EnviroSound Consulting Inc.

Geotechnical & Environmental Consulting

# Geotechnical Engineering Report

## Project Information

Project Name: Oslo Bay Apartments
Location: Poulsbo, Washington
Client: Edward Rose & Sons
Project #: ESC19-G047
Date: November 23, 2020

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# GEOTECHNICAL ENGINEERING REPORT

**OSLO BAY APARTMENTS**
**STATE HIGHWAY 305**
**POULSBO, WASHINGTON 98370**

**Prepared for:**

**EDWARD ROSE & SONS**
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**Project No. ESC19-G047**
**November 23, 2020**

EnviroSound Consulting Geotechnical & Environmental Consulting

November 23, 2020

Project: ESC19-G047

Edward Rose & Sons
Attn: Mr. Lindon Ivezaj
38525 Woodward Avenue
Bloomfield Hills, Michigan 48303

**Geotechnical Engineering Report**
**Oslo Bay Apartments**
**State Highway 305**
**Poulsbo, Washington**

Dear Mr. Ivezaj,

Submitted herewith is our report for EnviroSound Consulting's geotechnical engineering investigation for the subject project. This investigation was conducted in accordance with our proposal dated December 12, 2016. The report presents findings from our geotechnical engineering investigation and provides recommendations for geotechnical engineering aspects of the project design.

We appreciate the opportunity to work with you on this project. If we can be of further assistance, or if you have any questions regarding this project, please contact our office.

Sincerely yours,

Shawn E. Williams, L.E.G.
Senior Engineering Geologist

Engineering Geologist
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Geologist

11-23-2020

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Enclosures

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# 1.0 INTRODUCTION

EnviroSound Consulting (EnviroSound) was retained by Mr. Lindon Ivezaj with Edward Rose & Sons to conduct a geotechnical engineering investigation for Tax Parcel Numbers 112601-3-040-2008, 112601-3-006-2000, 112601-3-008-2008, 112601-3-021-2001, and 102601-4-022-2009 (Resultant Parcels V-VII of a boundary line adjustment submitted concurrently with the project application) in Poulsbo, Washington. The geotechnical report was done in general compliance with geological report requirements outlined in the City of Poulsbo Critical Areas Ordinance, sections 16.20.735, Geologically Hazardous Areas, Geotechnical/Geological Report.

EnviroSound previously performed a Geotechnical Engineering Report dated November 12, 2010 for the subject property which included logging and sampling 28 exploratory test pits on the site. The 2010 Geotechnical Report is included in Appendix C.

## 1.1 Site Location

The site is located on the northern side of State Highway 305 between Viking Way and Bond Road in Poulsbo, Washington. According to the United States Geologic Survey (USGS), 7.5 minute Poulsbo, Washington topographic quadrangle map, the property is located in Kitsap County in Sections 10, Township 26 North, Range 1 East, W.M. and at Longitude -122.646 degrees W and Latitude 47.756 degrees N. The site location is shown on the Site Vicinity Map, Figure 1.

## 1.2 Proposed Construction

Based on our discussions and review of preliminary plans, we understand that the proposed development will consist of thirteen 3-story apartment buildings with building footprints ranging in size from 12,236 square feet to 13,509 square feet, and a 5,935 square foot community building. The preliminary plans indicate that the development of the property will also include associated parking, access off of Viking Avenue and SR 305, landscaping and associated utilities. Two detention ponds are proposed across the property.

The plans are in a preliminary stage for land use approval. Final building floor elevations range from approximately 104 feet to 219 feet with a maximum cut of about 6.0 feet and a maximum fill of about 18 feet. The preliminary plans indicate that the apartment buildings will be 3-stories in height. Retaining walls will be utilized across the site. The maximum height of the retaining walls will be approximately 16 feet in height. The final planned elevations will be important in evaluating the most suitable procedures for temporary excavation and foundation construction. EnviroSound should review plans, once these details are established, so that we can provide additional recommendations for finalizing earthwork and foundation construction specifications. We recommend that EnviroSound be involved in the process of developing the plan details, so that we can assist with developing the most suitable and cost-effective building configurations.

## 1.3 Purpose

The purpose of this investigation is to determine the subsurface soils and groundwater conditions at the site. This evaluation has been completed to develop geotechnical engineering recommendations for earthwork, foundation and retaining wall construction. The investigation also addresses portions of the subject property that are mapped as critical areas by the City of Poulsbo.

## 2.0 SITE INVESTIGATION

### 2.1 Site Description

The subject site is located on the northern side of State Highway 305 between Viking Way and Bond Road in Poulsbo, Washington. At the time of our explorations, the site was undeveloped and forested with some trails and former logging roads. Vegetation consisted of mature cedar, fir, maple, and alder trees with underbrush consisting of salal, ferns and blackberries. The site is bordered by scattered single-family residences to the north and east, by the Kitsap County Transit Park, and to the south by State Route 305. The Vetter Road right-of-way cuts across the middle of the site.

The subject site consists of five tax parcels: Tax Account Numbers 112601-3-040-2008, 112601-3-006-2000, 112601-3-008-2005, 112601-3-021-2000, and 1102601-4-022-2009 (Resultant Parcels V-VII of a boundary line adjustment submitted concurrently with the project application). These parcels occupy approximately 56 acres. The subject site slopes to the south (generally less than 6 percent slopes). The site slopes from an elevation of approximately 235 feet in the northwest corner of the property to an elevation of approximately 25 feet in the southern portion of the site where it abuts Dogfish Creek. The slopes in the southern portion of the property become steeper (over 40%), as they slope down to Dogfish Creek. Dogfish Creek flows toward the southwest in a drainage swale area along the southern edge of the property.

### 2.2 Geologic Setting

The "Geologic Map of Surficial Deposits in the Seattle 30’ x 60’ Quadrangle Washington," Young and others, 1993 indicates that the site is underlain by between Vashon Till (Qvt). Vashon till is described as a light to dark gray, nonsorted, nonstratified mixture of clay, silt, sand, and gravel up to boulder size. Glacial till typically is dense to very dense, being glacially overridden.

The United States Department of Agriculture (USDA) Soil Survey of Kitsap County Area, Washington, information indicates the following soil type exists on the project site:

- 37 – Norma fine sandy loam
- 39 – Poulsbo gravelly sandy loam, 0 to 6 percent slopes
- 40 – Poulsbo gravelly sandy loam, 6 to 15 percent slopes
- 41 – Poulsbo gravelly sandy loam, 15 to 30 percent slopes

The soil survey descriptions of these soil types are summarized in the following table:

| USDA Soil Survey Name | **37 – Norma fine sandy loam** | **39 – Poulsbo gravelly sandy loam, 0 to 6 percent slopes** | **40 – Poulsbo gravelly sandy loam, 6 to 15 percent slopes** | **41 – Poulsbo gravelly sandy loam, 15 to 30 percent slopes** |
|---|---|---|---|---|
| Typical Profile | 0 to 8 inches: ashy fine sandy loam<br>8 to 22 inches: fine sandy loam<br>22 to 60 inches: stratified loamy sand to clay loam | 0 to 24 inches: gravelly ashy sandy loam<br>24 to 60 inches: very gravelly sandy loam | 0 to 24 inches: gravelly ashy sandy loam<br>24 to 60 inches: very gravelly sandy loam | 0 to 24 inches: gravelly ashy sandy loam<br>24 to 60 inches: very gravelly sandy loam |
| Origination | Alluvium with some volcanic ash in the upper part. | Basal till with volcanic ash in the upper part. | Basal till with volcanic ash in the upper part. | Basal till with volcanic ash in the upper part. |
| Drainage | Poorly drained | Moderately well drained. | Moderately well drained. | Moderately well drained. |
| Permeability | Moderately rapid. | Moderately rapid above the hardpan and very slow in the pan. | Moderately rapid above the hardpan and very slow in the pan. | Moderately rapid above the hardpan and very slow in the pan. |
| Surface Runoff | Ponded. | Slow. | Slow. | Slow. |
| Erosion Hazard | Slight. | Slight. | Slight. | Slight. |

### 2.3 Subsurface Explorations

Seven exploratory borings were drilled on the site, six on January 4, 2017 and one on January 5, 2017. The borings were drilled and sampled with a track-mounted drill rig provided by Geologic Drill. The borings were drilled to depths ranging from approximately 20 to 40 feet below ground surface. The borings were logged by a senior engineering geologist with our firm and representative subsurface soil samples were obtained and transported to our office for further evaluation.

The borings were completed with hollow stem auger drilling methods. Split Spoon (1-3/8 inch inner diameter) samples were obtained from the boring in general accordance with Standard Penetration Test (SPT) procedures (ASTM D 1586), at 5 feet intervals. The split spoon sampler is driven 18 inches into the soil by a 140 pound hammer falling freely through a distance of 30 inches. The number of blows required to drive the sampler are counted for each 6 inches of penetration. The blow count for the first 6 inches of penetration is considered a seating drive and ignored, and the remaining blow counts are summed to produce the Standard Penetration Resistance (N-value).

