ATD)

**Logged by:** TG

**Approved by:** JHS

911

NWWELL- B 160384.GPJ BORING.GDT 2/14/18

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# Exploration Log

ATTACHMENT 34

| Project Number | Exploration Number | Sheet |
|---|---|---|
| 160384E001 | EB-3 | 1 of 2 |

| | | | |
|---|---|---|---|
| Project Name | Londo Forbes Creek | Ground Surface Elevation (ft) | ~152 |
| Location | Kirkland, WA | Datum | NAVD 88 |
| Driller/Equipment | Boretec / Track Rig | Date Start/Finish | 1/24/18,1/24/18 |
| Hammer Weight/Drop | 140# / 30" | Hole Diameter (in) | 8 inches |

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Well Completion | Water Level | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **Topsoil - 6 inches** | | | | | |
| | | | | **Lawton Clay** | | | | | |
| 5 | | S-1 | | Moist to very moist, light brown to light gray, SILT, trace sand; oxidized laminations in silt (ML). | | | 3 4 5 | ▲9 | |
| 10 | | S-2 | | Moist to very moist, gray to dark gray, SILT, some fine sand; faintly stratified (ML). | | | 9 15 15 | ▲30 | |
| 15 | | S-3 | | Very moist to wet, gray to dark gray, silty, fine SAND (SM). | | | 13 14 16 | ▲30 | |
| 20 | | S-4 | | Very moist, gray to dark gray, SILT; disturbed light and dark gray silt; some minor lamination (ML). | | | 12 22 25 | ▲47 | |
| 25 | | S-5 | | Very moist, gray to dark gray, SILT; some disturbed texture dark gray and light gray silt; shiny fracture angles (ML). | | | 12 18 21 | ▲39 | |
| 30 | | S-6 | | Very moist, gray to light gray, SILT; some minot lamination in silt; angular fracture surfaces; massive (ML). | | | 9 14 16 | ▲30 | |
| | | | | **Pre-Fraser Non Glacial Deposits** | | | | | |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

Water Level ()

Water Level at time of drilling (ATD)

**Logged by:** TG

**Approved by:** JHS

912

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# Exploration Log

ATTACHMENT 34

| Project Number | Exploration Number | Sheet |
|---|---|---|
| 160384E001 | EB-3 | 2 of 2 |

| | | | |
|---|---|---|---|
| Project Name | Londo Forbes Creek | Ground Surface Elevation (ft) | ~152 |
| Location | Kirkland, WA | Datum | NAVD 88 |
| Driller/Equipment | Boretec / Track Rig | Date Start/Finish | 1/24/18,1/24/18 |
| Hammer Weight/Drop | 140# / 30" | Hole Diameter (in) | 8 inches |

| Depth (ft) | ST | Samples | Graphic Symbol | DESCRIPTION | Well Completion | Water Level | Blows/6" | Blows/Foot (10 20 30 40) | Other Tests |
|---|---|---|---|---|---|---|---|---|---|
| | | S-7 | | Very moist, gray to greenish gray, sandy, SILT; some laminated silt; interbed (9 inches thick) of light brown with some oxidation, fine sand (ML). | | | 15 18 18 | ▲36 | |
| 40 | | S-8 | | Very moist to wet, gray, SILT, some sand; occasional organics; 3 inches of oxidized fine sand in sampler tip (ML). | | | 12 50/6" | | ▲50/6" |
| 45 | | S-9 | | Very moist, dark gray to dark brown, SILT; organics; interbed (12 inches thick) of clean, fine to medium sand (ML). | | | 14 24 30 | | ▲54 |
| 50 | | S-10 | | Very moist, dark gray, SILT, trace sand, trace gravel; faint organic odor; interbed (~4 inches thick) of oxidized light brown, fine to medium sand (ML). | | | 34 50/5" | | ▲50/5" |
| | | | | **Pre-Olympia Glacial Deposits** | | | | | |
| 55 | | S-11 | | Very moist, dark grayish brown, gravelly, silty, fine to medium SAND (SM). | | | 50/3" | | ▲50/3" |
| 60 | | S-12 | | Very moist, brownish gray, silty, fine to medium SAND (SM). | | | 50/4" | | ▲50/4" |
| 65 | | | | Bottom of exploration boring at 60.5 feet<br>No groundwater encountered. | | | | | |

Sampler Type (ST):

- 2" OD Split Spoon Sampler (SPT)
- 3" OD Split Spoon Sampler (D & M)
- Grab Sample
- No Recovery
- Ring Sample
- Shelby Tube Sample

M - Moisture

Water Level ()

Water Level at time of drilling (ATD)

**Logged by:** TG

**Approved by:** JHS

913

# LOG OF EXPLORATION PIT NO. EP-1

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

| Depth (ft) | DESCRIPTION |
|---|---|
| | **Topsoil** |
| 1 | Loose, moist, brown, silty SAND, few gravel. |
| | **Recessional Outwash** |
| 2 | Medium dense, moist, brown, medium SAND, trace to few silt, few gravel |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | Medium dense to dense, wet |
| 11 | |
| 12 | |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | Bottom of exploration pit at depth 16 feet<br>No ground water. Slight caving |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by:

Project No. KE05310A

June 2005

KCTP3 05310A.GPJ August 3, 2005

# LOG OF EXPLORATION PIT NO. EP-2

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

| Depth (ft) | DESCRIPTION |
|---|---|
| | **Topsoil** |
| 1 | Loose, moist, brown, silty SAND, few gravel. |
| | **Possible Fill** |
| 2 | Loose, wet, brown, medium SAND, few silt and gravel. |
| 3 | **Transitional Beds** |
| 4 | Soft, wet, blue-gray, sandy SILT, trace gravel. |
| 5 | |
| 6 | Stiff, moist, brown, SILT, trace to few SAND, trace gravel. |
| 7 | |
| 8 | |
| 9 | |
| 10 | Stiff, moist, blue-gray, SILT, trace sand, trace gravel. |
| 11 | |
| 12 | |
| 13 | |
| 14 | Bottom of exploration pit at depth 13 feet<br>No ground water. No caving. |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by:

Project No. KE05310A

June 2005

KCTP3 05310A.GPJ August 1, 2005

# LOG OF EXPLORATION PIT NO. EP-3

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

| Depth (ft) | DESCRIPTION |
|---|---|
| | **Topsoil** |
| 1 | Loose, wet, brown, silty SAND, few gravel. |
| | **Possible Fill** |
| 2 | Medium dense, wet, brown, silty SAND, few gravel. |
| 3 | |
| 4 | |
| 5 | |
| 6 | **Recessional Outwash** |
| 7 | Medium dense, wet, brown, SAND with gravel, few silt. |
| 8 | |
| 9 | |
| 10 | |
| 11 | |
| 12 | Bottom of exploration pit at depth 11 feet<br>No ground water. Slight caving at 6'. |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by:

Project No. KE05310A

June 2005

KCTP3 05310A.GPJ August 1, 2005

# LOG OF EXPLORATION PIT NO. EP-4

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

| Depth (ft) | DESCRIPTION |
|---|---|
| | **Topsoil** |
| 1 | Loose, moist, dark brown, silty SAND, few gravel, thin fibrous roots. |
| | **Pre-Vashon Lacustrine** |
| 2 | Stiff, moist, brown, sandy SILT, few gravel. |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | Stiff, moist to wet, blue-gray, SILT, trace sand and gravel. |
| 9 | |
| 10 | |
| 11 | Bottom of exploration pit at depth 10 feet<br>No ground water. No caving |
| 12 | |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by:

Project No. KE05310A

June 2005



KCTP3 05310A.GPJ August 1, 2005

# LOG OF EXPLORATION PIT NO. EP-5

| Depth (ft) | This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.<br><br>DESCRIPTION |
|---|---|
| | **Topsoil** |
| 1 | Loose, moist, brown, silty SAND, few gravel. |
| | **Recessional Outwash** |
| 2 | Medium dense, moist, brown, SAND, few silt and gravel, frequent thin roots. |
| 3 | |
| 4 | |
| 5 | |
| 6 | **Transitional Beds** |
| | Dense, moist, tan, silty SAND, few gravel and weakly cemented. |
| 7 | Dense, moist, blue-gray, SAND, trace silt and gravel with (blue) silt interbeds. |
| 8 | |
| 9 | |
| 10 | |
| 11 | |
| 12 | Bottom of exploration pit at depth 11 feet<br>Slight seepage at 11'. No caving. |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by:

Project No. KE05310A

June 2005

KCTP3 05310A.GPJ August 1, 2005

# LOG OF EXPLORATION PIT NO. EP-6

This log is part of the report prepared by Associated Earth Sciences, Inc (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

| Depth (ft) | DESCRIPTION |
|---|---|
| | **Topsoil** |
| 1 | **Recessional Outwash** |
| | Medium dense, moist, brown, medium SAND, few silt, trace to some gravel. |
| 2 | |
| 3 | |
| 4 | **Advance Outwash** |
| 5 | Dense, wet, brown, sandy GRAVEL, trace to some silt. |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| 11 | |
| 12 | |
| 13 | Bottom of exploration pit at depth 12 feet<br>No ground water No caving. |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by:

Project No. KE05310A

June 2005

KCTP3 05310A.GPJ August 1, 2005

# LOG OF EXPLORATION PIT NO. EP-7

| Depth (ft) | This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. DESCRIPTION |
|---|---|
| | **Topsoil** |
| 1 | Loose, moist, brown, SAND, few silt and gravel. |
| | **Recessional Outwash** |
| 2 | Dense, moist, brown, medium SAND, trace silt and gravel, some fibrous roots |
| 3 | |
| 4 | |
| 5 | |
| | **Transitional Beds** |
| 6 | Very stiff, moist, blue-gray, SILT, few sand, trace gravel |
| 7 | |
| 8 | |
| 9 | Grades to sandy SILT |
| 10 | |
| 11 | |
| 12 | Bottom of exploration pit at depth 11 feet<br>No ground water. No caving. |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by:

Project No. KE05310A

June 2005



KCTP3 05310A.GPJ August 1, 2005

# LOG OF EXPLORATION PIT NO. EP-8

| Depth (ft) | This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered. |
|---|---|
| | DESCRIPTION |
| | Topsoil |
| 1 | **Recessional Outwash** |
| | Medium dense, moist, brown, medium SAND, few silt, few gravel, thin, fibrous roots |
| 2 | |
| 3 | |
| 4 | **Transitional Beds** |
| | Stiff, wet, tan, SILT, few sand, trace gravel |
| 5 | |
| 6 | |
| 7 | |
| | Dense, wet, blue-gray, SAND, trace silt and gravel with very stiff (blue) silt interbeds |
| 8 | |
| 9 | |
| 10 | |
| 11 | Bottom of exploration pit at depth 10 feet<br>No ground water. No caving. |
| 12 | |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by

Project No. KE05310A

June 2005

KCTP3 05310A.GPJ August 1, 2005

# LOG OF EXPLORATION PIT NO. EP-9

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

| Depth (ft) | DESCRIPTION |
|---|---|
| | **Topsoil** |
| | **Recessional Outwash** |
| 1 | Medium dense, moist, brown, SAND, few silt and gravel, thin, fibrous roots |
| 2 | |
| 3 | |
| 4 | Dense, moist, brown, sandy GRAVEL, trace to some silt. |
| | **Pre-Vashon Lacustrine** |
| 5 | Hard, moist, tan, SILT, few sand, trace gravel. |
| 6 | |
| 7 | |
| 8 | |
| 9 | Very stiff, wet, blue-gray SILT, few sand, trace gravel |
| 10 | |
| | **Advance Outwash** |
| 11 | Dense, wet, brown, gravelly SAND, trace silt. |
| 12 | |
| 13 | Bottom of exploration pit at depth 12 feet<br>No ground water |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by:

Project No. KE05310A

June 2005

KCTP3 05310A.GPJ August 3, 2005

# LOG OF EXPLORATION PIT NO. EP-10

Depth (ft)

This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplification of actual conditions encountered.

DESCRIPTION

**Topsoil**

Loose, moist, dark brown, SAND, few silt and gravel.

1

**Recessional Outwash**

Medium dense, moist, brown, SAND, few silt and gravel

2

3

**Transitional Beds**

4

Stiff, moist, tan, SILT, few sand, trace gravel.

5

6

Dense, wet, blue-gray, SAND, trace silt and gravel with silt interbeds.

7

8

9

10

Bottom of exploration pit at depth 10 feet
No ground water

11

12

13

14

15

16

17

18

19

20

**Lien Plat**
**Kirkland, WA**

Associated Earth Sciences, Inc.

Logged by: EG

Approved by:

Project No. KE05310A

June 2005

KCTP3 05310A.GPJ August 3, 2005

associated
earth sciences
incorporated

October 13, 2016
Project No. KE160384A

Orcas Moon, LLC
P.O. Box 2710
Redmond, Washington 98073

Attention: Mr. Robert Londo

Subject: Site Reconnaissance - Wetland "A"
Londo Forbes Creek
20th Avenue and 4th Place
Kirkland, Washington

Dear Mr. Londo:

As requested, Associated Earth Sciences, Inc. (AESI) has observed site conditions at Wetland "A", previously delineated by others, at the southwest portion of the subject site. We have previously prepared a "Subsurface Exploration, Geologic Hazard, and Geotechnical Engineering Report - Londo Forbes Creek," dated July 28, 2016, for the above-referenced project.

We visited the site on October 11, 2016, during a period of dry weather, to observe conditions at and surrounding Wetland "A". The previously-delineated wetland area lies within the relatively gently sloping base of a gully possessing a northerly aspect and generally moderately to steeply sloping sidewalls. Several young (4- to 8-inch-diameter) alders were growing at the base of the gully. We did not observe water flowing through the bottom of the gully during our reconnaissance, although wet soils were observed at the surface of the gully bottom.

A steep headwall extends across the south end of this gully, as well as down the western flank. The western portion of the headwall displays freshly exposed silt, and includes a stepped, recently incised channel between the western flank and southern end of the gully. This morphology suggests active downcutting of the gully and adjacent slopes. Quarry rock has been placed near the head of the gully in apparent attempt to mitigate channel erosion. We also observed fill placed at the top of the south end of the gully, with soil spilling into the gully, suggestive of past dumping activities at the subject site.

Outside of the gully, the vegetation along the site slopes consists of shrubs, ferns, blackberries, small- to medium-sized deciduous and evergreen trees. We did not observe indications of slope instability, such as bowed or tilted trees, naturally occurring terraced topography,

tension cracks, reversed drainage gradients, and large-scale unvegetated soil exposures outside of that described in the gully.

We observed two storm water drains outleting immediately above the gully area. One drain consists of a perforated pipe placed over the aforementioned rock spalls and oriented toward the area of the stepped, eroded channel at the southwest portion of the gully. This drain pipe appears to originate at a catch basin along the north side of 20th Avenue. The second drain pipe outlets upslope of the south end of the gully, discharging in a sheetflow fashion over the headscarp. This pipe, which we understand was installed circa 2005, originates from a catch basin along the south side of 20th Avenue. These drain systems serve to concentrate storm water flow from 20th Avenue and release this flow as two point discharges near the top of the steep headscarp of the gully.

Based on our observations, it is our opinion that the water collected by the drain system along 20th Avenue and point-discharged onto the subject site, through the drain pipes described above, has led to erosion or shallow slide activity within the gully. Deposits placed by this type of earth movement, particularly fine-grained material as observed in the western flank of the headwall, can remain wet well beyond storm events. The apparent age of the alders observed within the base of the gully suggests that slide activity had occurred relatively recently, perhaps in response to the concentrated storm water discharge introduced to the gully circa 2005.

To mitigate the potential for future slope erosion and instability we recommend that uncontrolled discharge from impermeable surfaces should not be allowed to flow towards or onto steep slope areas. We recommend that any drains currently discharging above or onto the slope either be extended downward to a suitable location at the bottom of the steep slope or tied into a suitable storm water system that discharges away from the slope.

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

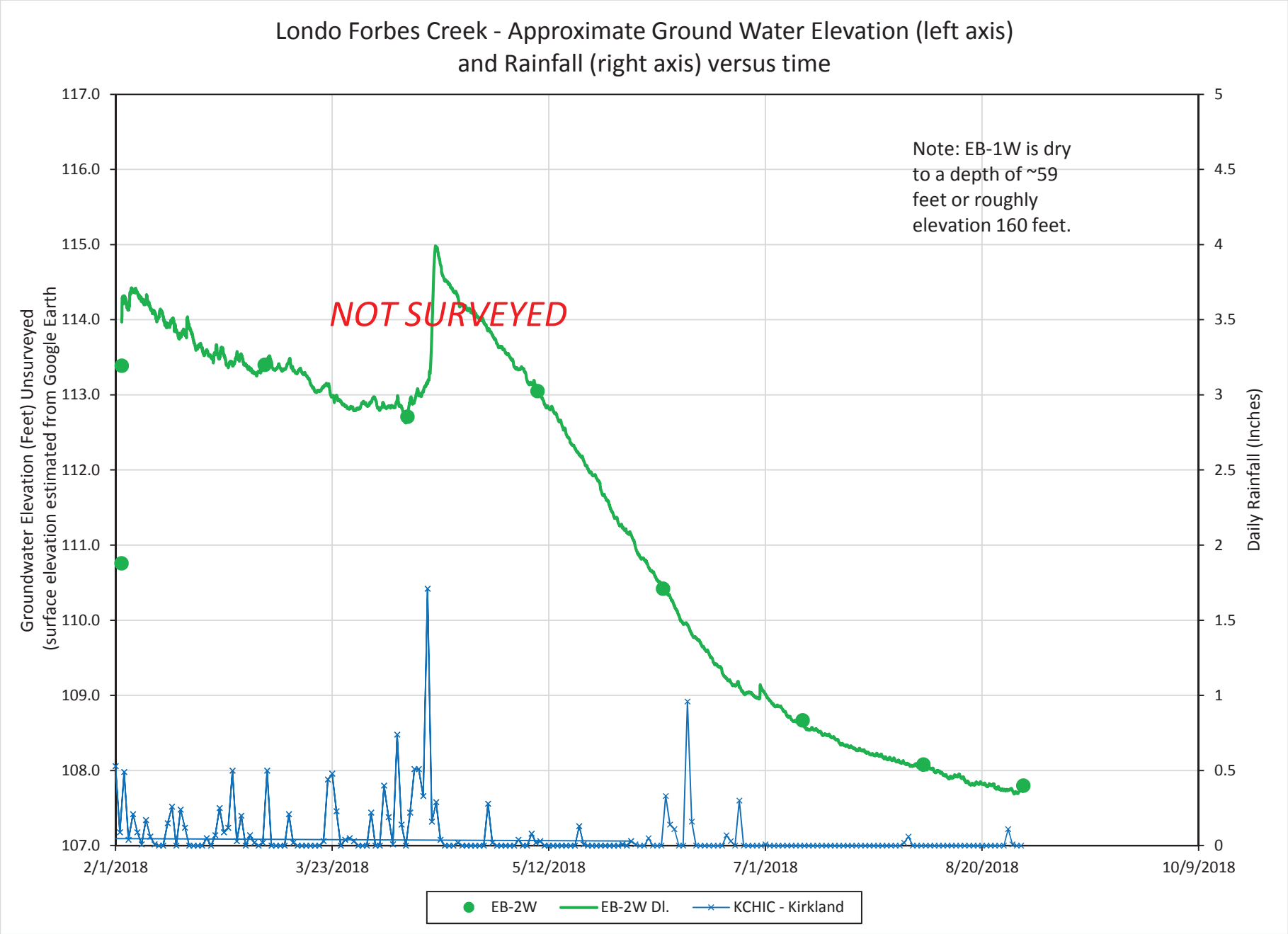
Sincerely,
**ASSOCIATED EARTH SCIENCES, INC.**
**Kirkland, Washington**

BRUCE L. BLYTON
STATE OF WASHINGTON
6890
REGISTERED
PROFESSIONAL ENGINEER
10/13/16

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

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

JPL/ld
KE160384A3
Projects\20160384\KE\WP


Londo Forbes Creek - Approximate Ground Water Elevation (left axis)
and Rainfall (right axis) versus time
Note: EB-1W is dry to a depth of ~59 feet or roughly elevation 160 feet.
NOT SURVEYED
Groundwater Elevation (Feet) Unsurveyed
(surface elevation estimated from Google Earth
Daily Rainfall (Inches)
117.0
116.0
115.0
114.0
113.0
112.0
111.0
110.0
109.0
108.0
107.0
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
2/1/2018
3/23/2018
5/12/2018
7/1/2018
8/20/2018
10/9/2018
EB-2W
EB-2W Dl.
KCHIC - Kirkland

GEODESIGN INC

April 3, 2018

City of Kirkland
Planning & Building Department
123 5th Avenue
Kirkland, WA 98033

Attention: Susan Lauinger
Associate Planner

**Geotechnical Consultation**
**Peer Review Services**
Londo Forbes Creek Proposed Development
Orcas Moon, LLC
Kirkland, Washington
GeoDesign Project: CKirkland-4-01

## INTRODUCTION

This letter presents a summary of our peer review of the geotechnical reports and background information regarding the proposed Londo Forbes Creek Development, which is also known as the "Orcas Moon Cottages." The project is located north of the intersection of 20th Avenue and 4th Place in Kirkland, Washington. The project area is currently undeveloped, heavily vegetated, and contains geologic hazard areas. We understand that Associated Earth Sciences, Inc. (AESI) has completed a geotechnical investigation to support the development and the report includes information to address Chapter 85 of the City of Kirkland Zoning Code.

Our scope of services is to provide third-party review of the submitted geotechnical information, reports, and proposed construction plans for compliance with Chapter 85 of the Kirkland Zoning Code.

## DOCUMENT REVIEW

As part of our scope of services, we reviewed the following documents:

- AESI, 2016. *Subsurface Exploration, Geologic Hazard, and Geotechnical Engineering Report; Londo Forbes Creek; Kirkland, Washington*, dated July 28, 2016 and revised February 20, 2018.
- AESI, 2016. *Site Reconnaissance – Wetland "A"; Londo Forbes Creek; 20th Avenue and 4th Place; Kirkland, Washington*, dated October 13, 2016.

- Preliminary construction drawings for Orcas Moon Cottages provided by Blueline and Talasaea Consultants, Inc., sheets CV-01, EC-01, BA-01, SP-01, TR-01, TR-02, GP-01, UT-01, RP-01, LS-01, W1.0, W1.1, 2.0, W3.0.
- Aerial images available from King County, Google Earth, and Historic Aerials.

**REVIEW COMMENTS**

Additional information is required to address the requirements of KZC Chapter 85 regarding development within or adjacent to areas classified as environmentally Critical Areas.

- **KZC 85.15 #1** – The code requires a plan that identifies areas with a slope of 15 percent or greater. The existing condition plan, Sheet EC-01, identifies areas with slopes greater than 40%. We recommend revising this to require the applicant to include a site plan identifying the areas meeting the KZC classifications of "High" and "Moderate" Landslide Hazard Areas. The areas should be hatched and clearly marked to assist in the determination of what areas will be impacted by the proposed development. Additionally, these areas should be shown on the proposed preliminary grading and building/retaining wall layout plan. This plan should be included as a figure in the geotechnical investigation report.
- **KZC 85.15 #4, a** – The report indicates that the slope stability analyses provided in Figures 3 through 6 of the report were completed for the proposed construction conditions and before the site grading plans were finalized. The grading plan should be reviewed and the slope stability analyses and geotechnical report revised as necessary to reflect the proposed grading.
- **KZC 85.15 #4, a** – Slope stability analyses of the existing site conditions are also required to verify how the proposed grading will impact existing slope stability.
- **KZC 85.15 #4, a** – Additonal slope stability analysis should be completed on the west side of the parking lot between Buildings 10 and 11 as well as from the southwest corner of Building 10 through the proposed tiered wall system.
- **KZC 85.15#4, h** – The retaining walls are considered structures and will need a suitable buffer/setback between the structure and the geologic hazard area. Provide recommendations on buffer/setback requirements and/or engineering methods that can be used to achieve them. The buffers and setbacks associated with geologic hazard areas should also be shown on the plan that identifies geologic hazard areas, along with the proposed development and grading.
- **KZC 85.15#4, h** – Provide additional recommendations for building foundations located adjacent to retaining walls or slopes with regard to appropriate embedment depth.
- **KZC 85.15#4, h** – Provide recommendations regarding the construction of the proposed walls pertaining to the required embedment and anticipated excavation depths to establish the bottom-of-wall footing elevation. Surficial loose soil conditions are indicated on the explorations and the existing slope stability analyses indicate wall embedments up to about 9 feet to reach suitable bearing. The wall heights shown on the preliminary grading plan do not reflect the embedment depths or the amount of ground disturbance necessary to complete the excavation. Address temporary cut slope inclinations and short-term stability.
- **KZC 85.15#4, h** – Confirm that the recommended passive pressure resistance for desiging retaining walls is suitable for the slope face in front of the proposed walls or provide additional recommendations.

- **KZC 85.15#4, h** – Stormwater drainage impacts and mitigation measures should be addressed with reference to the proposed grading and utility plan. Recommentions and information pertaining to the following should be provided:
  - Subsurface drains behind retaining walls showing discharge paths or locations
  - Surface water collection along the east, west, and north perimeter of the proposed development as well as between buildings and retaining walls. The proposed ground surface slopes to the retaining wall and away from the buildings toward the surrounding geologically critical areas.
  - Preventing subsurface flow along proposed utilities.
- **KZC 85.15#4, h** – Address the installation of utilities through geologic hazard areas and provide recommendations regarding appropriate embedment depth and anchorage requirements; identify mitigation measures to address slope stability and drainage imacts.
- **KZC 85.15#4, h** – The plans should show the location of the two drain pipes that discharge stormwater onto the property from 20th Avenue. The AESI letter dated October 13, 2016 indicates that the discharge from these pipes has resulted in erosion, ground movement, and regression of the gully that extends north to Wetland "A." Areas impacted by erosion and slide activity should be shown on the plans. Address impacts associated with continued regression of the gully to the proposed construction. Identify suitable mitigation alternatives.
- **KZC 85.15#4, h** – The stormwater detention vault at the north end of the property has a base elevation of 67.3. Groundwater in EB-2W is indicated at elevations between 72 and 74. Provide information on dewatering requirements to construct the vault, impacts to adjacent areas, and proposed mitigation measures.
- **KZC 85.15#4, h** – A wet-season reconnaissance should be completed to observe indications of seasonal groundwater seepage. The report references a reconnaissance completed in October 13, 2016, which is at the end of the dry season when groundwater levels are typically at a minimum. We recommend requiring a visit in April, when seasonal groundwater seepage is more likely to be present.
- **KZC 85.15#4, h** – The geotechnical report should provide a summary list of geotechnical-related items that require geotechnical observation. Many of these items are indicated throughout the report, but it would be helpful to have a complete list in one section that could be shown on the permit plans and that the City could easily reference.
- **KZC 85.25 #1** – AESI should also provide a letter indicating that they have reviewed the plans and confirm that the plans are consistent with the geotechnical recommendations.
- **KZC 85.25 #3** – If approved, the permit should require geotechnical professional observation throughout construction and submittal of a close-out report prior to occupancy.

♦ ♦ ♦

We appreciate the opportunity to provide our services on this project. Please give us a call if you have questions.

Sincerely,

GeoDesign, Inc.

Kevin J. Lamb, P.E.
Principal Engineer

KEVIN J. LAMB
STATE OF WASHINGTON
29441
REGISTERED
PROFESSIONAL ENGINEER

Signed 04/03/2018

KJL:sn
One copy submitted (via email only)
Document ID: CKirkland-4-01-040318-geolr.docx
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GEODESIGN INC

August 21, 2018

City of Kirkland
Planning & Building Department
123 5th Avenue
Kirkland, WA 98033

Attention: Susan Lauinger, Associate Planner

**Geotechnical Consultation**
**Peer Review Services**
Londo Forbes Creek Proposed Development
Review of Applicant Response to Geotechnical Peer Review Comments
Orcas Moon, LLC
Kirkland, Washington
GeoDesign Project: CKirkland-4-01

## INTRODUCTION

This letter presents a summary of our review of the additional information submitted by the applicant in response to our geotechnical peer review comments regarding project conformance with Chapter 85 of the City of Kirkland Zoning Code. We have reviewed Associated Earth Sciences, Inc.'s letter dated May 1, 2018 responding to the review comments. Provided below is our original review comment (in italics) and a summary as to whether the applicant response is adequate or if additional information or revisions are required.

## REVIEW COMMENTS

- ***KZC 85.15 #1*** *- The code requires a plan that identifies areas with a slope of 15 percent or greater. The existing condition plan, Sheet EC-01, identifies areas with slopes greater than 40%. We recommend revising this to require the applicant to include a site plan identifying the areas meeting the KZC classifications of "High" and "Moderate" Landslide Hazard Areas. The areas should be hatched and clearly marked to assist in the determination of what areas will be impacted by the proposed development. Additionally, these areas should be shown on the proposed preliminary grading and building/retaining wall layout plan. This plan should be included as a figure in the geotechnical investigation report.*

***RESPONSE***
Applicant indicates that site slopes greater than 15 percent are classified as "High Landslide Hazard Area" and that a revised site plan will be incorporated as Figure 2 of the geotechnical report. The revised report should be submitted for review.

- ***KZC 85.15 #4, a*** *- The report indicates that the slope stability analyses provided in Figures 3 through 6 of the report were completed for the proposed construction conditions and before the site grading plans were finalized. The grading plan should be reviewed and the slope stability analyses and geotechnical report revised as necessary to reflect the proposed grading.*

***RESPONSE***
Applicant indicates that they will review future versions of the grading plan and update slope stability analyses to reflect changes. The final grading plan should be submitted so that impacts to slopes can be properly evaluated.

- ***KZC 85.15 #4, a*** *- Slope stability analyses of the existing site conditions are also required to verify how the proposed grading will impact existing slope stability.*

***RESPONSE***
Applicant has provided the results of additional slope stability analysis for the existing conditions as requested. Based on the results of stability analyses, along sections A-A' and B-B' the proposed retaining wall construction and fill placed behind the wall and at the top of the slope decreases the factor of safety approximately 20 percent along section A-A' and approximately 2 percent along B-B'. The factor of safety remains well above acceptable factors of safety for engineered slopes in both cases. Typically for engineered slopes a minimum factor of safety under static loading conditions is 1.5. The analysis indicates the proposed slopes have a factor of safety for static conditions greater than 1.8.

- ***KZC 85.15 #4, a*** *- Additional slope stability analysis should be completed on the west side of the parking lot between Buildings 10 and 11 as well as from the southwest corner of Building 10 through the proposed tiered wall system.*

***RESPONSE***
Applicant has provided additional stability analyses along sections C-C' and D-D' through the proposed tiered retaining walls as requested. Stability analyses for both sections indicate a lower factor of safety (25 percent for section C-C' and 6 percent for section D-D') for the proposed slope condition compared to the existing condition. However, the factors or safety for the proposed conditions (2.2 for section C-C' and 2.8 for section D-D') are well above acceptable factors of safety for engineered slopes.

- ***KZC 85.15#4, h*** *- The retaining walls are considered structures and will need a suitable buffer/setback between the structure and the geologic hazard area. Provide recommendations on buffer/setback requirements and/or engineering methods that can be used to achieve them. The buffers and setbacks associated with geologic hazard areas should also be shown on the plan that identifies geologic hazard areas, along with the proposed development and grading.*

***RESPONSE***
Applicant has provided stability analyses that demonstrate the proposed retaining walls and fill placement have factors of safety for both static and seismic conditions that are greater than industry acceptable minimum factors of safety for engineered slopes. Additional buffers have not been recommended.

Isolated, episodic, shallow-based failure modes within saturated colluvium material are not typically considered in the large-scale slope stability analyses. These types of failures are difficult to address in typical slope stability analysis. Mitigation techniques that can be used to address the risk associated with these types of failures are buffers or increased foundation embedment depths. Please provide additional information regarding the risk associated with these failures, particularly in the case of sections C-C' and D-D' where the structures appear to be supported on weathered Lawton Clay.

- ***KZC 85.15#4, h*** *- Provide additional recommendations for building foundations located adjacent to retaining walls or slopes with regard to appropriate embedment depth.*

***RESPONSE***
Applicant has provided additional recommendations regarding foundation embedment that have addressed this comment. The recommendations should be provided in the revised geotechnical report.

- ***KZC 85.15#4, h*** *- Provide recommendations regarding the construction of the proposed walls pertaining to the required embedment and anticipated excavation depths to establish the bottom-of-wall footing elevation. Surficial loose soil conditions are indicated on the explorations and the existing slope stability analyses indicate wall embedments up to about 9 feet to reach suitable bearing. The wall heights shown on the preliminary grading plan do not reflect the embedment depths or the amount of ground disturbance necessary to complete the excavation. Address temporary cut slope inclinations and short-term stability.*

***RESPONSE***
Applicant provided temporary cut slopes in the geotechnical report and has provided additional recommendations to address wall foundation excavation. Please address mitigation measures regarding filling temporary excavations constructed in front of mechanically stabilized earth retaining walls (fill material, placement, and compaction).

- ***KZC 85.15#4, h*** *- Confirm that the recommended passive pressure resistance for designing retaining walls is suitable for the slope face in front of the proposed walls or provide additional recommendations.*

***RESPONSE***
Applicant response is acceptable.

- ***COMMENT KZC 85.15#4, h*** *– Stormwater drainage impacts and mitigation measures should be addressed with reference to the proposed grading and utility plan. Recommendations and information pertaining to the following should be provided:*
  - *Subsurface drains behind retaining walls showing discharge paths or locations*
  - *Surface water collection along the east, west, and north perimeter of the proposed development as well as between buildings and retaining walls. The proposed ground surface slopes to the retaining wall and away from the buildings toward the surrounding geologically critical areas.*
  - *Preventing subsurface flow along proposed utilities.*

***RESPONSE***
Applicant response indicates surface and subsurface drainage will be shown on final civil plans. Surface water drainage can impact slope stability. Impacts of the development on slope stability are unknown without the final drainage plans. Applicant should provide the drainage plan to the geotechnical engineer for review and conclusions as to impacts on slope stability.