Previously, twenty-two test pits were excavated on the site on December 30 and 31, 2016. The test pits were excavated with a Caterpillar 315 track mounted track-hoe provided by Bullseye Excavation under the direction of an EnviroSound representative. The test pits reached depths of about 3 to 4 feet below existing grade. The test pits were logged by a senior engineering geologist with our firm and representative subsurface soil samples were obtained and transported to our office for further evaluation. All test pits were backfilled upon completion of logging.

The locations of the borings and test pits were located and marked by Team 4 Engineering prior to the start of our subsurface investigation. Selected soil samples from the borings and test pits were submitted to Phoenix Soil Research for soil classification. Boring and test pit locations are shown on the Site Plan, Figure 2. Logs of the borings and test pits are provided in Appendix A.

### 2.3.1 Soil

The soils encountered within the test pits were very consistent. The majority of the test pits had a 6-inch to 1-foot mantle of forest duff material often with roots and rootlets. The duff was typically underlain by a medium dense reddish tan, silty sand with scattered gravels and cobbles (some oversized). The silty sand was underlain by a layer of medium dense weathered glacial till, which in turn was underlain by dense to very dense cemented glacial till.

The soils encountered in the borings were relatively consistent as well. There was a 6-inch to 1-foot mantle of forest duff material often with roots. The duff was typically underlain by a medium dense to dense reddish tan or tan, silty sand with gravels and scattered cobbles to a depth of approximately 5.0 feet. The silty sand was underlain by dense to very dense glacial till to the depths explored. The till consisted of gravelly, silty sand with scattered cobbles.

Detailed descriptions of the soils encountered in the test pits and the borings are provided in Appendix A.

### 2.3.2 Groundwater

Groundwater was not encountered within any of the test pits but was encountered in boring B-5 at a depth of approximately 37.0 feet. No piezometers were installed for long term groundwater monitoring, as part of this investigation. A piezometer was installed in a boring placed adjacent to Bond Road under a separate scope of work with groundwater measured at approximately 5.0 feet in depth.

Water table elevations can fluctuate with time. Groundwater levels are typically influenced by seasonal precipitation, irrigation, land use, and climatic conditions, as well as other factors. Groundwater level observations at the time of the field investigation may vary from those encountered during the construction phase of the project.

There are two streams located within 1,000 feet of the proposed development as identified in a 2020 Ecological Land Services Wetland Delineation Report. Dogfish Creek (Type F1 Stream) flows in a southwest direction through the southern edge of the parcels adjacent to Bond Road. An unnamed, Type F2 stream flows in a southerly direction through the western portion of the site.

### 2.3.3 Laboratory Testing

To aid in classifying the soils and to evaluate the strength characteristics and for potential infiltration, laboratory tests were performed on selected samples. Test method references are shown in the following table. Phoenix Soil Research of Kingston, Washington and Spectra Laboratories of Poulsbo, Washington were retained to provide geotechnical laboratory analysis.

| Parameter | Testing Method Reference |
|---|---|
| Particle Size Analysis | ASTM D422 |
| USDA Sieve Analysis | USDA Sieve Analysis |
| Cation Exchange Capacity | CEC by NH4 Replacement |
| Organic Content Analysis | ASTM D2974 C |

The results of the laboratory testing are provided in Table 1 in Appendix B.

## 2.4 Geologic Hazards

General

A review of "Slope Stability, Kitsap County, Washington", Jerry Deeter, 1979, City of Poulsbo Critical Areas Mapping and Kitsap County Critical Areas Mapping has been performed in conjunction with this study.

Seismic Hazard

EnviroSound has reviewed table 1613.3.2 of the 2015 International Building Code (IBC). Site specific data is not available to a depth of 100 feet. The explorations at this site reached a maximum depth of 41.5 feet. The majority of the soils encountered in borings had N-values greater than 50 to a depth of 40.0 feet. Therefore, for seismic design of structures, the site should be considered class C, "very dense soil and soft rock", as defined in the IBC.

Ground motion accelerations for the site were obtained from the USGS Earthquake Hazards Program website and are presented in the following table. The latitude/longitude method was used to obtain the ground motions at Longitude -122.647680° and Latitude 47.757465° using the 2015 data tables.

| Probability of Exceedance | 2% in 50 years |
|---|---|
| Peak Ground Acceleration (PGA) | 0.500 g |
| 0.2 second period ($S_s$) | 1.301 g |
| 1 second period ($S_1$) | 0.522 g |

Landslide Hazard

A review of the "Slope Stability, Kitsap County, Washington", Jerry Deeter, 1979 indicates that the subject property has been mapped as having areas of stable and intermediate slopes. Stable slopes are generally less than 15 percent but can include areas of steeper slopes that are stable due to low groundwater concentration or competent bedrock. Intermediate slopes are slopes generally steeper than fifteen percent but do not exceed thirty percent. This includes slopes without known failures of sand and gravel, till or thin soils over bedrock. It should be noted that the mapping was performed in the 1970's and does not reflect more recent activity that may have occurred. There was no visible evidence of sloughing or erosion on the slopes at the time of our site visit.

A review of the City of Poulsbo Geological Hazards Map shows areas mapped in the southern portion of the property near Dogfish Creek as a potential geological hazard. A further review of the Kitsap County Critical Areas mapping indicates that the areas mapped by the City of Poulsbo are considered a moderate landslide hazard.

Erosion Hazard

The United States Department of Agriculture (USDA) Soil Survey of Kitsap County Area, Washington, mapping indicates that the native glacial till soil at the site has a slight erosion hazard. Soil disturbance of sloped areas will require immediate implementation of erosion control measures due to high erosion potential.

It has been our experience that soil erosion potential can be minimized through landscaping and surface water runoff control. Typically, erosion of exposed soils will be most noticeable during periods of rainfall and may be controlled by the use of normal temporary erosion control measures, such as silt fences, hay bales, mulching, control ditches or

diversion trenching, and contour furrowing. Erosion control measures should be in place before the onset of wet weather. Erosion hazard mitigation is presented in the Conclusions and Recommendation section of this report.

Critical Aquifers

Critical aquifer mapping provided by City of Poulsbo maps the subject property in an area of Aquifer Recharge Area of Concern (Shallow Aquifer). Development standards provided in the City of Poulsbo Critical Areas Ordinance, Section 16.20.515-B explains that a hydrogeological report is required for operations proposed in aquifer recharge areas of concern that pose a potential threat to groundwater according to Table 16.20.515 – Activities with Potential Threat to Groundwater. A hydrogeological report was completed for the proposed development in 2019.

Seattle Fault Zone

Based on our review of the United States Geological Survey (USGS) information for the Seattle Fault Zone and available LIDAR (Puget Sound LIDAR Consortium) information for the Poulsbo area, the proposed building site lies within the generally delineated area of the Seattle Fault Zone. Although fault surface ruptures have not been mapped or observed in the Silverdale area, surface ruptures of Seattle Fault strands have been observed and mapped on south Bainbridge Island which is approximately 5 miles away.

## 3.0 CONCLUSIONS AND RECOMMENDATIONS

### 3.1 General

Based on the findings of this investigation and previous geotechnical experience in the area of this project, it is our opinion that the proposed buildings could be supported on shallow foundation systems bearing on undisturbed, dense native soils, or on compacted structural fill pads placed over dense to very dense, native soil. We recommend that EnviroSound be involved in the process of planning the construction, configurations and elevations for the proposed structures. We also recommend that EnviroSound review updated plans, as these documents become available, to verify that geotechnical recommendations are being incorporated.

The native soils in the upper six inches at the site contain organic material in the form of roots and root mats that will need to be removed prior to development of the site. The high fines content of the soils below the layer of forested duff make them moisture sensitive and difficult to use during the winter season. The dense to very dense cemented till encountered in all of the test pits will be difficult for excavating utility trenches. Soils encountered in the 2016 test pits were for the most part similar to the 28 exploratory test pits excavated in 2010. The 2010 Geotechnical Report is included in Appendix C.

Dense to very dense soils were encountered in the 7 exploratory borings, to depths ranging from 21.5 feet to 41.5 feet. The maximum cut will be approximately 6.0 feet and the maximum fill will be approximately 18.0 feet.

The proposed berm for the east pond will be constructed utilizing a maximum of 2.0H:1.0V slope. It will be sited upslope of the steep slopes on the southern edge of the property. A slope stability analysis is provided below. The west pond will be graded with slopes less (flatter) than 2.0H:1.0V and will not require a slope stability analyses.

Retaining walls will be utilized across the site in parking areas and on the two stormwater detention ponds. The maximum vertical height of the retaining walls will be approximately 16 feet. The retaining walls are discussed in more detail in Section 3.7.

Due to the overall size of the development and the proposed size of the buildings it is recommended that a representative of EnviroSound view all foundations for proposed structures.

### 3.2 Slope Stability

The site plan shows a stormwater pond with a fill berm on top of steep slopes on the southern portion of the subject site. The berm will be graded with a slope of 3H:1V. EnviroSound performed two slope stability analyses on representative cross sections (A) and (B) through this portion of the property as shown on Figure 3. The cross section used in the analysis was obtained from the grading plan provided by Team 4 Engineering.

The analysis was performed using the commercially available computer program GeoStudio. Soil strength parameters used in the analysis were estimated values based on exploratory borings excavated on the site as part of our report.