- ***KZC 85.15#4, h*** *– Address the installation of utilities through geologic hazard areas and provide recommendations regarding appropriate embedment depth and anchorage requirements; identify mitigation measures to address slope stability and drainage impacts.*

***RESPONSE***
Applicant response is to provide situation-specific recommendations. Preliminary plans indicate sewer and stormwater utilities will extend through the "High Landslide Hazard Area." Risks associated with subsurface drainage in pipe trenches are not always evident during construction. The geotechnical report indicates the colluvial soil is not suitable for foundation support; please address pipe support on colluvial soil. The geotechnical report should be revised to include specific recommendations regarding utility trenching through the "High Landslide Hazard Areas." Recommendations should address trench cutoff drains and mitigation measures to address slope creep risk on utility pipes, such as minimum trench depth and pipe anchorage.

- ***KZC 85.15#4, h*** *– The plans should show the location of the two drain pipes that discharge stormwater onto the property from 20th Avenue. The AESI letter dated October 13, 2016 indicates that the discharge from these pipes has resulted in erosion, ground movement, and regression of the gully that extends north to Wetland "A." Areas impacted by erosion and slide activity should be shown on the plans. Address impacts associated with continued regression of the gully to the proposed construction. Identify suitable mitigation alternatives.*

***RESPONSE***
Plans indicate the location of the pipes; although site development does not extend into the area of the gullies near the pipes, they are on the property being developed. Please indicate the areas impacted by erosion and slide activity on the geotechnical report site plan. Applicant has provided a statement that they do not expect direct impacts to the proposed development from further discharge from the pipes.

- ***KZC 85.15#4, h*** *– The stormwater detention vault at the north end of the property has a base elevation of 67.3. Groundwater in EB-2W is indicated at elevations between 72 and 74. Provide information on dewatering requirements to construct the vault, impacts to adjacent areas, and proposed mitigation measures.*

***RESPONSE***
Additional information is required. Applicant indicates groundwater will be limited to interflow perched on the very dense pre-Olympia Age deposits encountered in EB-2W.

The well summary log indicates that EB-2W is screened within the very dense pre-Olympia Age Glacial Deposits that underly the colluvium in which applicant has indicated groundwater is perched. The bentonite seal begins 4 feet into the pre-Olympia Age Glacial Deposits and extends to the surface. The pre-Olympia Glacial Deposits within the well screen zone are indicated to consist of sand, silty sand, and a gravel deposit approximately 5 feet below the bottom of the anticipated vault excavation. Heaving drilling conditions are noted on the log approximately 8 feet below the bottom of the vault excavation. Provide information on dewatering requirements to construct the vault, impacts to adjacent areas, and proposed mitigation measures.

- ***KZC 85.15#4, h*** *– A wet-season reconnaissance should be completed to observe indications of seasonal groundwater seepage. The report references a reconnaissance completed in October 13, 2016, which is at the end of the dry season when groundwater levels are typically at a minimum. We recommend requiring a visit in April, when seasonal groundwater seepage is more likely to be present.*

***RESPONSE***
Applicant response is acceptable.

- ***KZC 85.15#4, h*** *– The geotechnical report should provide a summary list of geotechnical-related items that require geotechnical observation. Many of these items are indicated throughout the report, but it would be helpful to have a complete list in one section that could be shown on the permit plans and that the City could easily reference.*

***RESPONSE***
Applicant response is acceptable.

- ***KZC 85.25 #1*** *– AESI should also provide a letter indicating that they have reviewed the plans and confirm that the plans are consistent with the geotechnical recommendations.*

***RESPONSE***
Applicant response is acceptable.

- ***KZC 85.25 #3*** *– If approved, the permit should require geotechnical professional observation throughout construction and submittal of a close-out report prior to occupancy.*

***RESPONSE***
Applicant response is acceptable.

♦ ♦ ♦

We appreciate the opportunity to provide our services on this project. Please give us a call if you have questions.

Sincerely,

GeoDesign, Inc.

Kevin J. Lamb, P.E.
Principal Engineer

KJL:kt
One copy submitted (via email only)
Document ID: CKirkland-4-01-082118-geol.docx
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Signed 08/21/2018

**From:** Kevin Lamb <klamb@geodesigninc.com>
**Sent:** Thursday, November 15, 2018 2:30 PM
**To:** Susan Lauinger
**Subject:** RE: GeoDesign letter: Londo Forbes Creek Proposed Development

Susan

I have reviewed the revised report and for permitting purposes it appears to have addressed three of the four items that were requested in my last email dated September 19, 2018, a copy of which is provided below.
The one item not addressed is the review of the final grading plan, which I assume can be done during grading permit process.

During construction it will be important to have a representative of AESI on site during grading operations, foundation and retaining wall construction, utility installation and backfilling to observe conditions and make sure they are consistent with the geotechnical report and the permitted plans and specifications. Their reports should be submitted to the city for review and inclusion in the project file.

Also, once the retaining wall designs are finalized they should be reviewed for conformance with the geotechnical engineer recommendations. I believe additional oversight and additional review of engineered foundation and retaining wall designs is addressed in Chapter 85.25 of the code.

Kevin

**Kevin J. Lamb, P.E., L.E.G.**
**Principal**

**Tacoma Office**
2502 Jefferson Avenue
Tacoma, WA 98402

**Seattle Office**
10700 Meridian Avenue North, #402
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**From:** Kevin Lamb
**Sent:** Wednesday, September 19, 2018 11:33 AM
**To:** 'Susan Lauinger' <SLauinger@kirklandwa.gov>
**Subject:** RE: GeoDesign letter: Londo Forbes Creek Proposed Development

Susan
From a Land Use permitting viewpoint I would want the following submitted:

- Revised site plan identifying slopes greater than 15 percent.
- Indicate the areas impacted by erosion and slide activity, associated with the existing storm water drainage pipes, on the geotechnical report site plan.
- Submit a "final" grading plan and any revisions to the Geotechnical report or slope stability analyses required to reflect the submitted grading plan.
- Address the potential of shallow colluvial slope failures below the proposed retaining walls and how the risk of these failure types is mitigated, such as through wall embedment or horizontal benches in front of the walls. Please address this risk in the case of sections C-C' and D-D' where the structures appear to be supported on weathered Lawton Clay.

The remaining items can be addressed in the review of the construction documents. And the geotechnical engineer of record should review the submitted construction plans for conformance with the geotechnical recommendations and provide a minimum risk statement regarding the proposed construction.

Kevin

**Kevin J. Lamb, P.E., L.E.G.**
**Principal**

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**From:** Susan Lauinger <SLauinger@kirklandwa.gov>
**Sent:** Wednesday, September 19, 2018 11:17 AM
**To:** Kevin Lamb <klamb@geodesigninc.com>
**Subject:** RE: GeoDesign letter: Londo Forbes Creek Proposed Development

Hi Kevin,
Thank you so much for the explanation.
My supervisor would also like to know if you could let us know which of these recommendations, if any could wait for the construction permits, and which need to be addressed for the land use decision.

Thanks,

**Susan Lauinger**
**Associate Planner**
**Planning and Building Department**
123 5th Ave
Kirkland, WA 98033
425-587-3252
slauinger@kirklandwa.gov

**Kirkland Maps makes property information searches fast and easy**
GIS mapping system now available to public at http://maps.kirklandwa.gov.

**From:** Kevin Lamb [mailto:klamb@geodesigninc.com]
**Sent:** Tuesday, September 18, 2018 3:37 PM
**To:** Susan Lauinger <SLauinger@kirklandwa.gov>
**Subject:** RE: GeoDesign letter: Londo Forbes Creek Proposed Development

Susan

I'll provide additional clarification:

**Response at the bottom of page 2 of your letter dated August 21, 2018.**

> **Clarification: The "Factor of Safety" for assessing slope stability can be thought of as the a ratio of the forces that resist instability divided by the forces that cause instability. When the factor or safety is greater than one the slope should be stable and when less than one it should be failing. The Kirkland Code requires a minimum factor of safety of 1.5 for static conditions and 1.1 for seismic conditions for proposed development that impacts slope stability. The proposed walls on the Londo Forbes Creek Development, impact the existing slope stability. However, the impacts are relatively minor and the resulting factor of safety of 2.2 (section C-C') and 2.8 (section D-D') are well above the minimum of 1.5 that the City requires. No additional information is required to address this unless the final grading plan changes the modeled topography significantly.**

Additional Information still required or that should be requested from the applicant includes the following:

- Revised site plan identifying slopes greater than 15 percent.
- Submit a final grading plan and any revisions to the Geotechnical report or slope stability analyses required to reflect the final grading plan
- Address the potential of shallow colluvial slope failures below the proposed retaining walls and how the risk of these failure types is mitigated, such as through wall embedment or horizontal

benches in front of the walls. Please address this risk in the case of sections C-C' and D-D' where the structures appear to be supported on weathered Lawton Clay.

- Please provide additional recommendations to address filling temporary excavations constructed in front of mechanically stabilized earth retaining walls (fill material, placement, and compaction)
- Provide drainage plan for owner's geotechnical engineer to review for conformance with geotechnical recommendations and mitigate impacts to slope stability
- Applicant response to provide situation-specific recommendations during construction to address installation of utilities through geologic hazard areas is not acceptable. Risks associated with subsurface drainage in pipe trenches are not always evident during construction. Provide specific recommendations to address to address Utility trenching through the "High Landslide Hazard Areas" that can be incorporated into the Civil Engineer's design documents, at a minimum these should include:
    - Pipe support, anchorage for pipes, and mitigation measures to address slope creep risk on utility pipes, such as minimum trench depth and pipe anchorage.
    - Trench cutoff drains materials and minimum spacing

- Indicate the areas impacted by erosion and slide activity, associated with the existing storm water drainage pipes, on the geotechnical report site plan.
- Provide information on dewatering requirements to construct the vault, impacts to adjacent areas, and proposed mitigation measures. The well summary log indicates that EB-2W is screened within the very dense pre-Olympia Age Glacial Deposits that underly the colluvium in which applicant has indicated groundwater is perched. The bentonite seal begins 4 feet into the pre-Olympia Age Glacial Deposits and extends to the surface. The pre-Olympia Glacial Deposits within the well screen zone are indicated to consist of sand, silty sand, and a gravel deposit approximately 5 feet below the bottom of the anticipated vault excavation. Heaving drilling conditions are noted on the log approximately 8 feet below the bottom of the vault excavation.

.

**Kevin J. Lamb, P.E., L.E.G.**
**Principal**

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**From:** Susan Lauinger <SLauinger@kirklandwa.gov>
**Sent:** Tuesday, September 18, 2018 1:55 PM
**To:** Kevin Lamb <klamb@geodesigninc.com>
**Cc:** Kristen Tebbe <ktebbe@geodesigninc.com>
**Subject:** RE: GeoDesign letter: Londo Forbes Creek Proposed Development

Hi Kevin,
I have reviewed your response letter dated August 21,2018 and I have questions and need some clarification.
I am having great difficulty deciphering some of the response comments from you because I simply don't speak the language of geotechnical engineers.

One example: look at your response at the bottom of page 2 of your letter dated August 21, 2018.
I read through this response with my boss and neither of us could determine if you needed more information on the safety factor or not. I wouldn't know what to ask the applicant to supply and I don't even understand what a safety factor is.

Could you provide recommendations in a bullet pointed list? They would read something like this:

- Provide a site plan showing all areas that have a slope greater than 15% (if that in fact is what you are asking for).
- Provide the safety factor for engineered slopes (I have no idea by the way if that is what you are asking for).
- Etc…

I see that there is some money in the account for these purposes.

Let me know if you have questions.

Thank you so much for your help on this.

Very Sincerely,

**Susan Lauinger**
**Associate Planner**
**Planning and Building Department**
123 5th Ave
Kirkland, WA 98033
425-587-3252
slauinger@kirklandwa.gov

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**From:** Kristen Tebbe [mailto:ktebbe@geodesigninc.com]
**Sent:** Tuesday, August 21, 2018 9:02 AM
**To:** Susan Lauinger <SLauinger@kirklandwa.gov>
**Cc:** Kevin Lamb <klamb@geodesigninc.com>; CKIRKLAND-4-01 <CKIRKLAND-4-01@geodesigninc.onmicrosoft.com>
**Subject:** GeoDesign letter: Londo Forbes Creek Proposed Development

On behalf of Kevin Lamb, attached is our letter regarding peer review services. If you have questions or comments regarding the attached, please contact Kevin.

**Note:** The PDF file is password protected. You do not need the password to open or print the file or copy text from the file. The password will need to be removed if you need to extract pages from the file or insert the file into another PDF. If you need the password or need me to remove the password and re-send, please let me know.

**Kristen Tebbe**
Senior Technical Editor

503.726.3105 direct
503.968.8787 main

**GeoDesign, Inc.**
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**Portland OR | Salem OR | Anaheim CA | Vancouver WA | Longview WA | Seattle WA | Tacoma WA**

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# GEOLOGICALLY HAZARDOUS AREAS COVENANT

| | |
|---|---|
| *File No.:* | |
| *Parcel Number:* | |
| *Project Name:* | |
| *Project Address:* | |

Declarant _____ hereby declares and agrees as follows:

1. Declarant is the owner of the real property described below and incorporated herein by reference, which is the "property" referred to herein.
2. Declarant agrees to defend, indemnify, and hold the City of Kirkland harmless from all loss, including claim made therefor, which the City may incur as a result of any landslide or seismic activity occurring on the property and for any loss including any claim made therefor resulting from soil disturbance on the "property" in connection with the construction of improvements, including but not limited to storm water retention and foundations. "Loss" as used herein means loss including claim made therefor from injury or damage incurred on or off the "property," together with reasonable expenses including attorneys fees for investigation and defense of such claim.
3. This hold harmless is a perpetual covenant running with the "property" and is binding upon the Declarant's successor and assigns.
4. The real property subject to this Agreement is situated in Kirkland, King County, Washington, and described as follows:

DATED at Kirkland, Washington, this _____ day of _____, _____.

(Sign in blue ink)

(***Individuals Only***)

OWNER(S) OF REAL PROPERTY (INCLUDING SPOUSE)

_____

_____

_____

(***Individuals Only***)

STATE OF WASHINGTON )
) SS.
County of King )

On this _____ day of _____, _____, before me, the undersigned, a Notary Public in and for the State of Washington, duly commissioned and sworn, personally appeared _____and _____to me known to be the individual(s) described herein and who executed the Geologically Hazardous Areas Covenant and acknowledged that _____ signed the same as _____free and voluntary act and deed, for the uses and purposes therein mentioned.
WITNESS my hand and official seal hereto affixed the day and year first above written.

_____
Notary's Signature

_____
Print Notary's Name
Notary Public in and for the State of Washington, Residing at: _____
My commission expires: _____

(***Partnerships Only***)

OWNER(S) OF REAL PROPERTY

_____
(Name of Partnership or Joint Venture)

_____
By General Partner

_____
By General Partner

_____
By General Partner

(***Partnerships Only***)

STATE OF WASHINGTON )
) SS.
County of King )

On this _____ day of _____, _____, before me, the undersigned, a Notary Public in and for the State of Washington, duly commissioned and sworn, personally appeared _____and _____ to me, known to be general partners of _____, the partnership that executed the Geologically Hazardous Areas Covenant and acknowledged the said instrument to be the free and voluntary act and deed of each personally and of said partnership, for the uses and purposes therein set forth, and on oath stated that they were authorized to sign said instrument.

WITNESS my hand and official seal hereto affixed the day and year first above written.

_____
Notary's Signature

_____
Print Notary's Name
Notary Public in and for the State of Washington,
Residing at: _____
My commission expires: _____

***(Corporations Only)***

OWNER(S) OF REAL PROPERTY

_____
(Name of Corporation)

_____
By President

_____
By Secretary

(***Corporations Only***)

STATE OF WASHINGTON )
) SS.
County of King )

On this _____ day of _____, _____, before me, the undersigned, a Notary Public in and for the State of Washington, duly commissioned and sworn, personally appeared _____and _____ to me, known to be the President and Secretary, respectively, of _____, the corporation that executed the Geologically Hazardous Areas Covenant and acknowledged the said instrument to be the free and voluntary act and deed of said corporation, for the uses and purposes therein set forth, and on oath stated that they were authorized to sign said instrument and that the seal affixed is the corporate seal of said corporation.

WITNESS my hand and official seal hereto affixed the day and year first above written.

_____
Notary's Signature

_____
Print Notary's Name
Notary Public in and for the State of Washington,
Residing at: _____
My commission expires: _____

THE WATERSHED COMPANY

SCIENCE & DESIGN

January 31, 2019

Susan Lauinger
City of Kirkland
Planning and Community Development
123 Fifth Avenue
Kirkland, WA 98033

## Re: Orcas Moon Cottage project, Public Trail Review - Stream and Wetland Delineation Report

The Watershed Company Reference Number: 160622.6

Dear Susan:

On December 19, 2018; January 18 and 25, 2019 Ecologists Nell Lund, Roen Hohlfeld, and Pete Heltzel visited a portion of Juanita Bay Park to delineate jurisdictional wetlands and streams within a defined study area. The park property is located south of Forbes Creek Drive in Kirkland, Washington (parcel # 3226059022). The study area was selected based on a proposed trail location. The purpose of this study is to document stream and wetland areas in the vicinity of a proposed trail through the park. The trail is proposed to meet a City requirement for public access associated with the proposed Orcas Moon subdivision. This letter summarizes the findings of the study and details applicable federal, state, and local regulations. The following documents are enclosed:

- Delineation Sketch
- Wetland Determination Data Forms
- Wetland Rating Forms

## Findings Summary

Four wetlands and three streams are located in proximity to the proposed trail. This project is vested to the old Kirkland Zoning Code, Chapter 90 – Drainage Basins, which was in-effect prior to March 2017. The site is in a primary basin, Forbes Creek. Wetland and stream classifications and buffer widths are summarized in Table 1 below.

Table 1. Wetland and stream classification and buffer width summary.

| Name | Classification | Buffer Width |
|---|---|---|
| Wetland A | Type 2 | 75 feet |
| Wetland B | Type 2 | 75 feet |
| Wetland C | Type 3 | 50 feet |
| Wetland D | Type 2 | 75 feet |
| Stream A | Class B | 60 feet |
| Stream B | Class C | 35 feet |
| Stream C | Class C | 35 feet |

## Methods

Public-domain information on the subject properties was reviewed for this delineation study. Resources and review findings are presented in Table 1 of the "Findings" section of this letter.

The study area was evaluated for wetlands using methodology from the *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region Version 2.0* (U.S. Army Corps of Engineers 2010). Presence or absence of wetlands was determined on the basis of an examination of vegetation, soils and hydrology. These parameters were sampled at several locations along the wetland boundary to determine the approximate wetland edge. This project is vested to the old Kirkland Zoning Code, Chapter 90 – Drainage Basins, which was in-effect prior to March 1, 2017. Under this code, wetlands were classified using the Kirkland field form.

Three wetlands were delineated and marked with pink- and black-striped flags within the study area. Wetlands A and B were partially delineated with ten and six flags, respectively. Wetland C was marked with 8 flags. One wetland, Wetland D, was sketched at a reconnaissance-level.

Characterization of climatic conditions for precipitation in the Wetland Determination Data Forms were determined using the WETS table methodology (USDA, NRCS 2015). The "Seattle Tacoma Intl AP" station from 1981-2010 was used as a source for precipitation data (http://agacis.rcc-acis.org/). The WETS table methodology uses climate data from the three months prior to the site visit month to determine if normal conditions are present in the study area region.

The study area was evaluated for streams based on the presence or absence of an ordinary high water mark (OHWM) as defined by Section 404 of the Clean Water Act, the Washington

Administrative Code (WAC) 220-660-030, and the Revised Code of Washington (RCW) 90.58.030.

The right bank of Stream A was delineated and marked with 25 blue- and white-striped flags. Streams B and C were sketched at a reconnaissance-level.

## Findings

The study area is within in the Forbes Creek sub-basin of the Cedar-Sammamish watershed (WRIA 8); Section 32 of Township 26 North, Range 5 East of the Public Land Survey System. The proposed trail location consists of an undeveloped, north facing forested slope dominated by bigleaf maple and Western red cedar.

Reviewed public-domain information for the site is summarized below (Table 2).

Table 2. Summary of online mapping and inventory resources.

| Resource | Summary |
|---|---|
| USDA NRCS: Web Soil Survey | *Kitsap silt loam, Indianola loamy sand.* |
| USFWS: NWI Wetland Mapper | *Riverine system mapped apx. 375 feet west of study area. Forested/Shrub wetland mapped apx. 125 feet north of study area.* |
| WDFW: PHS on the Web | *Forested/Shrub wetland mapped apx. 150 feet north of study area. Sockeye, coho, resident coastal cutthroat mapped apx. 450 feet north of study area.* |
| WDFW: SalmonScape | *Intermittent/Ephemeral and Stream/Perennial water courses mapped apx. 325 feet west and 425 feet north of study area. Documented Coho rearing, Sockeye presence mapped apx. 425 feet north of study area.* |
| WA-DNR: Forest Practices Activity Mapping Tool | *Type N stream mapped apx. 300 feet west of study area. Type F stream mapped apx. 275 feet north of study area.* |
| King County iMap | *Forbes Creek mapped apx. 300 feet west and 275 feet north of study area; No wetlands mapped within study area or vicinity.* |
| City of Kirkland maps | *Open streams mapped at east, west and north edges of study area. Wetland mapped apx. 100 feet west of study area.* |
| WETS Climatic Condition | *Normal conditions.* |

### Wetlands

Four wetlands were identified in the vicinity of the marked trail alignment. They are referred to here as Wetlands A, B, C and D.

### *Wetland A*

Wetland A is a slope wetland located at the northern end of the study area containing forested and scrub-shrub classes. Common vegetation in Wetland A includes Western red cedar, vine maple, salmonberry, red-osier dogwood, and giant horsetail.

The soil observed in Wetland A is a sandy clay loam with a very dark gray (10YR 3/1) colored surface layer and underlying depleted layer with redoximorphic features present. The soil sampled satisfies the criteria for the hydric soil indicators Depleted Matrix (F3) and Depleted Below Dark Surface (A11). Soil conditions were saturated at 4 inches below the ground surface (BGS), and the water table was present 7 inches BGS on the day of our fieldwork.

Vegetation, soil, and hydrology indicators were observed within Wetland A at Data Point-1 (DP-1).

### *Wetland B*

Wetland B is a slope wetland located in the southeast quadrant of the study area containing forested and scrub-shrub classes. Common vegetation in Wetland B includes vine maple, Himalayan blackberry, salmonberry, and spiny wood fern.

The soil observed in Wetland B is a black (10YR 2/1) sandy loam colored surface layer. The underlying layer is a depleted loamy sand containing redoximorphic features. The soil sampled satisfies the criteria for the hydric soil indicators Depleted Matrix (F3) and Depleted Below Dark Surface (A11). Soil conditions were saturated at 8 inches below the ground surface (BGS), and the water table was present 12 inches BGS on the day of our fieldwork.

Vegetation, soil, and hydrology indicators were observed within Wetland B at Data Point-5 (DP-5).

### *Wetland C*

Wetland C is a small slope wetland located at the southern end of the study area containing a scrub-shrub class. Common vegetation in Wetland C includes Himalayan blackberry, salmonberry, and spiny wood fern.

The soil observed in Wetland C is a silt loam with a very dark gray (10YR 3/1) colored surface layer with redoximorphic features present. The underlying layer is a silty clay loam that is depleted and contains redoximorphic features. Soils smelled of hydrogen sulfide (indicator A4) during pit excavation. The soil sampled satisfies the criteria for the hydric soil indicators Depleted Matrix (F3) and Depleted Below Dark Surface (A11). Soil conditions were saturated at 3 inches below the ground surface (BGS), and the water table was present 7 inches BGS on the day of our fieldwork.

Vegetation, soil, and hydrology indicators were observed within Wetland C at Data Point-4 (DP-4).

### *Wetland D*

Wetland D is small riverine wetland located in the northwestern corner of the study area with a forested class and an understory of scrub-shrub and emergent vegetation. Common vegetation includes western red cedar, salmonberry, creeping buttercup, and piggyback. Surface water originating from Stream A was observed within Wetland D.

## Non-wetlands

Non-wetland areas were observed across the majority of the study area. Common vegetation in these areas includes bigleaf maple, western red cedar, Himalayan blackberry, osoberry, salmonberry, western hazelnut, western sword fern, bracken fern, Oregon grape, and trailing blackberry.

In some sampling locations, including DP-3 and DP-6, wetland hydrology and/or hydric soils were present at the time of the study, however the plants growing in these areas did not meet wetland vegetation criteria. A large percentage of the bigleaf maple population appear to be in a state of declining health, as indicated by numerous standing snags and developing snags. These factors indicate that hydrologic conditions on portions of the site may be changing.

## Streams

Three streams were identified within the study area. They are referred to here as Streams A, B and C.

### *Stream A*

Stream A originates from a culvert in the southwestern corner of the study area. The often steep and incised open channel of Stream A flows north through Juanita Bay Park for approximately 575 feet before losing channel definition within Wetland D. Since it was beyond our study area, our fieldwork did not determine if or where Stream A reemerges as an open channel again. Stream A is fairly steep, flowing on an estimated gradient of 20 percent as measured on King County iMAP. The bed is composed of clay, cobble, gravel, and sand with large woody debris (LWD) throughout the reach. Stream A is estimated to be 7 feet wide on average and appears to flow year-round. The stream is presumed to be a non-fish bearing channel due to its steep gradient (WAC 22-16-031).

### *Streams B and C*

Streams B and C originate within Wetland B located in the eastern edge of the study area. These streams are also fairly steep, flowing on an estimated gradient of 20 percent as measured on KC iMAP. Both streams have heavily vegetated stream banks dominated by shrubs including salmonberry, vine maple, and Himalayan blackberry. Bank-full-width for both streams average approximately 6 feet with mud, gravel, cobble and sand substrates. They are fed by precipitation and groundwater seeps and are presumed to be seasonal streams. Due to natural (steep gradient) fish passage barriers, both Streams B and C are presumed to be a non-fish bearing streams.

## Local Regulations

This project is vested to an older version of the Kirkland Zoning Code, Chapter 90 – Drainage Basins, which was in-effect prior to March 1, 2017. Wetlands are classified based on size, structural complexity, and landscape position using the Wetland Field Form. Stream classifications are based on salmonid fish presence or absence and flow conditions, seasonal or perennial (KZC 90.30). Wetland and stream classifications and buffer widths are summarized in Table 1 above.

Under KZC 90.45(1), "No land surface modification or tree removal shall occur and no improvement may be located in a wetland or its buffer, except as provided in this section." KZC 90.45(5) outlines criteria that may be considered in order to allow minor improvements within the outer one-half of a sensitive area buffer. This may require submitting a report form a qualified professional evaluating how factors such as water quality, wildlife, and erosion hazards may be affected under the proposal. Specific to this project, KZC 90.70 regulates wetland access as follows: "The City may develop access through a wetland and its buffer in conjunction with a public park." However, trail realignment at the south end can avoid direct wetland impacts and minimize buffer impacts.

Chapter 90.90 regulates activities in stream buffers. Minor improvements may be located is the outer half of the stream buffer, except where approved stream crossings are made, pursuant to KZC 90.90(5). The improvement must not adversely affect water quality, habitat or drainage. No erosion hazards or detrimental loss to the property or City as a whole shall result from proposed improvements. The Planning Official may require a report by a qualified professional to document code compliance.

# State and Federal Regulations

## Federal Agencies

Wetlands and streams are regulated by the Corps under section 404 of the Clean Water Act. Any proposed filling or other direct impacts to Waters of the U.S., including wetlands (except isolated wetlands), would require notification and permits from the Corps. Unavoidable impacts to jurisdictional wetlands are typically required to be compensated through implementation of an approved mitigation plan.

Federally permitted actions that could affect endangered species may also require a biological assessment study and consultation with the U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service. Compliance with the Endangered Species Act must be demonstrated for activities within jurisdictional wetlands and the 100-year floodplain. Application for Corps permits may also require an individual 401 Water Quality Certification and Coastal Zone Management Consistency determination from Ecology and a cultural resource study in accordance with Section 106 of the National Historic Preservation Act.

## Washington Department of Ecology (Ecology)

Similar to the Corps, Ecology, under Section 401 of the Clean Water Act, is charged with reviewing, conditioning, and approving or denying certain federally permitted actions that result in discharges to state waters. However, Ecology review would only become necessary if a Section 404 permit from the Corps was issued. Therefore, if filling activities are avoided, authorization from Ecology would not be needed.

If filling is proposed, a JARPA could be submitted to Ecology in order to obtain a Section 401 Water Quality Certification and Coastal Zone Management Consistency Determination. Ecology permits are either issued concurrently with the Corps permit or within 90 days following the Corps permit.

## Washington Department of Fish and Wildlife (WDFW)

Chapter 77.55 of the RCW (the Hydraulic Code) gives WDFW the authority to review, condition, and approve or deny "any construction activity that will use, divert, obstruct, or change the bed or flow of state waters." This provision includes any in-water work, the crossing or bridging of any state waters and can sometimes include stormwater discharge to state waters. If a project meets regulatory requirements, WDFW will issue a Hydraulic Project Approval (HPA).

Through issuance of an HPA, WDFW can also restrict activities to a particular timeframe. Work is typically restricted to late summer and early fall. However, WDFW has in the past allowed crossings that don't involve in-stream work to occur at any time during the year.

In general, neither the Corps, Ecology nor WDFW regulates wetland and stream buffers, unless direct impacts are proposed. When direct impacts are proposed, mitigated wetlands and streams may be required to employ buffers based on Corps and Ecology joint regulatory guidance.

## Disclaimer

The information contained in this letter is based on the application of technical guidelines currently accepted as the best available science and in conjunction with the manuals and criteria referenced above. All discussions, conclusions and recommendations reflect the best professional judgment of the author(s) and are based upon information available at the time the study was conducted. All work was completed within the constraints of budget, scope, and timing. The findings of this report are subject to verification and agreement by the appropriate local, state and federal regulatory authorities. No other warranty, expressed or implied, is made.

Please call if you have any questions or if we can provide you with any additional information.

Sincerely,

Peter Heltzel
Ecologist / Fisheries Biologist, Msc, CFP

Nell Lund
Senior Ecologist, PWS

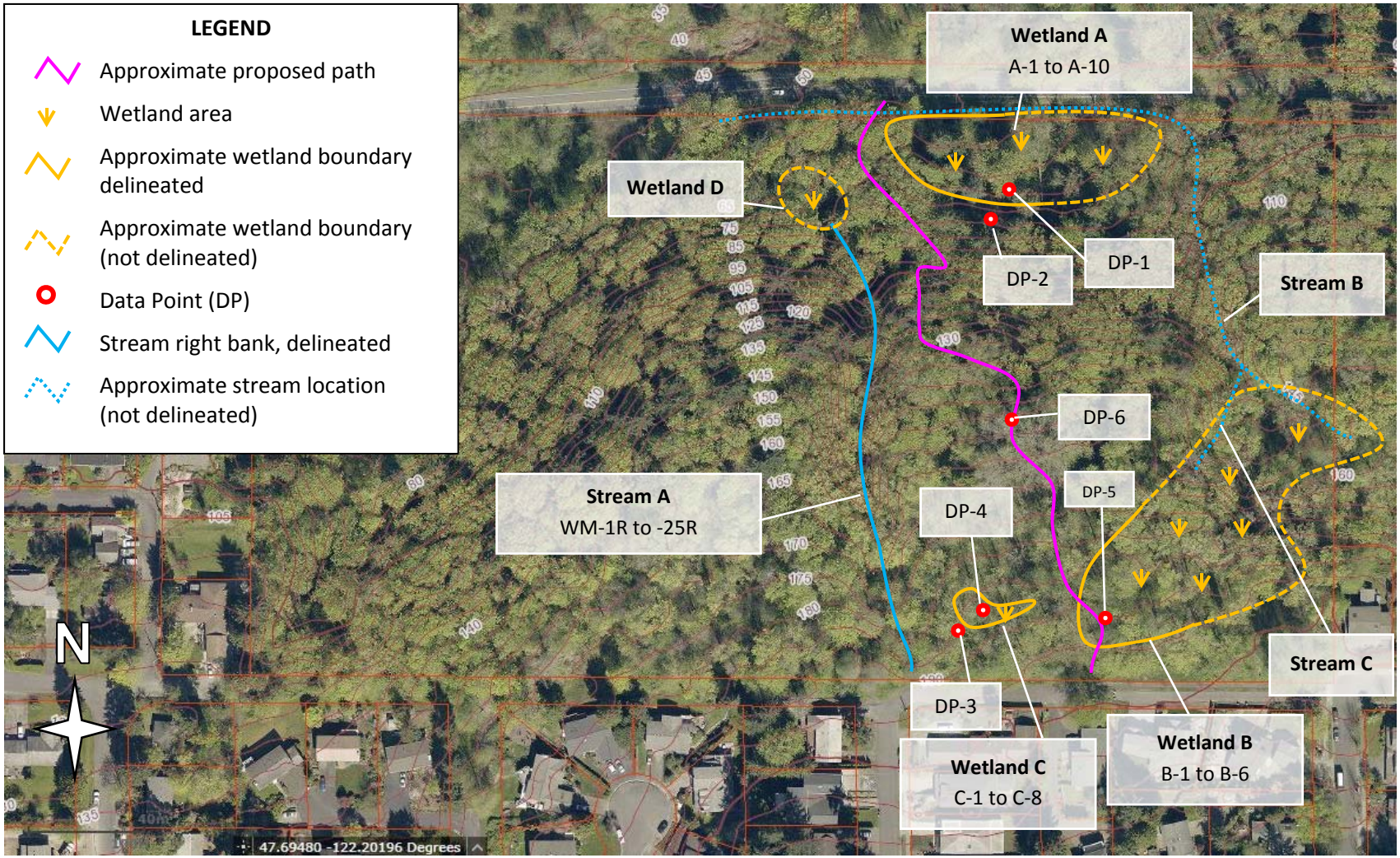
*Enclosures*

THE WATERSHED COMPANY
750 Sixth Street South | Kirkland | WA 98033
p 425.822.5242 f 425.827.8136



## Orcas Moon Path – Stream & Wetland Delineation and Reconnaissance Field Sketch

| | | | |
|---|---|---|---|
| Site Address: | Juanita Bay Park, Kirkland, WA | Prepared for: | City of Kirkland, Susan Lauinger |
| Parcel Number: | 3226059022 | TWC Ref. No.: | 160622.6 |
| Site Visit Date: | December 19, 2018; January 18 and 25, 2018 | | |




**Note**: Field sketch only. Features depicted are approximate and not to scale. Wetland flags are pink-and-black striped. Stream flags are blue- and white-striped. Data point flags are yellow-and black striped. (Data point locations can be approximated if not located by survey.)