The pseudostatic method was used for the slope stability analysis to estimate the factor of safety (FS) under seismic conditions. The seismic coefficient used in a pseudostatic analysis is typically taken to be 1/2 of the peak ground acceleration (PGA) that the site is estimated to experience during the design earthquake. For this project site the PGA was 0.500, Kh was 0.25 g, based on the information from the USGS for the event with a 2 percent probability of being exceeded in 50 years.

The results of slope stability analysis are expressed as a FS against displacement failure. The FS is the ratio of resisting forces to driving forces. A FS of 1.0 is equilibrium; a FS of less than 1.0 indicates failure. Typically, a FS of 1.5 for static conditions and 1.1 for seismic (pseudostatic) conditions is considered adequate in standard local practice. A FS between 1.0 and 1.5 (or < 1.0 under seismic conditions) is not adequate due to the uncertainties in the modeling process. A lower FS for seismic conditions is adequate as the probability of occurrence of the seismic conditions analyzed is relatively low.

The results of the slope stability analyses are presented in the following tables. A graphical presentation of the results of the static and seismic slope stability analyses are presented in the attached Figures 4-7, respectively.

**Stability Results for Oslo Bay Apartments (Static)**

| | Factor of Safety Observed | Factor of Safety Required |
|---|---|---|
| **A-A Global Stability** | 4.978 | 1.5 |
| **B-B Global Stability** | 4.611 | 1.5 |

**Stability Results for Oslo Bay Apartments (Seismic)**

| | Factor of Safety Observed | Factor of Safety Required |
|---|---|---|
| **A-A Global Stability** | 1.501 | 1.1 |
| **B-B Global Stability** | 1.725 | 1.1 |

The results of the analysis indicate that the standard minimum required factors of safety are met. Proper construction practices, long term drainage measures, and reducing the impact of grading effects on the existing slopes will be important in maintaining the long term stability.

Based on our observations and understanding of site geology and proposed development, it is our opinion that the placement of the stormwater detention pond should be done using the recommendations provided below in order to not adversely impact the nearby slopes to the south.

### 3.3 Erosion Control

The USDA erosion classification is listed as "slight" for the native soils located on the site. For the size and scope of this development, a Storm Water Pollution Prevention Plan (SWPPP) will be required. Given potential for erosion on disturbed slopes (as noted in Section 2.4 of this report), we recommend that EnviroSound review the grading and TESC plans and SWPPP during construction document preparation.

### 3.4 Foundations

The proposed structures can be supported on perimeter foundations founded either on the undisturbed, dense glacial till present at relatively shallow depths (5 feet or less) or on compacted structural fill placed on the undisturbed native soils. In order to minimize differential settlement it is not recommended that portions of the building foundations be founded on both fill and glacial till. Some over excavation of footings may be necessary due to the length of the buildings.

Footings founded upon the dense native soils could be designed for an allowable soil bearing pressure of 3,000 psf. This soil pressure may also be used for footings founded upon structural fill compacted as recommended in the fill placement and compaction section of this report. Minimum footing widths should be 24 inches for individual square footings and 12 inches for continuous footings. Footings should have adequate embedment for local frost penetration requirements. In the area of this project, the minimum depths are typically 18 inches for exterior footings and 12 inches for interior footings. If footings are supported by structural fill, the fill should extend beyond the outer edges of footings a minimum distance equal to the thickness of the fill beneath the footing. Based on the results of our explorations it is anticipated that the top of the bearing layer (medium dense or denser) will be encountered between roughly 1 to 5 feet below the existing ground surface within the proposed building footprint.

The allowable bearing pressures given could be increased by one-third for wind or earthquake loads.

Footing excavations should be cleaned of all loose soil, leveled, and protected from water. The site soils contain a sufficient quantity of fines to become soft and spongy when subjected to water and disturbance. If construction is to take place during wet conditions, we recommend that a thin layer (2 to 3 inches thick) of lean concrete or compacted clean crushed rock be placed immediately after excavating to suitable foundation soils to serve as a working surface. Footing excavations should be kept free of water at all times.

Each footing excavation should be evaluated by a qualified geotechnical engineer to confirm suitable bearing conditions and to determine that all loose materials have been removed. This should be accomplished prior to placement of concrete or the working surface.

Assuming compliance with the above recommendations, we expect settlements to be less than 3/4 inch, with differential settlements (between adjacent footings or over a 20-foot span of continuous footing) less than 1/2 inch.

Lateral footing displacement can be resisted by friction along the base of the foundation and passive pressure acting against the appropriate footing faces. We recommend an allowable friction factor of 0.4 and an allowable equivalent fluid passive pressure of 240 psf/ft of depth. These values include a factor of safety of 1.5 for the allowable friction factor and 2.0 for the allowable equivalent fluid passive pressure.

### 3.5 Drainage

Runoff from buildings and impervious surfaces should be directed into an appropriately designed stormwater disposal system. Ground surfaces immediately adjacent to foundations should be sloped a minimum of 3 percent for a minimum distance of 10 feet away from structures in accordance with Section 1804.4 in the 2015 International Building Code (IBC). If physical obstructions or lot lines prohibit 10 feet of horizontal distance, a 5-percent slope shall be provided as an approved alternative of diverting water away from the foundation. Swales used for this purpose shall be sloped a minimum of 2 percent where located within 10 feet of the building foundation. Impervious surfaces within 10 feet of the building foundation shall be sloped a minimum of 2 percent away from the building.

We recommend that footing drains be installed along the outside perimeter of the proposed structures. Footing subdrains should consist of slotted, 4-inch-diameter (minimum), rigid plastic perforated pipe (with perforations placed at 4 and 8 o'clock) bedded in a minimum thickness of 6 inches of washed ⅜-inch pea gravel around the pipe. Drain socks should not be installed around the pipe. The backfill soils within 1 foot of the walls should consist of free-draining sand and gravel material. This drainage system should be designed to transport water away from the structure and discharge into an appropriate area. If gravity flow to daylight is not possible, a sump-pump system may be necessary. The perimeter subdrain invert should be located at least 18 inches below the lowest adjacent grade.

Roof drains should not be connected to the footing subdrains. The discharge from footing drains, roof drains, or other drains should be routed by means of a tightline to a suitable discharge point that assume excessive stormwater flows do not back-up into the footing drain system assuming the suitable discharge point is a storm sewer.

### 3.6 Floor Slabs

Floor slabs for the proposed commercial buildings should be constructed over suitable subgrade surfaces. The subgrade should consist of medium dense to dense, native soil or structural fill placed over suitable native soil. Floor slab subgrade areas should be evaluated by a representative of the geotechnical engineer. Replacement of in-place, moisture sensitive soils, with aggregate or a sand and gravel mixture may be recommended for subgrade improvement. The layer should consist of at least 4 inches of clean, free-draining coarse sand or gravel. A capillary break consisting of at least 4 inches of clean, pea gravel or 5/8 inch of crushed rock should be placed beneath the floor slabs.

We recommend that concrete slab-on-grade floors be underlain by a water vapor barrier in areas where it is critical to reduce moisture intrusion, such as those with moisture sensitive floor coverings. The moisture barrier system should be installed in accordance with ASTM guidelines.

Any loose soil encountered beneath slab areas should be removed and replaced with structural fill. Because ground surfaces may be unintentionally disturbed during construction activities, we recommend that all slab subgrades be compacted prior to slab construction.

### 3.7 Lateral Earth Pressures & Retaining Walls

Lateral pressures will be exerted on below grade (basement) and retaining walls by backfill soils, surcharge loads, and hydrostatic pressures caused by groundwater. Lateral earth pressures on walls depend upon the type of wall, type of backfill material and allowable wall movements. For walls that are restrained at the top, lateral earth pressures should be estimated for an "at rest" condition. For walls that are free to rotate away from the retained soil, lateral earth pressures should be estimated for an "active" earth pressure. For walls that are compressing the retained soil, lateral earth pressures should be estimated for a "passive" earth pressure. Recommended lateral earth pressures coefficients are provided in the following table along with equivalent fluid pressures. These pressures are calculated assuming a moist unit weight for the backfill soil of 125 pounds per cubic foot (pcf) and an angle of internal friction of 35 degrees. These values are representative of the on-site materials, however we recommend that imported structural fill be used for wall backfill.

| Lateral Earth Pressures, no slope above or below the wall | | | | | |
|---|---|---|---|---|---|
| "Active" Condition | | "At Rest" Condition | | "Passive" Condition | |
| Coefficient (Ka) | Equivalent Fluid Unit Weight (pcf) | Coefficient (Ko) | Equivalent Fluid Unit Weight (pcf) | Coefficient (Kp) | Equivalent Fluid Unit Weight (pcf) |
| 0.27 | 34 | 0.43 | 54 | 1.84 | 230 |

The recommended equivalent fluid unit weights do not include hydrostatic pressure due to groundwater accumulated behind walls. The recommended fluid pressures assume a horizontal ground surface above and below the wall and do not include seismic loading, or any surcharge due to nearby loading from structures, equipment or traffic. The passive pressure has been reduced by a factor of 2 to limit wall translation.