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# WETLAND DETERMINATION DATA FORM

**Western Mountains, Valleys, and Coast Supplement to the 1987 COE Wetlands Delineation Manual**

ATTACHMENT 39

DP- 1

| | | | |
|---|---|---|---|
| Project Site: | Juanita Bay Park (parcel 3226059022) | Sampling Date: | 12/19/2018 |
| Applicant/Owner: | Orcas Moon LLC | Sampling Point: | DP- 1 |
| Investigator: | ROEN HOHLFELD, PETER HELTZEL | City/County: | Kirkland / King County |
| Sect., Township, Range: | S 32 T 26 R 5 | State: | WA |
| Landform (hillslope, terrace, etc): slope | Slope (%): >5% | Local relief (concave, convex, none): concave | |
| Subregion (LRR): A | Lat: | Long: | Datum: |
| Soil Map Unit Name: KpB (Kitsap silt loam) | | NWI classification: None | |

Are climatic/hydrologic conditions on the site typical for this time of year? ☒ Yes ☐ No (If no, explain in remarks.)
Are "Normal Circumstances" present on the site? ☒ Yes ☐ No
Are Vegetation☐, Soil ☐, or Hydrology ☐ significantly disturbed?
Are Vegetation☐, Soil ☐, or Hydrology ☐ naturally problematic (If needed, explain any answers in Remarks.)

## SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes ☒ | No ☐ | **Is the Sampling Point within a Wetland?** Yes ☒ No ☐ |
| Hydric Soils Present? | Yes ☒ | No ☐ | |
| Wetland Hydrology Present? | Yes ☒ | No ☐ | |

*Remarks:* **Wetland A**

## VEGETATION – Use scientific names of plants.

| **Tree Stratum** (Plot size: 5m diam.) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. *Thuja plicata* | 40 | Y | FAC |
| 2. *Acer macrophyllum* | 65 | Y | FACU |
| 3. | | | |
| 4. | | | |
| | 105 | = Total Cover | |
| **Sapling/Shrub Stratum** (Plot size: 3m diam.) | | | |
| 1. *Rubus spectabilis* | 85 | Y | FAC |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 85 | = Total Cover | |
| **Herb Stratum** (Plot size: 1m diam.) | | | |
| 1. *Rubus ursinus* | 35 | Y | FACU |
| 2. *Equisetum telmateia* | 25 | Y | FACW |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 60 | = Total Cover | |
| **Woody Vine Stratum** (Plot size: ) | | | |
| 1. | | | |
| 2. | | | |
| | | = Total Cover | |
| % Bare Ground in Herb Stratum: | | | |

### Dominance Test Worksheet

| | | |
|---|---|---|
| Number of Dominant Species that are OBL, FACW, or FAC: | 3 | (A) |
| Total Number of Dominant Species Across All Strata: | 5 | (B) |
| Percent of Dominant Species that are OBL, FACW, or FAC: | 60% | (A/B) |

### Prevalence Index Worksheet

| | Total % Cover of | Multiply by |
|---|---|---|
| OBL species | | x 1 = |
| FACW species | | x 2 = |
| FAC species | | x 3 = |
| FACU species | | x 4 = |
| UPL species | | x 5 = |
| Column totals | (A) | (B) |

Prevalence Index = B / A =

### Hydrophytic Vegetation Indicators

- ☒ Dominance test is > 50%
- ☐ Prevalence test is ≤ 3.0 *
- ☐ Morphological Adaptations * (provide supporting data in remarks or on a separate sheet)
- ☐ Wetland Non-Vascular Plants *
- ☐ Problematic Hydrophytic Vegetation * (explain)

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

**Hydrophytic Vegetation Present?** Yes ☒ No ☐

*Remarks:*

## SOIL

**Sampling Point – DP- 1**

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| **0-8** | **10YR 3/1** | **100** | | | | | **Sandy clay loam** | |
| **8-18** | **10YR 5/2** | **90** | **7.5YR 4/6** | **10** | **C** | **M** | **Sandy clay loam** | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains

[2]Loc: PL=Pore Lining, M=Matrix

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☒ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ☐ Loamy Gleyed Matrix (F2)
- ☒ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]**

- ☐ 2cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Other (explain in remarks)
- ☐

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic

Restrictive Layer (if present):
Type:
Depth (inches):

**Hydric soil present?** Yes ☒ No ☐

*Remarks:*

## HYDROLOGY

**Wetland Hydrology Indicators:**

*Primary Indicators (minimum of one required: check all that apply):*

- ☐ Surface water (A1)
- ☒ High Water Table (A2)
- ☒ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (**except MLRA 1, 2, 4A & 4B**) (B9)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (explain in remarks)

*Secondary Indicators (2 or more required):*

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A & 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks

**Field Observations**

| | | | | |
|---|---|---|---|---|
| Surface Water Present? | Yes ☐ | No ☒ | Depth (in): | |
| Water Table Present? | Yes ☒ | No ☐ | Depth (in): | **7"** |
| Saturation Present? (includes capillary fringe) | Yes ☒ | No ☐ | Depth (in): | **4"** |

**Wetland Hydrology Present?** Yes ☒ No ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

*Remarks:*

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# WETLAND DETERMINATION DATA FORM

**Western Mountains, Valleys, and Coast Supplement to the 1987 COE Wetlands Delineation Manual**

ATTACHMENT 39

DP- 2

| | | | |
|---|---|---|---|
| Project Site: | Juanita Bay Park (parcel 3226059022) | Sampling Date: | 12/19/2018 |
| Applicant/Owner: | Orcas Moon LLC | Sampling Point: | DP- 2 |
| Investigator: | ROEN HOHLFELD, PETER HELTZEL | City/County: | Kirkland / King County |
| Sect., Township, Range: | S 32 T 26 R 5 | State: | WA |
| Landform (hillslope, terrace, etc): slope | Slope (%): 10% | Local relief (concave, convex, none): | concave |
| Subregion (LRR): A | Lat: | Long: | Datum: |
| Soil Map Unit Name: KpB (Kitsap silt loam) | | NWI classification: | None |

Are climatic/hydrologic conditions on the site typical for this time of year? ☒ Yes ☐ No (If no, explain in remarks.)
Are "Normal Circumstances" present on the site? ☒ Yes ☐ No
Are Vegetation☐, Soil ☐, or Hydrology ☐ significantly disturbed?
Are Vegetation☐, Soil ☐, or Hydrology ☐ naturally problematic (If needed, explain any answers in Remarks.)

## SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | |
|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes ☐ | No ☒ | Is the Sampling Point within a Wetland? Yes ☐ No ☒ |
| Hydric Soils Present? | Yes ☐ | No ☒ | |
| Wetland Hydrology Present? | Yes ☐ | No ☒ | |

*Remarks:* **Wetland A out-pit**

## VEGETATION – Use scientific names of plants.

| **Tree Stratum** (Plot size: 5m diam.) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. *Acer macrophyllum* | 45 | Y | FACU |
| 2. *Thuja plicata* | 25 | Y | FAC |
| 3. *Tsuga heterophylla* | 10 | N | FACU |
| 4. | | | |
| | 80 | = Total Cover | |
| **Sapling/Shrub Stratum** (Plot size: 3m diam.) | | | |
| 1. *Oemleria cerasiformis* | 45 | Y | FACU |
| 2. *Acer circinatum* | 25 | Y | FAC |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 70 | = Total Cover | |
| **Herb Stratum** (Plot size: 1m diam.) | | | |
| 1. *Mahonia nervosa* | 50 | Y | FACU |
| 2. *Polystichum munitum* | 20 | Y | FACU |
| 3. *Carex deweyana* | 5 | N | FAC |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 75 | = Total Cover | |
| **Woody Vine Stratum** (Plot size: ) | | | |
| 1. *Rubus ursinus* | 5 | Y | FACU |
| 2. | | | |
| | | = Total Cover | |
| % Bare Ground in Herb Stratum: | | | |

### Dominance Test Worksheet

| | | |
|---|---|---|
| Number of Dominant Species that are OBL, FACW, or FAC: | 2 | (A) |
| Total Number of Dominant Species Across All Strata: | 7 | (B) |
| Percent of Dominant Species that are OBL, FACW, or FAC: | 29% | (A/B) |

### Prevalence Index Worksheet

| | Total % Cover of | Multiply by |
|---|---|---|
| OBL species | | x 1 = |
| FACW species | | x 2 = |
| FAC species | | x 3 = |
| FACU species | | x 4 = |
| UPL species | | x 5 = |
| Column totals | (A) | (B) |

Prevalence Index = B / A =

### Hydrophytic Vegetation Indicators

- ☐ Dominance test is > 50%
- ☐ Prevalence test is ≤ 3.0 *
- ☐ Morphological Adaptations * (provide supporting data in remarks or on a separate sheet)
- ☐ Wetland Non-Vascular Plants *
- ☐ Problematic Hydrophytic Vegetation * (explain)

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

**Hydrophytic Vegetation Present?** Yes ☐ No ☒

*Remarks:*

## SOIL

**Sampling Point – DP- 2**

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| **0-10** | **10YR 3/1** | **100** | | | | | **Sandy loam** | |
| **10-16** | **2.5Y 5/4** | **100** | | | | | **Sandy loam** | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains

[2]Loc: PL=Pore Lining, M=Matrix

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]**

- ☐ 2cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Other (explain in remarks)
- ☐

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic

Restrictive Layer (if present):

Type:

Depth (inches):

**Hydric soil present?** Yes ☐ No ☒

*Remarks:*

## HYDROLOGY

**Wetland Hydrology Indicators:**

*Primary Indicators (minimum of one required: check all that apply):*

- ☐ Surface water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (**except MLRA 1, 2, 4A & 4B**) (B9)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (explain in remarks)

*Secondary Indicators (2 or more required):*

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A & 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks

**Field Observations**

| | | | |
|---|---|---|---|
| Surface Water Present? | Yes ☐ | No ☒ | Depth (in): |
| Water Table Present? | Yes ☐ | No ☒ | Depth (in): |
| Saturation Present? (includes capillary fringe) | Yes ☐ | No ☒ | Depth (in): |

**Wetland Hydrology Present?** Yes ☐ No ☒

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

*Remarks:*

THE WATERSHED COMPANY
750 Sixth Street South
Kirkland, Washington 98033
(425) 822-5242
watershedco.com

# WETLAND DETERMINATION DATA FORM

**Western Mountains, Valleys, and Coast Supplement to the 1987 COE Wetlands Delineation Manual**

DP- 3

| | | | |
|---|---|---|---|
| Project Site: | Juanita Bay Park (parcel 3226059022) | Sampling Date: | 12/19/2018 |
| Applicant/Owner: | Orcas Moon LLC | Sampling Point: | DP- 3 |
| Investigator: | ROEN HOHLFELD, PETER HELTZEL | City/County: | Kirkland / King County |
| Sect., Township, Range: | S 32 T 26 R 5 | State: | WA |
| Landform (hillslope, terrace, etc): slope | Slope (%): >5% | Local relief (concave, convex, none): concave | |
| Subregion (LRR): A | Lat: | Long: | Datum: |
| Soil Map Unit Name: KpB (Kitsap silt loam) | | NWI classification: None | |

Are climatic/hydrologic conditions on the site typical for this time of year? ☒ Yes ☐ No (If no, explain in remarks.)
Are "Normal Circumstances" present on the site? ☒ Yes ☐ No
Are Vegetation☐, Soil ☐, or Hydrology ☐ significantly disturbed?
Are Vegetation☐, Soil ☐, or Hydrology ☐ naturally problematic (If needed, explain any answers in Remarks.)

## SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | | |
|---|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes ☐ | No ☒ | **Is the Sampling Point within a Wetland?** | Yes ☐ No ☒ |
| Hydric Soils Present? | Yes ☒ | No ☐ | | |
| Wetland Hydrology Present? | Yes ☒ | No ☐ | | |

*Remarks:* **Wetland C out-pit**

## VEGETATION – Use scientific names of plants.

| **Tree Stratum** (Plot size: 5m diam.) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. *Acer macrophyllum* | 95 | Y | FACU |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 95 | = Total Cover | |

| **Sapling/Shrub Stratum** (Plot size: 3m diam.) | | | |
|---|---|---|---|
| 1. *Corylus cornuta* | 30 | Y | FACU |
| 2. *Oemleria cerasiformis* | 25 | Y | FACU |
| 3. *Ilex aquifolium* | 5 | N | FACU |
| 4. | | | |
| 5. | | | |
| | 60 | = Total Cover | |

| **Herb Stratum** (Plot size: 1m diam.) |
|---|
| 1. |
| 2. |
| 3. |
| 4. |
| 5. |
| 6. |
| 7. |
| 8. |
| 9. |
| 10. |
| 11. |
| = Total Cover |

| **Woody Vine Stratum** (Plot size: ) | | | |
|---|---|---|---|
| 1. *Rubus ursinus* | 15 | Y | FACU |
| 2. | | | |
| | 15 | = Total Cover | |

% Bare Ground in Herb Stratum:

### Dominance Test Worksheet

| | | |
|---|---|---|
| Number of Dominant Species that are OBL, FACW, or FAC: | 0 | (A) |
| Total Number of Dominant Species Across All Strata: | 4 | (B) |
| Percent of Dominant Species that are OBL, FACW, or FAC: | 0% | (A/B) |

### Prevalence Index Worksheet

| | Total % Cover of | Multiply by |
|---|---|---|
| OBL species | | x 1 = |
| FACW species | | x 2 = |
| FAC species | | x 3 = |
| FACU species | | x 4 = |
| UPL species | | x 5 = |
| Column totals | (A) | (B) |

Prevalence Index = B / A =

### Hydrophytic Vegetation Indicators

- ☐ Dominance test is > 50%
- ☐ Prevalence test is ≤ 3.0 *
- ☐ Morphological Adaptations * (provide supporting data in remarks or on a separate sheet)
- ☐ Wetland Non-Vascular Plants *
- ☐ Problematic Hydrophytic Vegetation * (explain)

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

**Hydrophytic Vegetation Present?** Yes ☐ No ☒

*Remarks:*

## SOIL

**Sampling Point – DP- 3**

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| **0-8** | **10YR 2/1** | **100** | | | | | **Silt loam** | |
| **8-18** | **2.5Y 4/2** | **97** | **7.5YR 5/6** | **3** | **C** | **M** | **Gravelly clay loam** | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains

[2]Loc: PL=Pore Lining, M=Matrix

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☒ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ☐ Loamy Gleyed Matrix (F2)
- ☒ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]**

- ☐ 2cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Other (explain in remarks)
- ☐

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic

Restrictive Layer (if present):
Type:
Depth (inches):

**Hydric soil present?** Yes ☒ No ☐

*Remarks:*

## HYDROLOGY

**Wetland Hydrology Indicators:**

*Primary Indicators (minimum of one required: check all that apply):*

- ☐ Surface water (A1)
- ☒ High Water Table (A2)
- ☒ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (**except MLRA 1, 2, 4A & 4B**) (B9)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (explain in remarks)

*Secondary Indicators (2 or more required):*

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A & 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks

**Field Observations**

| | | | | |
|---|---|---|---|---|
| Surface Water Present? | Yes ☐ | No ☒ | Depth (in): | |
| Water Table Present? | Yes ☒ | No ☐ | Depth (in): | **7”** |
| Saturation Present? (includes capillary fringe) | Yes ☒ | No ☐ | Depth (in): | **6”** |

**Wetland Hydrology Present?** Yes ☒ No ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

*Remarks:*

THE WATERSHED COMPANY
750 Sixth Street South
Kirkland, Washington 98033
(425) 822-5242
watershedco.com

# WETLAND DETERMINATION DATA FORM

**Western Mountains, Valleys, and Coast Supplement to the 1987 COE Wetlands Delineation Manual**

DP- 4

| | | | |
|---|---|---|---|
| Project Site: | Juanita Bay Park (parcel 3226059022) | Sampling Date: | 12/19/2018 |
| Applicant/Owner: | Orcas Moon LLC | Sampling Point: | DP- 4 |
| Investigator: | ROEN HOHLFELD, PETER HELTZEL | City/County: | Kirkland / King County |
| Sect., Township, Range: | S 32 T 26 R 5 | State: | WA |
| Landform (hillslope, terrace, etc): slope | Slope (%): >5% | Local relief (concave, convex, none): concave | |
| Subregion (LRR): A | Lat: | Long: | Datum: |
| Soil Map Unit Name: KpB (Kitsap silt loam) | | NWI classification: None | |

Are climatic/hydrologic conditions on the site typical for this time of year? ☒ Yes ☐ No (If no, explain in remarks.)
Are "Normal Circumstances" present on the site? ☒ Yes ☐ No
Are Vegetation☐, Soil ☐, or Hydrology ☐ significantly disturbed?
Are Vegetation☐, Soil ☐, or Hydrology ☐ naturally problematic (If needed, explain any answers in Remarks.)

## SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | | |
|---|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes ☒ | No ☐ | Is the Sampling Point within a Wetland? | Yes ☒ No ☐ |
| Hydric Soils Present? | Yes ☒ | No ☐ | | |
| Wetland Hydrology Present? | Yes ☒ | No ☐ | | |

*Remarks:* Wetland C

## VEGETATION – Use scientific names of plants.

| Tree Stratum (Plot size: 5m diam.) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. *Acer macrophyllum* | 80 | Y | FACU |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 80 | = Total Cover | |

| Sapling/Shrub Stratum (Plot size: 3m diam.) | | | |
|---|---|---|---|
| 1. *Rubus armeniacus* | 70 | Y | FAC |
| 2. *Rubus spectabilis* | 55 | Y | FAC |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 125 | = Total Cover | |

| Herb Stratum (Plot size: 1m diam.) |
|---|
| 1. |
| 2. |
| 3. |
| 4. |
| 5. |
| 6. |
| 7. |
| 8. |
| 9. |
| 10. |
| 11. |
| = Total Cover |

| Woody Vine Stratum (Plot size: ) |
|---|
| 1. |
| 2. |
| = Total Cover |

% Bare Ground in Herb Stratum:

### Dominance Test Worksheet

| | | |
|---|---|---|
| Number of Dominant Species that are OBL, FACW, or FAC: | 2 | (A) |
| Total Number of Dominant Species Across All Strata: | 3 | (B) |
| Percent of Dominant Species that are OBL, FACW, or FAC: | 67% | (A/B) |

### Prevalence Index Worksheet

| | Total % Cover of | Multiply by |
|---|---|---|
| OBL species | | x 1 = |
| FACW species | | x 2 = |
| FAC species | | x 3 = |
| FACU species | | x 4 = |
| UPL species | | x 5 = |
| Column totals | (A) | (B) |

Prevalence Index = B / A =

### Hydrophytic Vegetation Indicators

- ☒ Dominance test is > 50%
- ☐ Prevalence test is ≤ 3.0 *
- ☐ Morphological Adaptations * (provide supporting data in remarks or on a separate sheet)
- ☐ Wetland Non-Vascular Plants *
- ☐ Problematic Hydrophytic Vegetation * (explain)

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

**Hydrophytic Vegetation Present?** Yes ☒ No ☐

*Remarks:*

## SOIL

**Sampling Point – DP-4**

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| **0-8** | **10YR 3/1** | **97** | **7.5YR 4/6** | **3** | **C** | **M** | **Silt loam** | |
| **8-18** | **2.5Y 4/2** | **75** | **7.5YR 5/6** | **25** | **C** | **M** | **Silty clay loam** | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Loc: PL=Pore Lining, M=Matrix

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☒ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ☐ Loamy Gleyed Matrix (F2)
- ☒ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]**

- ☐ 2cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Other (explain in remarks)
- ☐

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic

Restrictive Layer (if present):
Type:
Depth (inches):

**Hydric soil present?** Yes ☒ No ☐

*Remarks:*

## HYDROLOGY

**Wetland Hydrology Indicators:**

*Primary Indicators (minimum of one required: check all that apply):*

- ☐ Surface water (A1)
- ☒ High Water Table (A2)
- ☒ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (**except MLRA 1, 2, 4A & 4B**) (B9)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (explain in remarks)

*Secondary Indicators (2 or more required):*

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A & 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks

**Field Observations**

| | | | | |
|---|---|---|---|---|
| Surface Water Present? | Yes ☐ | No ☒ | Depth (in): | |
| Water Table Present? | Yes ☒ | No ☐ | Depth (in): | **7”** |
| Saturation Present? (includes capillary fringe) | Yes ☒ | No ☐ | Depth (in): | **3”** |

**Wetland Hydrology Present?** Yes ☒ No ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

*Remarks:*

THE WATERSHED COMPANY
750 Sixth Street South
Kirkland, Washington 98033
(425) 822-5242
watershedco.com

# WETLAND DETERMINATION DATA FORM

**Western Mountains, Valleys, and Coast Supplement to the 1987 COE Wetlands Delineation Manual**

DP- 5

| | | | |
|---|---|---|---|
| Project Site: | Juanita Bay Park (parcel 3226059022) | Sampling Date: | 1/18/2019 |
| Applicant/Owner: | Orcas Moon LLC | Sampling Point: | DP- 5 |
| Investigator: | ROEN HOHLFELD, NELL LUND | City/County: | Kirkland / King County |
| Sect., Township, Range: | S 32 T 26 R 5 | State: | WA |
| Landform (hillslope, terrace, etc): slope | Slope (%): >5% | Local relief (concave, convex, none): none | |
| Subregion (LRR): A | Lat: | Long: | Datum: |
| Soil Map Unit Name: KpB (Kitsap silt loam) | | NWI classification: None | |

Are climatic/hydrologic conditions on the site typical for this time of year? ☒ Yes ☐ No (If no, explain in remarks.)
Are "Normal Circumstances" present on the site? ☒ Yes ☐ No
Are Vegetation☐, Soil ☐, or Hydrology ☐ significantly disturbed?
Are Vegetation☐, Soil ☐, or Hydrology ☐ naturally problematic (If needed, explain any answers in Remarks.)

**SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.**

| | | | | |
|---|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes ☒ | No ☐ | **Is the Sampling Point within a Wetland?** | Yes ☒ No ☐ |
| Hydric Soils Present? | Yes ☒ | No ☐ | | |
| Wetland Hydrology Present? | Yes ☒ | No ☐ | | |

*Remarks:* **Wetland B**

**VEGETATION – Use scientific names of plants.**

| **Tree Stratum** (Plot size: 5m diam.) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. *Acer macrophyllum* | 90 | Y | FACU |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 90 | = Total Cover | |
| **Sapling/Shrub Stratum** (Plot size: 3m diam.) | | | |
| 1. *Rubus armeniacus* | 90 | Y | FAC |
| 2. *Rubus spectabilis* | 60 | Y | FAC |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 150 | = Total Cover | |
| **Herb Stratum** (Plot size: 1m diam.) | | | |
| 1. | | | |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | | = Total Cover | |
| **Woody Vine Stratum** (Plot size: ) | | | |
| 1. | | | |
| 2. | | | |
| | | = Total Cover | |

% Bare Ground in Herb Stratum:

**Dominance Test Worksheet**

| | | |
|---|---|---|
| Number of Dominant Species that are OBL, FACW, or FAC: | 2 | (A) |
| Total Number of Dominant Species Across All Strata: | 3 | (B) |
| Percent of Dominant Species that are OBL, FACW, or FAC: | 67% | (A/B) |

**Prevalence Index Worksheet**

| Total % Cover of | | Multiply by |
|---|---|---|
| OBL species | | x 1 = |
| FACW species | | x 2 = |
| FAC species | | x 3 = |
| FACU species | | x 4 = |
| UPL species | | x 5 = |
| Column totals | (A) | (B) |

Prevalence Index = B / A =

**Hydrophytic Vegetation Indicators**

- ☒ Dominance test is > 50%
- ☐ Prevalence test is ≤ 3.0 *
- ☐ Morphological Adaptations * (provide supporting data in remarks or on a separate sheet)
- ☐ Wetland Non-Vascular Plants *
- ☐ Problematic Hydrophytic Vegetation * (explain)

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

**Hydrophytic Vegetation Present?** Yes ☒ No ☐

*Remarks:*

**SOIL** **Sampling Point – DP-5**

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| **0-9** | **10YR 2/1** | **100** | | | | | **Sandy loam** | **With gravel** |
| **9-16** | **10YR 4/2** | **95** | **10YR 4/6** | **5** | **C** | **M** | **Loamy sand** | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Loc: PL=Pore Lining, M=Matrix

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☒ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ☐ Loamy Gleyed Matrix (F2)
- ☒ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]**

- ☐ 2cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Other (explain in remarks)
- ☐

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic

Restrictive Layer (if present):
Type:
Depth (inches):

**Hydric soil present?** Yes ☒ No ☐

*Remarks:*

**HYDROLOGY**

**Wetland Hydrology Indicators:**

*Primary Indicators (minimum of one required: check all that apply):*

- ☐ Surface water (A1)
- ☒ High Water Table (A2)
- ☒ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (**except MLRA 1, 2, 4A & 4B**) (B9)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (explain in remarks)

*Secondary Indicators (2 or more required):*

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A & 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks

**Field Observations**

| | | | | |
|---|---|---|---|---|
| Surface Water Present? | Yes ☐ | No ☒ | Depth (in): | |
| Water Table Present? | Yes ☒ | No ☐ | Depth (in): | **12"** |
| Saturation Present? (includes capillary fringe) | Yes ☒ | No ☐ | Depth (in): | **8"** |

**Wetland Hydrology Present?** Yes ☒ No ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

*Remarks:*

THE WATERSHED COMPANY
750 Sixth Street South
Kirkland, Washington 98033
(425) 822-5242
watershedco.com

# WETLAND DETERMINATION DATA FORM

**Western Mountains, Valleys, and Coast Supplement to the 1987 COE Wetlands Delineation Manual**

DP- 6

| | | | |
|---|---|---|---|
| Project Site: | Juanita Bay Park (parcel 3226059022) | Sampling Date: | 1/18/2019 |
| Applicant/Owner: | Orcas Moon LLC | Sampling Point: | DP- 6 |
| Investigator: | ROEN HOHLFELD, NELL LUND | City/County: | Kirkland / King County |
| Sect., Township, Range: | S 32 T 26 R 5 | State: | WA |
| Landform (hillslope, terrace, etc): slope | Slope (%): >5% | Local relief (concave, convex, none): none | |
| Subregion (LRR): A | Lat: | Long: | Datum: |
| Soil Map Unit Name: KpB (Kitsap silt loam) | | NWI classification: None | |

Are climatic/hydrologic conditions on the site typical for this time of year? ☒ Yes ☐ No (If no, explain in remarks.)
Are "Normal Circumstances" present on the site? ☒ Yes ☐ No
Are Vegetation☐, Soil ☐, or Hydrology ☐ significantly disturbed?
Are Vegetation☐, Soil ☐, or Hydrology ☐ naturally problematic (If needed, explain any answers in Remarks.)

## SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

| | | | | |
|---|---|---|---|---|
| Hydrophytic Vegetation Present? | Yes ☐ | No ☒ | **Is the Sampling Point within a Wetland?** | Yes ☐ No ☒ |
| Hydric Soils Present? | Yes ☒ | No ☐ | | |
| Wetland Hydrology Present? | Yes ☒ | No ☐ | | |

*Remarks:* **Mid trail out-pit**

## VEGETATION – Use scientific names of plants.

| **Tree Stratum** (Plot size: 5m diam.) | Absolute % Cover | Dominant Species? | Indicator Status |
|---|---|---|---|
| 1. *Acer macrophyllum* | 20 | Y | FACU |
| 2. | | | |
| 3. | | | |
| 4. | | | |
| | 20 | = Total Cover | |
| **Sapling/Shrub Stratum** (Plot size: 3m diam.) | | | |
| 1. *Rubus armeniacus* | 90 | Y | FAC |
| 2. Ornamental species | 20 | N | FAC* |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| | 110 | = Total Cover | |
| **Herb Stratum** (Plot size: 1m diam.) | | | |
| 1. *Polystichum munitum* | 10 | Y | FACU |
| 2. *Tolmiea menziesii* | 5 | Y | FAC |
| 3. | | | |
| 4. | | | |
| 5. | | | |
| 6. | | | |
| 7. | | | |
| 8. | | | |
| 9. | | | |
| 10. | | | |
| 11. | | | |
| | 15 | = Total Cover | |
| **Woody Vine Stratum** (Plot size: ) | | | |
| 1. *Rubus ursinus* | 10 | Y | FACU |
| 2. | | | |
| | 10 | = Total Cover | |
| % Bare Ground in Herb Stratum: | | | |

### Dominance Test Worksheet

| | | |
|---|---|---|
| Number of Dominant Species that are OBL, FACW, or FAC: | 2 | (A) |
| Total Number of Dominant Species Across All Strata: | 5 | (B) |
| Percent of Dominant Species that are OBL, FACW, or FAC: | 40% | (A/B) |

### Prevalence Index Worksheet

| Total % Cover of | | Multiply by |
|---|---|---|
| OBL species | | x 1 = |
| FACW species | | x 2 = |
| FAC species | | x 3 = |
| FACU species | | x 4 = |
| UPL species | | x 5 = |
| Column totals | (A) | (B) |

Prevalence Index = B / A =

### Hydrophytic Vegetation Indicators

- ☐ Dominance test is > 50%
- ☐ Prevalence test is ≤ 3.0 *
- ☐ Morphological Adaptations * (provide supporting data in remarks or on a separate sheet)
- ☐ Wetland Non-Vascular Plants *
- ☐ Problematic Hydrophytic Vegetation * (explain)

* Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic

**Hydrophytic Vegetation Present?** Yes ☐ No ☒

*Remarks:* ***Unknown ornamental shrub species presumed FAC.**
**Bracken fern (FACU) in vicinity**

## SOIL

**Sampling Point – DP-6**

**Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)**

| Depth (inches) | Matrix Color (moist) | Matrix % | Redox Features Color (moist) | Redox % | Type[1] | Loc[2] | Texture | Remarks |
|---|---|---|---|---|---|---|---|---|
| **0-10** | **10YR 3/1** | **100** | | | | | **Silt loam** | |
| **10-16** | **2.5Y 5/2** | **65** | **10YR 4/6** | **35** | **C** | | **Silt loam** | |
| | | | | | | | | |

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Loc: PL=Pore Lining, M=Matrix

**Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)**

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☒ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Mucky Mineral (S1)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Loamy Mucky Mineral (F1) **(except MLRA 1)**
- ☐ Loamy Gleyed Matrix (F2)
- ☐ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)

**Indicators for Problematic Hydric Soils[3]**

- ☐ 2cm Muck (A10)
- ☐ Red Parent Material (TF2)
- ☐ Other (explain in remarks)
- ☐

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic

Restrictive Layer (if present):
Type:
Depth (inches):

**Hydric soil present?** Yes ☒ No ☐

*Remarks:*

## HYDROLOGY

**Wetland Hydrology Indicators:**

*Primary Indicators (minimum of one required: check all that apply):*

- ☐ Surface water (A1)
- ☐ High Water Table (A2)
- ☒ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift Deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Surface Soil Cracks (B6)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Water-Stained Leaves (**except MLRA 1, 2, 4A & 4B**) (B9)
- ☐ Salt Crust (B11)
- ☐ Aquatic Invertebrates (B13)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Stunted or Stressed Plants (D1) (**LRR A**)
- ☐ Other (explain in remarks)

*Secondary Indicators (2 or more required):*

- ☐ Water-Stained Leaves (B9) (**MLRA 1, 2, 4A & 4B**)
- ☐ Drainage Patterns (B10)
- ☐ Dry-Season Water Table (C2)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ FAC-Neutral Test (D5)
- ☐ Raised Ant Mounds (D6) (**LRR A**)
- ☐ Frost-Heave Hummocks

**Field Observations**

| | | | |
|---|---|---|---|
| Surface Water Present? | Yes ☐ | No ☒ | Depth (in): |
| Water Table Present? | Yes ☐ | No ☒ | Depth (in): |
| Saturation Present? (includes capillary fringe) | Yes ☒ | No ☐ | Depth (in): **7"** |

**Wetland Hydrology Present?** Yes ☒ No ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

*Remarks:*

WETLAND A – TYPE 2

## WETLAND FIELD DATA FORM – Orcas Moon property located at 4xx 20th Avenue Kirkland, WA 98033.

## Rating done on 1-18-2019 by The Watershed Company.

**WETLAND FIELD DATA FORM**

BEGIN BY CHECKING ANY OF THE FOLLOWING (a. – e.) THAT APPLY:

a. The wetland is contiguous to Lake Washington;

b. The wetland contains at least 1/4 acre of organic soils, such as peat bogs or mucky soils;

c. The wetland is equal to or greater than 10 acres in size and having three or more wetland classes, as defined by the U.S. Fish & Wildlife Service (Cowardin et al., 1979), one of which is open water;

d. The wetland has significant habitat value to state or federally listed threatened or endangered wildlife species; or

e. The wetland contains state or federally listed threatened or endangered plant species.

IF ANY OF THE CRITERIA LISTED ABOVE ARE MET, THEN THE WETLAND IS CONSIDERED TO BE TYPE 1. IF THAT IS THE CASE, PLEASE CONTINUE TO COMPLETE THE ENTIRE FORM, BUT DO NOT ASSIGN POINTS.

IF THE WETLAND DOES NOT MEET THE CRITERIA LISTED ABOVE FOR TYPE 1, COMPLETE THE ENTIRE FORM, USING THE ASSIGNED POINTS TO DETERMINE IF IT IS A TYPE 2 OR TYPE 3 WETLAND.

Type 2 wetlands typically have at least two wetland vegetation classes, are at least partially surrounded by buffers of native vegetation, connected by surface water flow (perennial or intermittent) to other wetlands or streams, and contain or are associated with forested habitat.

**1. Total wetland area**

| Estimate wetland area and score from choices | Acres | | Point Value | **Points** |
|---|---|---|---|---|
| | >20.00 | = | 6 | |
| | 10-19.99 | = | 5 | |
| | 5-9.99 | = | 4 | |
| | 1-4.99 | = | 3 | |
| | 0.1-0.99 | = | 2 | **2** |
| | <0.1 | = | 1 | |

**(2 points)**

# WETLAND A – TYPE 2

**2. Wetland classes: Determine the number of wetland classes that qualify, and score according to the table.**

| | # of Classes | | Points |
|---|---|---|---|
| **Open Water:** if the area of open water is >1/3 acre or >10% of the total wetland area | 1 | = | 1 |
| **Aquatic Beds:** if the area of aquatic beds is >10% of the **open water** area **or** >1/2 acre | 2 | = | 3 |
| **Emergent:** if the area of emergent class is >1/2 acre **or** >10% of the total wetland area | 3 | = | 5 |
| **Scrub-Shrub:** if the area of scrub-shrub class is >1/2 acre **or** >10% of the total wetland area | 4 | = | 7 |
| **Forested:** if the area of forested class is >1/2 acre or >10% of the total wetland area | 5 | = | 10 |

**(3 points)**

**3. Plant species diversity.**

For all wetland classes which qualified in 2 above, count the number of different plant species and score according to the table below. You do not have to name them.

e.g., if a wetland has an aquatic bed class with 3 species, and emergent class with 4 species and a scrub-shrub class with 2 species, you would circle 2, 2, and 1 in the second column (below).

| Class | # of Species | Point Value | Class | # of Species | Point Value |
|---|---|---|---|---|---|
| Aquatic Bed | 1-2 | = 1 | Scrub-Shrub | 1-2 | = 1 |
| | 3 | = 2 | | 3-4 | = 2 |
| | >3 | = 3 | | >4 | = 3 |
| Emergent | 1-2 | = 1 | Forested | 1-2 | = 1 |
| | 3-4 | = 2 | | 3-4 | = 2 |
| | >4 | = 3 | | >4 | = 3 |

**(6 points)**

**4. Structural diversity.**

If the wetland has a forested class, add 1 point for each of the following attributes present:

Trees >50′ tall = 1
Trees 20′ to 49′ tall = 1
shrubs = 1
Herbaceous ground cover = 1

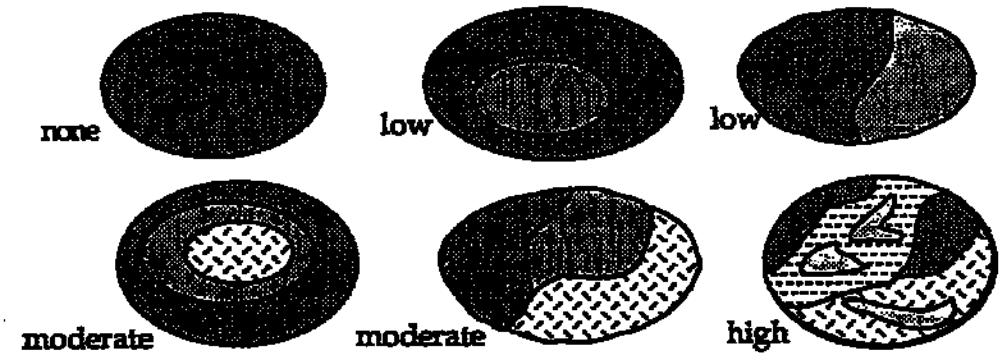
**(4 points)**

# WETLAND A – TYPE 2

**5. Interspersion between wetland classes.**

Decide from the diagrams below whether interspection between wetland classes is high, moderate, low or none

3 = High
2 = Moderate
1 = Low
0 = None




**(1 points)**

**6. Habitat features**

Add points associated with each habitat feature listed:

| | |
|---|---|
| Is there evidence of current use by beavers? | = 3 |
| Is a heron rookery located within 300′? | = 2 |
| Are raptor nest(s) located within 300′? | = 1 |
| Are there at least 2 standing dead trees (snags) per acre? | = 1 |
| Are there any other perches (wires, poles, or posts)? | = 1 |
| Are there at least 3 downed logs per acre? | = 1 |

**(3 points)**

**7. Connection to streams**

Is the wetland connected at any time of the year via surface water? **(score one answer only)**

| Is the wetland connected at any time of the year via surface water? | |
|---|---|
| To a perennial stream or a seasonal stream *with* fish | = 5 |
| To a seasonal stream *without* fish | = 3 |
| Is not connected to any stream | = 0 |

**(3 points)**

# WETLAND A – TYPE 2

**8. Buffers**

*Step 1:* Estimate (to the nearest 5%) the percentage of each buffer or land-use type (below) that adjoins the wetland boundary. Then multiply these percentages by the factor(s) below and enter result in the column to the right.

| | % of Buffer | | Step 1 | Width Factor | | Step 2 |
|---|---|---|---|---|---|---|
| Roads, buildings or parking lots | 40 % | X 0 = | 0 | 0 | = | 0 |
| Lawn, grazed pasture, vineyards or annual crops | % | X 1 = | | | = | |
| Ungrazed grassland or orchards | % | X 2 = | | | = | |
| Open water or native grasslands | % | X 3 = | | | = | |
| Forest or shrub | 60 % | X 4 = | 240 | 3 | = | 720 |

Add buffer total 720

*Step 2:* Multiply result(s) of step 1:

By 1 if buffer width is 25-50′

By 2 if buffer width is 50-100′

By 3 if buffer width is >100′

Enter results and add subscores

*Step 3:* Score points according to the following table:

Buffer Total

900-1200 = 4

600-899 = 3

300-599 = 2

100-299 = 1

**(3 points)**

**9. Connection to other habitat areas:**

Is there a riparian corridor to other wetlands within 0.25 of a mile, or a corridor >100′ wide with good forest or shrub cover to any other habitat area? = 5

Is there a narrow corridor <100′ wide with good cover or a wide corridor >100′ wide with low cover to any other habitat area? = 3

Is there a narrow corridor <100′ wide with low cover or a significant habitat area within 0.25 mile but no corridor? = 1

Is the wetland and buffer completely isolated by development and/or cultivated agricultural land? = 0

**(5 points).**

**10. Scoring**

Add the scores to get a total: 30

Question: Is the total greater than or equal to 22 points?

Answer:

Yes = Type 2

No = Type 3

WETLAND B – TYPE 2

## WETLAND FIELD DATA FORM – Orcas Moon property located at 4xx 20th Avenue Kirkland, WA 98033.

## Rating done on 1-18-2019 by The Watershed Company.

**WETLAND FIELD DATA FORM**

BEGIN BY CHECKING ANY OF THE FOLLOWING (a. – e.) THAT APPLY:

a. The wetland is contiguous to Lake Washington;

b. The wetland contains at least 1/4 acre of organic soils, such as peat bogs or mucky soils;

c. The wetland is equal to or greater than 10 acres in size and having three or more wetland classes, as defined by the U.S. Fish & Wildlife Service (Cowardin et al., 1979), one of which is open water;

d. The wetland has significant habitat value to state or federally listed threatened or endangered wildlife species; or

e. The wetland contains state or federally listed threatened or endangered plant species.

IF ANY OF THE CRITERIA LISTED ABOVE ARE MET, THEN THE WETLAND IS CONSIDERED TO BE TYPE 1. IF THAT IS THE CASE, PLEASE CONTINUE TO COMPLETE THE ENTIRE FORM, BUT DO NOT ASSIGN POINTS.

IF THE WETLAND DOES NOT MEET THE CRITERIA LISTED ABOVE FOR TYPE 1, COMPLETE THE ENTIRE FORM, USING THE ASSIGNED POINTS TO DETERMINE IF IT IS A TYPE 2 OR TYPE 3 WETLAND.

Type 2 wetlands typically have at least two wetland vegetation classes, are at least partially surrounded by buffers of native vegetation, connected by surface water flow (perennial or intermittent) to other wetlands or streams, and contain or are associated with forested habitat.

**1. Total wetland area**

| Estimate wetland area and score from choices | Acres | | Point Value | **Points** |
|---|---|---|---|---|
| | >20.00 | = | 6 | |
| | 10-19.99 | = | 5 | |
| | 5-9.99 | = | 4 | |
| Wetland B<br>Approx. 1.5-acres | 1-4.99 | = | 3 | **3** |
| | 0.1-0.99 | = | 2 | |
| | <0.1 | = | 1 | |

**(3 points)**

# WETLAND B – TYPE 2

**2. Wetland classes: Determine the number of wetland classes that qualify, and score according to the table.**

| | # of Classes | | Points |
|---|---|---|---|
| **Open Water:** if the area of open water is >1/3 acre or >10% of the total wetland area | 1 | = | 1 |
| **Aquatic Beds:** if the area of aquatic beds is >10% of the **open water** area **or** >1/2 acre | 2 | = | 3 |
| **Emergent:** if the area of emergent class is >1/2 acre **or** >10% of the total wetland area | 3 | = | 5 |
| **Scrub-Shrub:** if the area of scrub-shrub class is >1/2 acre **or** >10% of the total wetland area | 4 | = | 7 |
| **Forested:** if the area of forested class is >1/2 acre or >10% of the total wetland area | 5 | = | 10 |

**(3 points)**

**3. Plant species diversity.**

For all wetland classes which qualified in 2 above, count the number of different plant species and score according to the table below. You do not have to name them.

e.g., if a wetland has an aquatic bed class with 3 species, and emergent class with 4 species and a scrub-shrub class with 2 species, you would circle 2, 2, and 1 in the second column (below).

| Class | # of Species | Point Value | Class | # of Species | Point Value |
|---|---|---|---|---|---|
| Aquatic Bed | 1-2 | = 1 | Scrub-Shrub | 1-2 | = 1 |
| | 3 | = 2 | | 3-4 | = 2 |
| | >3 | = 3 | | >4 | = 3 |
| Emergent | 1-2 | = 1 | Forested | 1-2 | = 1 |
| | 3-4 | = 2 | | 3-4 | = 2 |
| | >4 | = 3 | | >4 | = 3 |

**(5 points)**

**4. Structural diversity.**

If the wetland has a forested class, add 1 point for each of the following attributes present:

Trees >50′ tall = 1
Trees 20′ to 49′ tall = 1
shrubs = 1
Herbaceous ground cover = 1

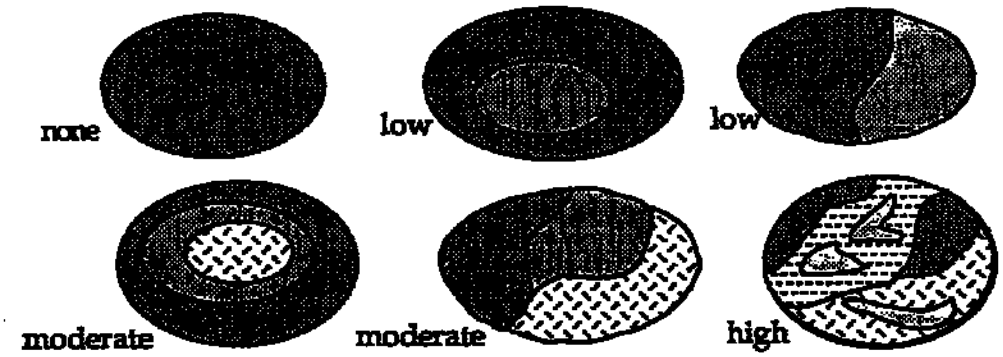
**(3 points)**

WETLAND B – TYPE 2

**5. Interspersion between wetland classes.**

Decide from the diagrams below whether interspection between wetland classes is high, moderate, low or none

3 = High
2 = Moderate
1 = Low
0 = None




**(1 points)**

**6. Habitat features**

Add points associated with each habitat feature listed:

| | |
|---|---|
| Is there evidence of current use by beavers? | = 3 |
| Is a heron rookery located within 300′? | = 2 |
| Are raptor nest(s) located within 300′? | = 1 |
| Are there at least 2 standing dead trees (snags) per acre? | = 1 |
| Are there any other perches (wires, poles, or posts)? | = 1 |
| Are there at least 3 downed logs per acre? | = 1 |

**(2 points)**

**7. Connection to streams**

Is the wetland connected at any time of the year via surface water? **(score one answer only)**

Is the wetland connected at any time of the year via surface water?

| | |
|---|---|
| To a perennial stream or a seasonal stream *with* fish | = 5 |
| To a seasonal stream *without* fish | = 3 |
| Is not connected to any stream | = 0 |

**(3 points)**

# WETLAND B – TYPE 2

**8. Buffers**

*Step 1:* Estimate (to the nearest 5%) the percentage of each buffer or land-use type (below) that adjoins the wetland boundary. Then multiply these percentages by the factor(s) below and enter result in the column to the right.

| | % of Buffer | | Step 1 | Width Factor | | Step 2 |
|---|---|---|---|---|---|---|
| Roads, buildings or parking lots | ____ % | X 0 = | ____ | ____ | = | ____ |
| Lawn, grazed pasture, vineyards or annual crops | ____ % | X 1 = | ____ | ____ | = | ____ |
| Ungrazed grassland or orchards | ____ % | X 2 = | ____ | ____ | = | ____ |
| Open water or native grasslands | ____ % | X 3 = | ____ | ____ | = | ____ |
| Forest or shrub | 100 % | X 4 = | 400 | 2 | = | 800 |
| | | | | Add buffer total 800 | | |

*Step 2:* Multiply result(s) of step 1:

By 1 if buffer width is 25-50′

By 2 if buffer width is 50-100′

By 3 if buffer width is >100′

Enter results and add subscores

*Step 3:* Score points according to the following table:

Buffer Total

900-1200 = 4

600-899 = 3

300-599 = 2

100-299 = 1

**(3 points)**

**9. Connection to other habitat areas:**

Is there a riparian corridor to other wetlands within 0.25 of a mile, or a corridor >100′ wide with good forest or shrub cover to any other habitat area? = 5

Is there a narrow corridor <100′ wide with good cover or a wide corridor >100′ wide with low cover to any other habitat area? = 3

Is there a narrow corridor <100′ wide with low cover or a significant habitat area within 0.25 mile but no corridor? = 1

Is the wetland and buffer completely isolated by development and/or cultivated agricultural land? = 0

**(5 points).**

**10. Scoring**

Add the scores to get a total: 28

Question: Is the total greater than or equal to 22 points?

Answer:

Yes = Type 2

No = Type 3

WETLAND C – TYPE 3

## WETLAND FIELD DATA FORM – Orcas Moon property located at 4xx 20th Avenue Kirkland, WA 98033.

## Rating done on 1-18-2019 by The Watershed Company.

**WETLAND FIELD DATA FORM**

BEGIN BY CHECKING ANY OF THE FOLLOWING (a. – e.) THAT APPLY:

a. The wetland is contiguous to Lake Washington;

b. The wetland contains at least 1/4 acre of organic soils, such as peat bogs or mucky soils;

c. The wetland is equal to or greater than 10 acres in size and having three or more wetland classes, as defined by the U.S. Fish & Wildlife Service (Cowardin et al., 1979), one of which is open water;

d. The wetland has significant habitat value to state or federally listed threatened or endangered wildlife species; or

e. The wetland contains state or federally listed threatened or endangered plant species.

IF ANY OF THE CRITERIA LISTED ABOVE ARE MET, THEN THE WETLAND IS CONSIDERED TO BE TYPE 1. IF THAT IS THE CASE, PLEASE CONTINUE TO COMPLETE THE ENTIRE FORM, BUT DO NOT ASSIGN POINTS.

IF THE WETLAND DOES NOT MEET THE CRITERIA LISTED ABOVE FOR TYPE 1, COMPLETE THE ENTIRE FORM, USING THE ASSIGNED POINTS TO DETERMINE IF IT IS A TYPE 2 OR TYPE 3 WETLAND.

Type 2 wetlands typically have at least two wetland vegetation classes, are at least partially surrounded by buffers of native vegetation, connected by surface water flow (perennial or intermittent) to other wetlands or streams, and contain or are associated with forested habitat.