The potential seismic force on the wall can be modeled as a uniform pressure on the back of the wall equal to 7H (H is the height of the wall (in feet)), for active conditions, with no slope above the wall. For walls designed for at rest conditions, with no slope above the wall, the uniform pressure for the seismic increase should be increased to 18H. The units for this pressure are pounds per square foot (psf).

Continuous drains with cleanouts should be installed at the base of retaining walls to prevent the buildup of hydrostatic pressure behind the structure. These drains should consist of a minimum 4-inch diameter perforated rigid pipe (with perforations placed down) with a minimum thickness of 6 inches of pea gravel around the pipe. The pipe and pea gravel should be wrapped in filter fabric to reduce the migration of fines into the drainage zone. The backfill soils within 1 foot of the walls should consist of free-draining sand and gravel material. This drainage system should be designed to transport water away from the structure and discharge into an appropriate area.

#### 3.7.1 Rockeries – Ecology Blocks

All walls shown on the entitlement plans are MSE walls. Should, rockery or ecology block walls be proposed in future detailed grading plans, their locations and application should be reviewed by EnviroSound. Rockery walls are generally considered slope protection for soils in a cut situation. Rockeries designed and constructed in accordance with Section 8-24 of the WSDOT Standard Specifications are not considered retaining walls. Concrete block (ecology block) walls for slope stabilization shall be designed and permitted as retaining walls.

#### 3.7.2 Mechanically Stabilized Earth Walls

There will be several tiered walls across the property in parking and landscaping areas that will be between approximately 5.0 and 10.0 feet in height and will be of MSE design consisting of structural backfill material and reinforcing agents

within the backfill to provide support for the fill slope above. The slope surface should be planted with vegetation that promotes slope stability and drainage.

The following table summarizes our recommended design values for the various soils involved in the wall construction, based on our explorations and subsequent coefficient acceleration of at least 0.26g for design purposes.

| Soil Types | Density (pcf) | Internal Friction Angle (degrees) | Cohesion (psf) | Allowable Bearing Capacity (psf) |
|---|---|---|---|---|
| Reinforced Soil (native advance sand) | 125 | 35 | 0 | N/A |
| Retained Soil (native glacial till) | 140 | 32 | 500 | N/A |
| Retained Soil (structural soil) | 125 | 35 | 0 | N/A |
| Subgrade Soil (structural fill) | 125 | 35 | 0 | 2,500 |
| Subgrade Soil (advance sand) | 135 | 36 | 100 | 2,500 |

### 3.8 Pavement

Preliminary recommendations for asphalt pavement thicknesses are based on the AASHTO Guide for Design of Pavement Structures. We presume that the primary traffic on the site will be passenger cars. We used the section on Low-Volume Road Design for Flexible Pavement with a 50 percent inherent reliability level, as recommended in the Guide for local roads. We further assumed that the traffic level would be low, corresponding to 50,000 to 100,000 Equivalent Single Axle Load (ESAL) applications over the lifetime of the pavement. Note that one ESAL is for an 18-kip axle load. One passenger car is approximately 0.008 ESALs. Therefore, the low traffic level corresponds to at least 6,250,000 passenger car trips over the pavement. In the test pits, we encountered weathered till consisting of medium dense sand with silt. We assigned this soil a relative quality of “Fair”.

Based on the previous assumptions, we preliminarily recommend 2 inches of surface course Asphaltic Concrete (AC) over 6 inches of crushed base course. Surface course AC can be substituted for base course and vice versa at a rate of 1 inch of AC per 3 inches of base course. We recommend that the AC thickness not be reduced below 2 inches. The final pavement section can be adjusted based on estimated vehicle loading and desired design life. In areas of heavier traffic such as garbage trucks or maintenance trucks we recommend 3 inches of AC over 8 inches of base course.

In preparing the preceding recommendations, we assumed that the Elastic Modulus of the Asphaltic Concrete would be at least 400,000 psi, and that the Base Course would be a well graded crushed rock with a California Bearing Ratio (CBR) of 100. If materials with different strengths than presented will be used, we should be contacted to adjust the pavement section recommendations accordingly.

If a porous type of AC is proposed, the available literature indicates that a minimum depth of porous AC at 3 inches. If porous pavement is proposed, alternative designs will be required due to the storage layer requirements.

Concrete pavement design recommendations are based on an assumed modulus rupture or 600 psi and a minimum compressive strength of 4,000 psi for the concrete. A minimum concrete thickness of 3.5 inches is recommended for the parking areas with a base course of 6 inches. In consideration of heavier traffic such as garbage trucks or maintenance vehicles we recommend 5 inches of concrete over a 6 inch layer of base. Pervious concrete typically has a 15 to 25 percent void structure and can have strengths ranging from 500 psi to 4,000 psi.

Prior to the placement of asphalt we recommend that the subgrade be proof rolled with heavy construction equipment such as a loaded dump truck or water truck to ensure that the subgrade is relatively stiff and unyielding.

## 3.9 Earthwork Considerations

During wet weather conditions, which are typically present from October through April, subgrade stability problems and grading difficulties may develop due to high moisture content in the soil, disturbance of sensitive soils and/or the presence of perched groundwater. Therefore, if possible we recommend that earthwork activity be performed during the dry season or as outlined in SWPPP during wet weather conditions.

### 3.9.1 Site Preparation

General site clearing should include removal of vegetation, trees and associated root systems. Site stripping, of any areas where topsoil is in place, should extend to a minimum depth of 6 to 18 inches with an average of 12 inches, or until all organics and loose fill in excess of 3 percent by volume are removed. Information obtained in the explorations indicate that unsuitable soils were encountered from between 6 and 18 inches. For estimating purposes we recommend that an average stripping depth of 12 inches be used. These materials will not be suitable for use as fill. However, stripped topsoil may be stockpiled and reused in landscape or non-structural areas.

Excavations, depressions, or soft and pliant areas extending below planned finish subgrade level should be cleaned to firm, undisturbed soil and backfilled with structural fill up to the planned finish subgrade elevation.

### 3.9.2 Groundwater Concerns

Groundwater was not encountered in the test pits but was encountered in boring B-5 at a depth of approximately 37.0 feet. Groundwater was encountered at approximately 5.0 feet in depth in a piezometer placed in the SR 307 pond under a separate scope of work. Perched groundwater in the near surface soils, particularly on top of the dense to very dense cemented glacial till may develop during the wetter portions of the year. If groundwater is encountered, we should be contacted for further recommendations. Significant groundwater flow, if encountered during construction, would require modifications in the completion of excavation work.

Water table elevations can fluctuate with time. Groundwater levels are typically influenced by seasonal precipitation, irrigation, land use, and climatic conditions, as well as other factors. Groundwater level observations at the time of the field investigation may vary from those encountered during the construction phase of the project.

### 3.9.3 Excavations & Constructed Slopes

It is our opinion that the soils encountered in the majority of the test pits, within the upper 5.0 feet, are Type C material as defined by the Washington Industrial Safety and Health Act's (WISHA) regulations on excavation, trenching and shoring. It is our opinion that the soils encountered 1.5 feet below existing grades are Type B material, due to the presence of cemented till. Temporary slopes excavated in Type B material should be inclined no steeper than 1 H:1 V (horizontal:

vertical). Temporary slopes excavated in Type C material should be inclined no steeper than 1.5 H:1 V, and these slopes may need to be reduced due to the presence of groundwater.

The current grading plan has most of the permanent slopes at a 2H:1V ratio. Permanent slopes steeper than 1.5H:1V can be considered stable as a cut slope in the consolidated Glacial Till. Areas proposed for finished slopes of 1H: 1.5V must be certified by the geotechnical engineer and may require enhanced methods for planting on the slopes.

In areas where it is not possible to maintain the recommended slopes due to space constraints, temporary shoring would be required. Such shoring would need to be properly designed by an engineer.

The Contractor should be familiar with applicable local, state, and federal safety regulations, including the current WISHA regulations on excavation, trenching and shoring. Construction site safety is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. EnviroSound is providing this information only as a service to our client. Under no circumstances should the information provided above be interpreted to mean that EnviroSound is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

### 3.9.4 Structural Fill

The majority of the onsite soils are likely to be suitable for use as structural fill provided that all organic material and topsoil are removed. However due to the amount of fines in the soils, particularly the glacial till, they will be moisture sensitive and difficult to work with during wet weather periods. Conversely near surface soils were dry at the time of the field investigation and will need to be moisture conditioned prior to compactive efforts. Care will need to be exercised in order to not saturate soils.

If earthwork takes place during wet weather periods, the stockpiled soils will need to be covered in visqueen. If the earthwork is to take place during the normally wet period of the year, provisions should be in place for export of wet, moisture sensitive soil and import of granular structural fill material. Imported structural fill should consist of well-graded gravel and/or sand with a maximum grain size of 1½ inches and less than 5 percent fines (material passing the U.S. Standard No. 200 Sieve).

Structural fill should be placed in loose lifts no more than 12 inches thick, moisture conditioned as necessary (moisture content of soil should be within 2 percent of optimum moisture) and compacted to at least 95 percent of the maximum dry density as determined by ASTM Test Method D-1557. Additional lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable. Note that, although in place density testing of fill is frequently used as the primary criterion for acceptance of fill, it should not be the only criterion. If, in the judgment of the geotechnical engineer or his representative, placed fill is not suitable it should be rejected regardless of in place density test results. As an example, fill that is compacted wet of the optimum moisture content may exhibit “pumping” behavior even if in place density test results indicate greater than 95 percent compaction has been achieved. In such a situation, the fill should be removed and replaced with drier material.

### 3.9.5 Utility Trench Fill

Excavations for utilities should be completed and maintained during utility installation and backfilling, in accordance with Occupational Safety and Health Administration (OSHA) requirements. The utility contractor should be responsible for maintaining safety within open trenches. Care should be taken to reduce surcharge loads and vibrations adjacent to utility

excavations. Although no groundwater seepage was encountered during excavation, the contractor should allow for shoring in the event that groundwater is encountered during construction.

The majority of the subsurface soils at this site generally included loose to medium dense gravelly sand and sandy gravel in the upper 1.5 to 5.0 feet with dense to very dense Glacial Till at greater depths. We expect that the potential in these areas for significant caving within open excavations will be low to moderate in the upper 3.0 to 5.0 feet, such that the utility contractor should exercise caution and be prepared to slope excavation sidewalls at gentler angles or install temporary shoring, if conditions indicate that caving may occur. The potential for sloughing or caving in within open excavations will be moderate to high in these soils. Additional factors that may influence the potential for caving could include the depth and length of trench that is opened at any one time, along with the length of time the trench is to remain open and surface and groundwater conditions. The utility contractor should be aware of these factors and observe the excavation for signs of possible caving, such as heavy seepage and tension cracks within and above the excavation sidewalls.

Backfill for utility trenches should consist of suitable material, as described in the **Structural Fill** section of this report. Utility trench backfill placed beneath building and pavement areas should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D-1557. The utility trench backfill placed beneath pavement areas, at depths greater than 2 feet below the final grade may be compacted to a minimum of 90 percent of the maximum dry density, as defined by ASTM Test Method D-1557. The bedding material for utility pipes should be in accordance with the manufacturer's specifications. The utility contractor should use equipment and backfill placement methods, which will reduce the possibility of damage to utilities or structures during placement and compaction.

### 3.9.6 Wet Weather Earthwork

The soils encountered during explorations that are likely to be encountered during grading activities contain sufficient amounts of silt and fine sand to make them moisture sensitive. The soils would likely provide a suitable working surface under dry conditions; however, after exposure to rain and continual vehicle traffic, the native soils will degrade rapidly and may require over-excavation.

Wet weather generally begins about October and continues through about May, although rainy periods may occur at any time of the year. If possible, we recommend scheduling earthwork during the dry weather months of May through September. Although it is our experience that undergoing earthwork during periods of wet weather typically makes the work more difficult to accomplish, taking it longer, and making it more costly, grading in wet weather is possible if done in accordance with best management practices (BMP's) as outlined in Section 2.9.4 of this report. It should be noted that this applies to working during periods of wet weather, regardless of the time of year.

The following recommendations are applicable if earthwork is to be accomplished in wet weather or in wet conditions:

- Structural fill material should consist of clean, well-graded sand, or sand and gravel, with not more than 5 percent passing the No. 200 sieve, based on wet-sieving the minus ¾ inch fraction. Any fines should be non-plastic.
- The ground surface in and surrounding the construction area should be sloped as much as possible to promote runoff of precipitation away from work areas and to prevent ponding of water.
- Covering work areas or slopes with plastic, sloping, ditching, use of sumps, dewatering, and other measures should be employed as necessary to permit proper completion of the work. Bales of straw and/or geotextile silt fences should be used to control surface soil movement and erosion.

- Earthwork should be accomplished in small sections to reduce exposure to wet conditions. Excavation or the removal of unsuitable soil should be followed immediately by the placement of concrete or a layer of compacted, clean, structural fill or lean-mix concrete.
- No soil should be left uncompacted and exposed to moisture. A smooth drum vibratory roller, or equivalent, should be used to seal the surface if wet weather is anticipated. Wet surface soils should be removed prior to filling each day. Stockpiles of structural fill should be protected from wet weather with waterproof sheeting.
- In-place soils or fill soils that become wet and unstable, and/or too wet to suitable compact, should be removed and replaced with clean granular soil (see above).
- Excavation and fill placement activities should be observed on a full-time basis by an experienced geotechnical engineer if these activities are to be completed during wet weather or under wet conditions.

The above recommendations for wet weather earthwork should be incorporated into the contract specifications.

### 3.9.7 Stormwater

Surface run-off from the development will be directed into two stormwater detention ponds located across the site. The stormwater system is being designed by Team 4 Engineering. Infiltration is not feasible due to the presence of glacial till at shallow depths. If dispersion BMP's are incorporated into the storm plan, additional geotechnical documentation will be required for downstream flow paths and slopes. EnviroSound should review pond grading and outfalls during construction document preparation.

## 4.0 LIMITATIONS

This report has been prepared for Edward Rose & Sons, regarding the subject project. Information presented in this report has been collected and interpreted in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions, and in accordance with sound and generally accepted principles consistent with normal consulting practice. No other warranty, expressed or implied, including (but not limited to) any warranty or merchantability or fitness for a particular use has been made.

Edward Rose & Sons and EnviroSound discussed the risks and rewards associated with this project, as well as EnviroSound's fee for services. Edward Rose & Sons and EnviroSound agreed to allocate certain of the risks so that, to the fullest extent permitted by law, EnviroSound's total aggregate liability to Edward Rose & Sons is limited to $50,000 or the fee, whichever is less, for any and all injuries, claims (including any claims for costs of defense or other incurred costs), losses, expenses, or damages whatsoever arising out of or in any way related to EnviroSound's services for this project, from any cause or causes whatsoever, including but not limited to, negligence, errors, omissions, strict liability, breach of contract, breach of warranty, negligent misrepresentation, or other acts giving rise to liability based upon contract tort, or statute.

In the event that change in the nature, design, or location of the proposed construction is made, or any physical changes to the site occur, recommendations are not to be considered valid unless the changes are reviewed by EnviroSound and conclusions of this report are modified or verified in writing.

The subsurface exploration logs and related information depicts conditions only at the specific locations and at the particular time designated on the logs. The passage of time may result in a change of subsurface conditions at these exploration locations. Subsurface conditions at other locations may differ from conditions occurring at the exploration locations. The nature and extent of variations of subsurface conditions between explorations are not known. If variations appear during additional explorations or construction, reevaluation of recommendations in this report may be necessary.

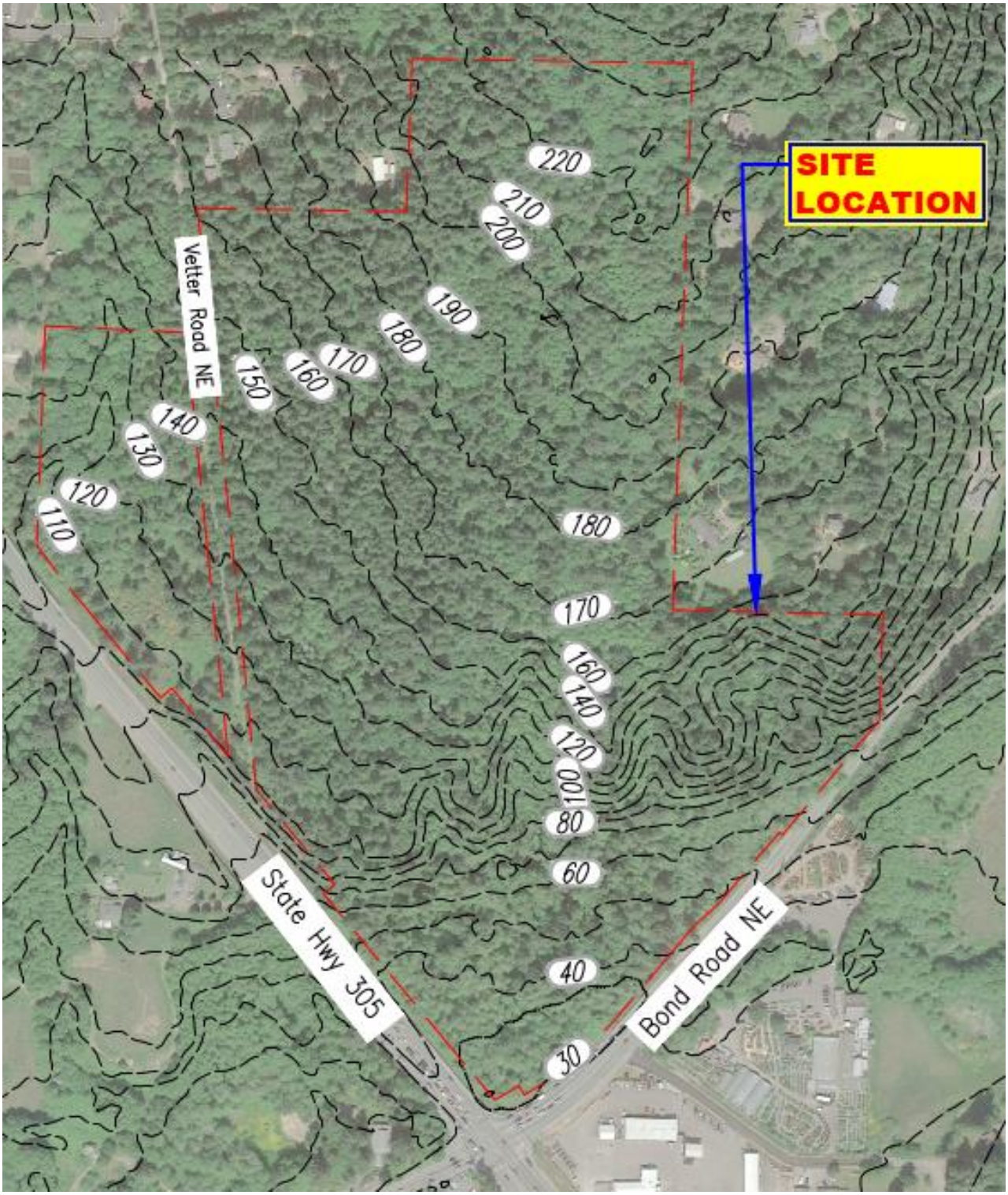
Stratification lines designating the interface between soil types in subsurface exploration logs represent approximate boundaries. The transition between materials may be gradual.