**1. Total wetland area**

| Estimate wetland area and score from choices | Acres | | Point Value | **Points** |
|---|---|---|---|---|
| | >20.00 | = | 6 | |
| | 10-19.99 | = | 5 | |
| | 5-9.99 | = | 4 | |
| | 1-4.99 | = | 3 | |
| | 0.1-0.99 | = | 2 | **1** |
| | <0.1 | = | 1 | |

**(1 points)**

# WETLAND C – TYPE 3

**2. Wetland classes: Determine the number of wetland classes that qualify, and score according to the table.**

| | # of Classes | | Points |
|---|---|---|---|
| **Open Water:** if the area of open water is >1/3 acre or >10% of the total wetland area | 1 | = | 1 |
| **Aquatic Beds:** if the area of aquatic beds is >10% of the **open water** area **or** >1/2 acre | 2 | = | 3 |
| **Emergent:** if the area of emergent class is >1/2 acre **or** >10% of the total wetland area | 3 | = | 5 |
| **Scrub-Shrub:** if the area of scrub-shrub class is >1/2 acre **or** >10% of the total wetland area | 4 | = | 7 |
| **Forested:** if the area of forested class is >1/2 acre or >10% of the total wetland area | 5 | = | 10 |

**(1 points)**

**3. Plant species diversity.**

For all wetland classes which qualified in 2 above, count the number of different plant species and score according to the table below. You do not have to name them.

e.g., if a wetland has an aquatic bed class with 3 species, and emergent class with 4 species and a scrub-shrub class with 2 species, you would circle 2, 2, and 1 in the second column (below).

| Class | # of Species | Point Value | Class | # of Species | Point Value |
|---|---|---|---|---|---|
| Aquatic Bed | 1-2 | = 1 | Scrub-Shrub | 1-2 | = 1 |
| | 3 | = 2 | | 3-4 | = 2 |
| | >3 | = 3 | | >4 | = 3 |
| Emergent | 1-2 | = 1 | Forested | 1-2 | = 1 |
| | 3-4 | = 2 | | 3-4 | = 2 |
| | >4 | = 3 | | >4 | = 3 |

**(3 points)**

**4. Structural diversity.**

If the wetland has a forested class, add 1 point for each of the following attributes present:

Trees >50′ tall = 1

Trees 20′ to 49′ tall = 1

shrubs = 1

Herbaceous ground cover = 1

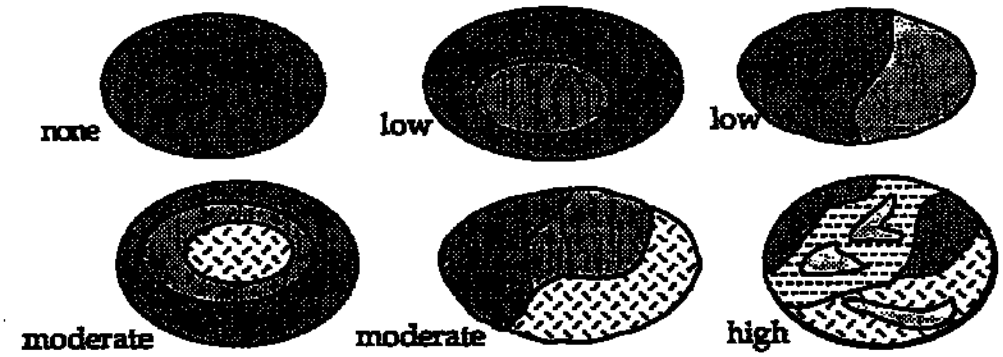
**(2 points)**

WETLAND C – TYPE 3

**5. Interspersion between wetland classes.**

Decide from the diagrams below whether interspection between wetland classes is high, moderate, low or none

3 = High
2 = Moderate
1 = Low
0 = None




**(0 points)**

**6. Habitat features**

Add points associated with each habitat feature listed:

| | |
|---|---|
| Is there evidence of current use by beavers? | = 3 |
| Is a heron rookery located within 300′? | = 2 |
| Are raptor nest(s) located within 300′? | = 1 |
| Are there at least 2 standing dead trees (snags) per acre? | = 1 |
| Are there any other perches (wires, poles, or posts)? | = 1 |
| Are there at least 3 downed logs per acre? | = 1 |

**(2 points)**

**7. Connection to streams**

Is the wetland connected at any time of the year via surface water? **(score one answer only)**

| Is the wetland connected at any time of the year via surface water? | |
|---|---|
| To a perennial stream or a seasonal stream *with* fish | = 5 |
| To a seasonal stream *without* fish | = 3 |
| Is not connected to any stream | = 0 |

**(0 points)**

# WETLAND C – TYPE 3

**8. Buffers**

*Step 1:* Estimate (to the nearest 5%) the percentage of each buffer or land-use type (below) that adjoins the wetland boundary. Then multiply these percentages by the factor(s) below and enter result in the column to the right.

| | % of Buffer | | Step 1 | Width Factor | | Step 2 |
|---|---|---|---|---|---|---|
| Roads, buildings or parking lots | % | X 0 = | | | = | |
| Lawn, grazed pasture, vineyards or annual crops | % | X 1 = | | | = | |
| Ungrazed grassland or orchards | % | X 2 = | | | = | |
| Open water or native grasslands | % | X 3 = | | | = | |
| Forest or shrub | 100 % | X 4 = | 400 | 2 | = | 800 |
| | | | | Add buffer total 800 | | |

*Step 2:* Multiply result(s) of step 1:

By 1 if buffer width is 25-50′

By 2 if buffer width is 50-100′

By 3 if buffer width is >100′

Enter results and add subscores

*Step 3:* Score points according to the following table:

Buffer Total

900-1200 = 4

600-899 = 3

300-599 = 2

100-299 = 1

**(3 points)**

**9. Connection to other habitat areas:**

Is there a riparian corridor to other wetlands within 0.25 of a mile, or a corridor >100′ wide with good forest or shrub cover to any other habitat area? = 5

Is there a narrow corridor <100′ wide with good cover or a wide corridor >100′ wide with low cover to any other habitat area? = 3

Is there a narrow corridor <100′ wide with low cover or a significant habitat area within 0.25 mile but no corridor? = 1

Is the wetland and buffer completely isolated by development and/or cultivated agricultural land? = 0

**(5 points).**

**10. Scoring**

Add the scores to get a total: 17

Question: Is the total greater than or equal to 22 points?

Answer:

Yes = Type 2

No = Type 3

WETLAND D – TYPE 2

## WETLAND FIELD DATA FORM – Orcas Moon property located at 4xx 20th Avenue Kirkland, WA 98033.

## Rating done on 1-18-2019 by The Watershed Company.

**WETLAND FIELD DATA FORM**

BEGIN BY CHECKING ANY OF THE FOLLOWING (a. – e.) THAT APPLY:

a. The wetland is contiguous to Lake Washington;

b. The wetland contains at least 1/4 acre of organic soils, such as peat bogs or mucky soils;

c. The wetland is equal to or greater than 10 acres in size and having three or more wetland classes, as defined by the U.S. Fish & Wildlife Service (Cowardin et al., 1979), one of which is open water;

d. The wetland has significant habitat value to state or federally listed threatened or endangered wildlife species; or

e. The wetland contains state or federally listed threatened or endangered plant species.

IF ANY OF THE CRITERIA LISTED ABOVE ARE MET, THEN THE WETLAND IS CONSIDERED TO BE TYPE 1. IF THAT IS THE CASE, PLEASE CONTINUE TO COMPLETE THE ENTIRE FORM, BUT DO NOT ASSIGN POINTS.

IF THE WETLAND DOES NOT MEET THE CRITERIA LISTED ABOVE FOR TYPE 1, COMPLETE THE ENTIRE FORM, USING THE ASSIGNED POINTS TO DETERMINE IF IT IS A TYPE 2 OR TYPE 3 WETLAND.

Type 2 wetlands typically have at least two wetland vegetation classes, are at least partially surrounded by buffers of native vegetation, connected by surface water flow (perennial or intermittent) to other wetlands or streams, and contain or are associated with forested habitat.

**1. Total wetland area**

| Estimate wetland area and score from choices | Acres | | Point Value | **Points** |
|---|---|---|---|---|
| | >20.00 | = | 6 | |
| | 10-19.99 | = | 5 | |
| | 5-9.99 | = | 4 | |
| | 1-4.99 | = | 3 | |
| | 0.1-0.99 | = | 2 | **1** |
| | <0.1 | = | 1 | |

**(1 point)**

# WETLAND D – TYPE 2

**2. Wetland classes: Determine the number of wetland classes that qualify, and score according to the table.**

| | # of Classes | | Points |
|---|---|---|---|
| **Open Water:** if the area of open water is >1/3 acre or >10% of the total wetland area | 1 | = | 1 |
| **Aquatic Beds:** if the area of aquatic beds is >10% of the **open water** area **or** >1/2 acre | 2 | = | 3 |
| **Emergent:** if the area of emergent class is >1/2 acre **or** >10% of the total wetland area | 3 | = | 5 |
| **Scrub-Shrub:** if the area of scrub-shrub class is >1/2 acre **or** >10% of the total wetland area | 4 | = | 7 |
| **Forested:** if the area of forested class is >1/2 acre or >10% of the total wetland area | 5 | = | 10 |

**(1 point)**

**3. Plant species diversity.**

For all wetland classes which qualified in 2 above, count the number of different plant species and score according to the table below. You do not have to name them.

e.g., if a wetland has an aquatic bed class with 3 species, and emergent class with 4 species and a scrub-shrub class with 2 species, you would circle 2, 2, and 1 in the second column (below).

| Class | # of Species | Point Value | Class | # of Species | Point Value |
|---|---|---|---|---|---|
| Aquatic Bed | 1-2 | = 1 | Scrub-Shrub | 1-2 | = 1 |
| | 3 | = 2 | | 3-4 | = 2 |
| | >3 | = 3 | | >4 | = 3 |
| Emergent | 1-2 | = 1 | Forested | 1-2 | = 1 |
| | 3-4 | = 2 | | 3-4 | = 2 |
| | >4 | = 3 | | >4 | = 3 |

**(3 points)**

**4. Structural diversity.**

If the wetland has a forested class, add 1 point for each of the following attributes present:

Trees >50′ tall = 1
Trees 20′ to 49′ tall = 1
shrubs = 1
Herbaceous ground cover = 1

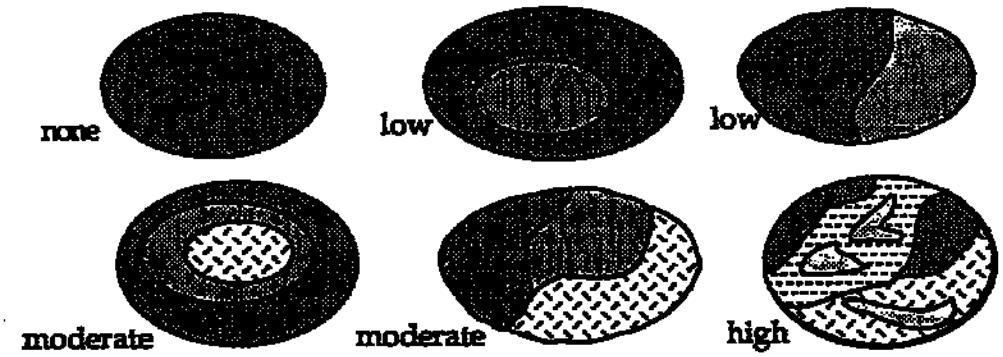
**(3 points)**

# WETLAND D – TYPE 2

**5. Interspersion between wetland classes.**

Decide from the diagrams below whether interspection between wetland classes is high, moderate, low or none

3 = High
2 = Moderate
1 = Low
0 = None




**(0 points)**

**6. Habitat features**

Add points associated with each habitat feature listed:

| | |
|---|---|
| Is there evidence of current use by beavers? | = 3 |
| Is a heron rookery located within 300′? | = 2 |
| Are raptor nest(s) located within 300′? | = 1 |
| Are there at least 2 standing dead trees (snags) per acre? | = 1 |
| Are there any other perches (wires, poles, or posts)? | = 1 |
| Are there at least 3 downed logs per acre? | = 1 |

**(1 point)**

**7. Connection to streams**

Is the wetland connected at any time of the year via surface water? **(score one answer only)**

Is the wetland connected at any time of the year via surface water?

| | |
|---|---|
| To a perennial stream or a seasonal stream *with* fish | = 5 |
| To a seasonal stream *without* fish | = 3 |
| Is not connected to any stream | = 0 |

**(5 points)**

# WETLAND D – TYPE 2

**8. Buffers**

*Step 1:* Estimate (to the nearest 5%) the percentage of each buffer or land-use type (below) that adjoins the wetland boundary. Then multiply these percentages by the factor(s) below and enter result in the column to the right.

| | % of Buffer | | Step 1 | Width Factor | | Step 2 |
|---|---|---|---|---|---|---|
| Roads, buildings or parking lots | % | X 0 = | | | = | |
| Lawn, grazed pasture, vineyards or annual crops | % | X 1 = | | | = | |
| Ungrazed grassland or orchards | % | X 2 = | | | = | |
| Open water or native grasslands | % | X 3 = | | | = | |
| Forest or shrub | 100 % | X 4 = | 400 | 2 | = | 800 |
| | | | | Add buffer total 800 | | |

*Step 2:* Multiply result(s) of step 1:

By 1 if buffer width is 25-50′

By 2 if buffer width is 50-100′

By 3 if buffer width is >100′

Enter results and add subscores

*Step 3:* Score points according to the following table:

Buffer Total

900-1200 = 4

600-899 = 3

300-599 = 2

100-299 = 1

**(3 points)**

**9. Connection to other habitat areas:**

Is there a riparian corridor to other wetlands within 0.25 of a mile, or a corridor >100′ wide with good forest or shrub cover to any other habitat area? = 5

Is there a narrow corridor <100′ wide with good cover or a wide corridor >100′ wide with low cover to any other habitat area? = 3

Is there a narrow corridor <100′ wide with low cover or a significant habitat area within 0.25 mile but no corridor? = 1

Is the wetland and buffer completely isolated by development and/or cultivated agricultural land? = 0

**(5 points).**

**10. Scoring**

Add the scores to get a total: 22

Question: Is the total greater than or equal to 22 points?

Answer:

Yes = Type 2

No = Type 3

SCIENCE & DESIGN

April 10, 2019

Susan Lauinger
City of Kirkland
Planning and Community Development
123 Fifth Avenue
Kirkland, WA 98125

**Re: Orcas Moon – Offsite Public Trail, Mitigation Plan Review**
The Watershed Company Ref. No.: 160622.6

Dear Susan:

This letter presents the findings of an environmental review of the applicant's mitigation plan for an offsite public trail provided for the Orcas Moon project. The Orcas Moon LLC property is located between 20th Avenue and Forbes Creek Drive (Parcel numbers 389010-0050 and -0055). The offsite public trail runs north-south between Forbes Creek Drive and 20th Street in Juanita Bay Park. The Watershed Company screened the preliminary trail alignment for streams and wetlands as documented in our January 31, 2019 report. This letter present a review of the applicant's mitigation plan for the public trail:

- March 20, 2019, *Proposed Off-Site Trail Plan, Existing Conditions, Proposed Trail Route & Planting Plan, City of Kirkland Parkland 20th Ave NE to Forbes Creek Drive Trail, Kirkland, Washington*. Prepared by Talasaea.

This project is vested to the old Kirkland Zoning Code, Chapter 90 – Drainage Basins, which was in-effect prior to March 2017.

## Findings & Recommendations

### Background

The applicant worked with City Planning and City Parks to identify the preferred public trail location as required for the Orcas Moon project. City Parks Operation Manager, Jason Filan, indicated a soft-surface foot trail connection between 20th Avenue NE and Forbes Creek Drive would support Parks' goal to improve pedestrian access in Juanita Bay Park. The applicant brush-cut and flagged a preliminary trail alignment. A wetland

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and stream delineation study covering the vicinity of the marked trail was completed by The Watershed Company in January 2019. A survey of the stream and wetland flagging was used for the applicant's current trail plan.

#### Proposed Impacts and Mitigation

This project is vested to the pre-March 2017 Kirkland Zoning Code. Under section 90.70, "The City may develop access through a wetland and its buffer in conjunction with a public park."

The proposed trail alignment now avoids direct wetland impacts. However, the north end of the trail is in the inner one-third of the Wetland A buffer. If feasible given site topography and significant tree locations, the buffer impact should be avoided or minimized by realigning that trail segment.

The proposed pedestrian trail would impact 322 SF of Wetland A buffer and 372 SF of overlapping Wetland B and C buffer. To off-set these impacts, enhancement at a one-to-one ratio is proposed along 90 lineal feet of trail within the buffers of Wetlands B and C. The plan targets a degraded buffer area in the overlapping buffer of Wetlands B and C. The proposed enhancement area is dominated by non-native blackberry. Two parallel rows of native trees spaced six feet on-center are proposed for enhancement. In our assessment, reducing the number of trees and adding native shrubs would improve habitat functions. No mitigation is proposed within the buffer of Wetland A. Mitigation for buffer impacts should be contiguous with the impacted buffer. The applicant's consultant needs to demonstrate proposed mitigation is sufficient given the net loss of buffer area.

The submitted plan lacks maintenance and monitoring notes and performance standards for the plant establishment period. The plan notes should also document compliance with KZC 90.130, which requires sensitive area impact minimization.

A bond or performance security is also required pursuant to KZC 90.145. An itemized bond quantity worksheet should be submitted.

Since portions of the trail cross through existing non-native blackberry, it is important to include blackberry control in the maintenance and monitoring plan for the site. Typically, blackberry canes and roots are grubbed out of mitigation areas and cut back at least ten feet from the edge of enhancement areas. The current mitigation plan does not include these site preparation and maintenance details.

### Recommendations

- Review northern trail alignment for potential to reduce impacts.

- Update the mitigation plan to document impact avoidance, minimization, and mitigation sufficient to maintain buffer functions and values. Address buffer impacts on disconnected buffer areas independently.
- Update the enhancement planting plan to include both native tree and shrub species.
- Update the mitigation plan to include maintenance and monitoring notes and performance standards.
- Provide a bond quantity worksheet.
- Update the mitigation plan notes to address removal of invasive plants prior to plant installation and invasive plant maintenance over the plant establishment period.

Please call if you have any questions or if I can provide you with any additional information.

Sincerely,

Nell Lund, PWS
Senior Ecologist