Analyses and recommendations provided in this report are based in part upon the data obtained from the subsurface explorations.

The scope of EnviroSound services did not include an environmental assessment for the presence or absence of hazardous and/or toxic materials, in the soil and groundwater.

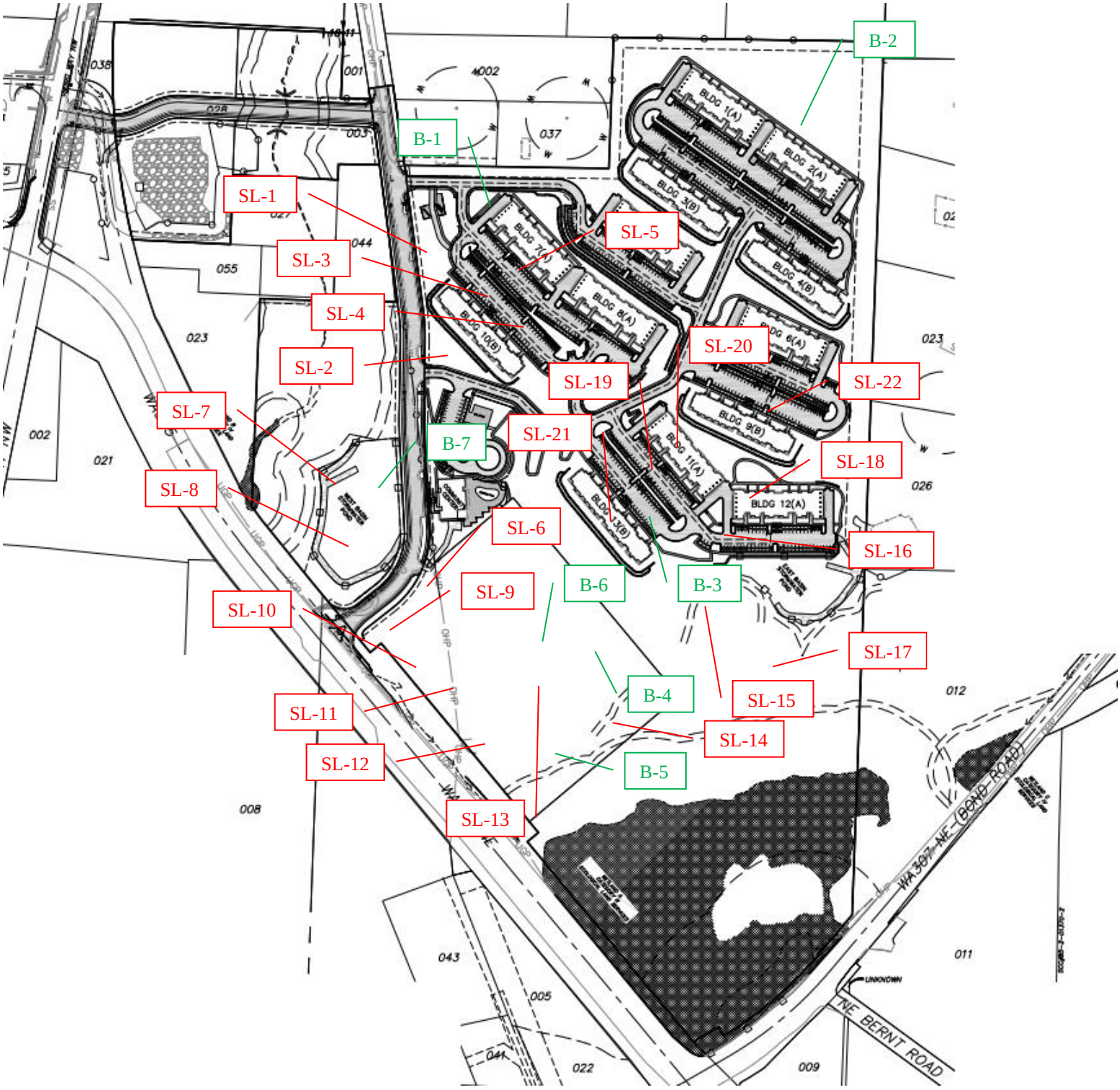
**REFERENCES**


- “Soil Survey of Kitsap County Washington”, United States Department of Agriculture, 1977.
- USDA Online Web Soil Survey – http://websoilsurvey.nrcs.usda.gov/app/.
- “Slope Stability, Kitsap County, Washington”, Jerry Deeter, 1979.
- U.S.G.S. 7.5 minute series topographic map “USGS Poulsbo Topographic Map”.
- "Geologic Map of Surficial Deposits in the Seattle 30’ x 60’ Quadrangle Washington," Young and others, 1993.
- City of Poulsbo Geologically Hazardous Areas Map
- City of Poulsbo Critical Aquifers Map
- Kitsap County Online Parcel Information – https://psearch.kitsapgov.com/psearch/index.html.
- Aerial photographs provided by Google Earth and Kitsap County.
- 2015 International Building Code (IBC)
- USGS Seismic Design Maps – https://earthquake.usgs.gov/designmaps/us/application.php.
- Geotechnical Engineering Report, “Rose Master Plan” EnviroSound Consulting, November 12, 2010.




**Source: Google Maps**

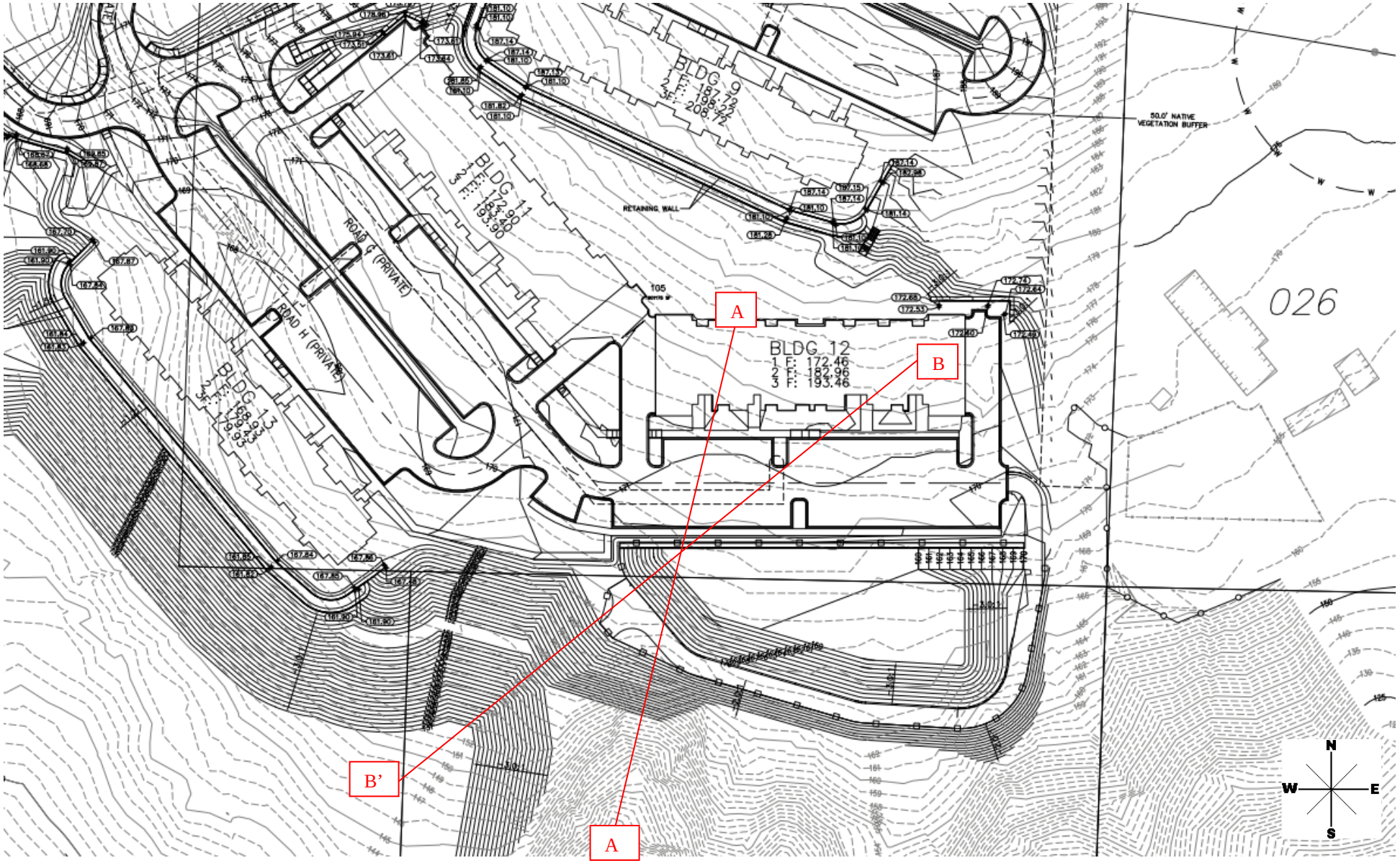
| Vicinity Map | Scale: NTS | Date: 11/20 | EnviroSound Consulting |
|---|---|---|---|
| Oslo Bay Apartments<br>WA 305 NE<br>Poulsbo, Washington | Drawn by: CB | Approved by: SEW | |
| | Project No. ESC19-G047 | Figure No. 1 | |




**B-1: ESC 2017 Boring Locations**
**SL-1: ESC 2016 Test Pit Locations**

**Figure generated from drawing provided by Team 4 Engineering**

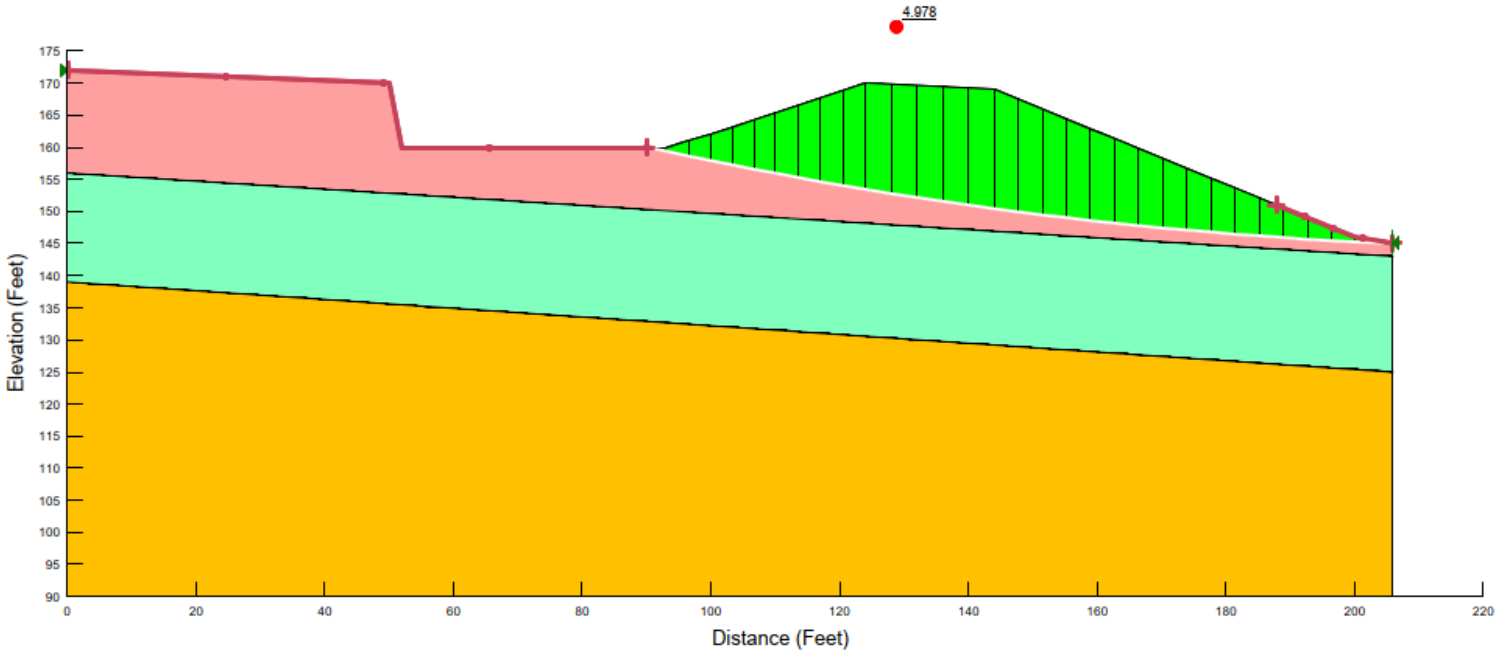
| | | | |
|---|---|---|---|
| **Site Plan** | **Scale:** NTS | **Date:** 11/20 | EnviroSound Consulting |
| **Oslo Bay Apartments**<br>**WA 305 NE**<br>**Poulsbo, Washington** | **Drawn by:** CB | **Approved by:** SEW | |
| | **Project No.** ESC19-G047 | **Figure No.** 2 | |




| | | | |
|---|---|---|---|
| **Cross Section Location** | **Scale:** NTS | **Date:** 11/20 | |
| **Oslo Bay Apartments**<br>**WA 305 NE**<br>**Poulsbo, Washington** | **Drawn by:** CB | **Approved by:** SEW | EnviroSound Consulting |
| | **Project No.** ESC19-G047 | **Figure No.** 3 | |

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) |
|---|---|---|---|---|
| | Dense Medium Sand | 115 | 0 | 36 |
| | Dense Silty Sand | 125 | 0 | 34 |
| | Fill Material | 125 | 0 | 34 |
| | Glacial Till | 135 | 25 | 38 |

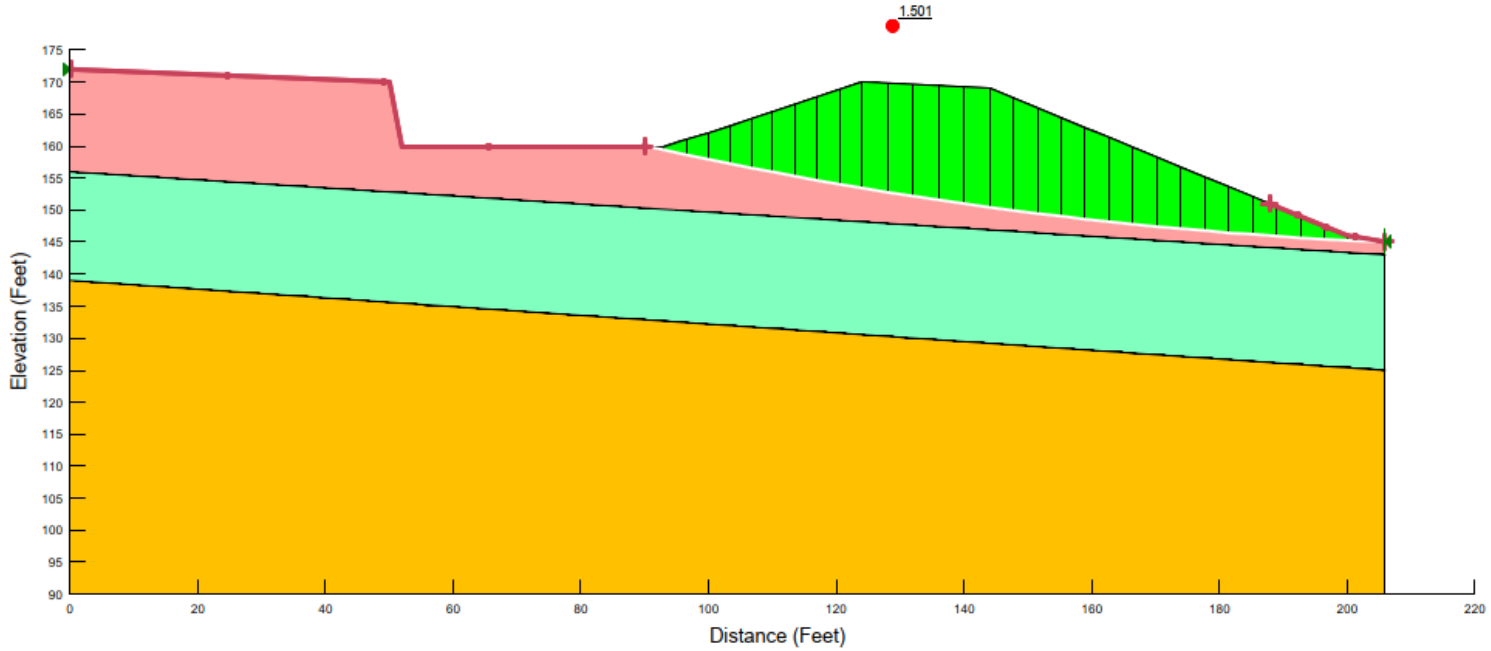
Static F of S: 4.978




| | | | |
|---|---|---|---|
| **A-A Static Slope Stability** | **Scale:** NTS | **Date:** 11/20 | EnviroSound Consulting |
| **Oslo Bay Apartments**<br>**WA 305 NE**<br>**Poulsbo, Washington** | **Drawn by:** CB | **Approved by:** SEW | |
| | **Project No.** ESC19-G047 | **Figure No.** 4 | |

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) |
|---|---|---|---|---|
| | Dense Medium Sand | 115 | 0 | 36 |
| | Dense Silty Sand | 125 | 0 | 34 |
| | Fill Material | 125 | 0 | 34 |
| | Glacial Till | 135 | 25 | 38 |

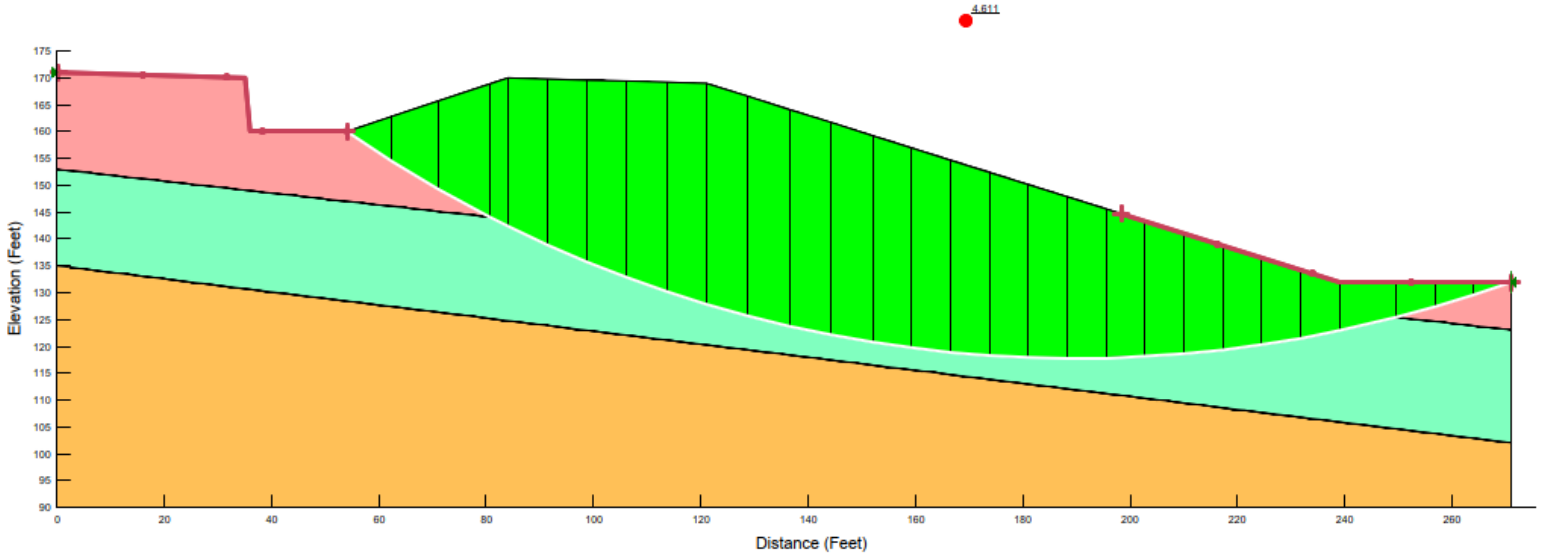
Seismic F of S: 1.501




| | | | |
|---|---|---|---|
| **A-A Seismic Slope Stability** | **Scale:** NTS | **Date:** 11/20 | |
| **Oslo Bay Apartments**<br>**WA 305 NE**<br>**Poulsbo, Washington** | **Drawn by:** CB | **Approved by:** SEW | EnviroSound Consulting |
| | **Project No.** ESC19-G047 | **Figure No.** 5 | |

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) |
|---|---|---|---|---|
| | Dense Medium Sand | 115 | 0 | 36 |
| | Dense Silty Sand | 125 | 0 | 34 |
| | Fill Material | 125 | 0 | 34 |
| | Glacial Till | 135 | 25 | 38 |

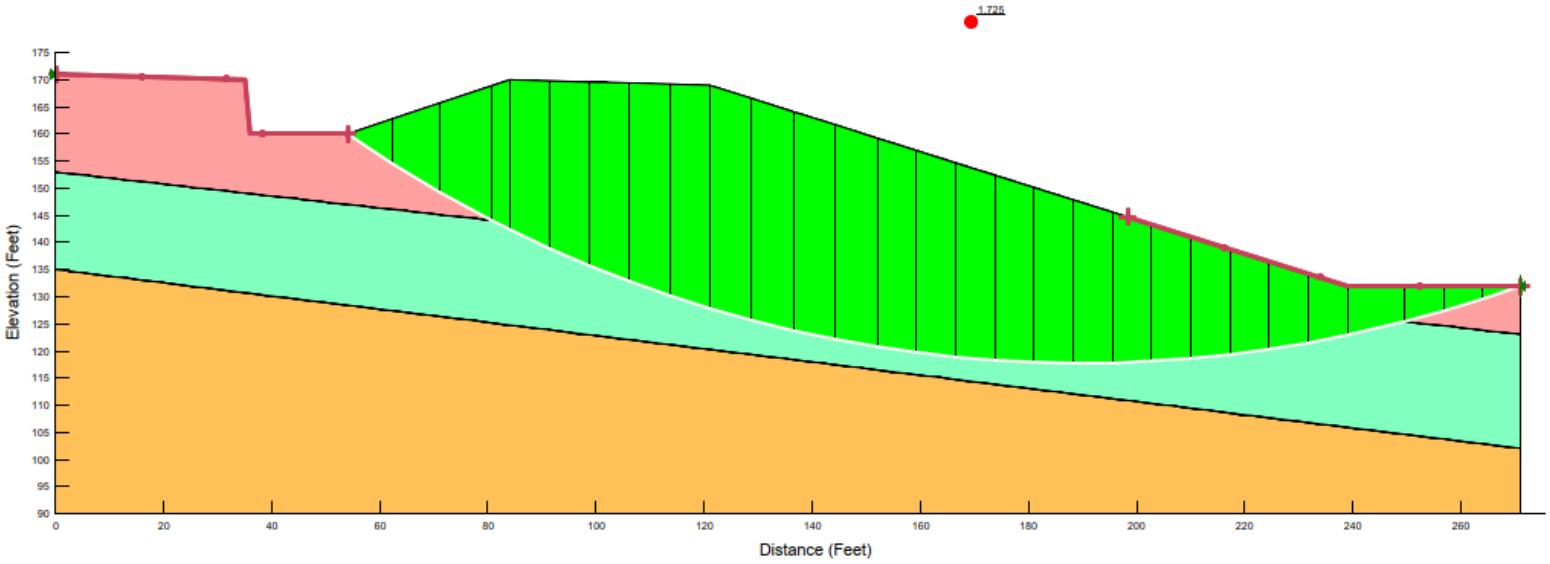
Static F of S: 4.611




| B-B Static Slope Stability | Scale: NTS | Date: 11/20 | |
|---|---|---|---|
| Oslo Bay Apartments<br>WA 305 NE<br>Poulsbo, Washington | Drawn by: CB | Approved by: SEW | EnviroSound Consulting |
| | Project No. ESC19-G047 | Figure No. 6 | |

| Color | Name | Unit Weight (pcf) | Cohesion' (psf) | Phi' (°) |
|---|---|---|---|---|
| | Dense Medium Sand | 115 | 0 | 36 |
| | Dense Silty Sand | 125 | 0 | 34 |
| | Fill Material | 125 | 0 | 34 |
| | Glacial Till | 135 | 25 | 38 |

Seismic F of S: 1.725




| | | | |
|---|---|---|---|
| **B-B Seismic Slope Stability** | **Scale:** NTS | **Date:** 11/20 | |
| **Oslo Bay Apartments**<br>**WA 305 NE**<br>**Poulsbo, Washington** | **Drawn by:** CB | **Approved by:** SEW | EnviroSound Consulting |
| | **Project No.** ESC19-G047 | **Figure No.** 7 | |

# APPENDIX A

## EnviroSound Test Pit Logs & Boring Logs

## TEST PIT SL- 1

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @145'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-0.5' Forest duff | | | | |
| | SM | 0.5'-2.0' Reddish brown, medium dense, silty SAND with cobbles and gravels; moist. | SL-1 | Grab | 1.0 | Gravel: 22.0%<br>Sand: 63.8%<br>Silt/Clay: 14.2% |
| | SM | 2.0'-3.0' Brownish gray, dense to very dense silty SAND, weathered TILL with cobbles; moist. Moisture increasing with depth. | | | | |
| 5 | | Total depth: 3.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Track hoe
Operator: Al

Excavation Date: 12/30/16
ESC Representative: SEW

## TEST PIT SL- 2

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @ 142'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-0.5' Forest duff with branches and cobbles | | | | |
| | SM | 0.5'-2.5' Reddish brown, medium dense, gravelly sandy; slightly moist. Branches on sidewalls to 2.0' | SL-2 | Grab | 1.0 | Gravel: 21.0%<br>Sand: 62.0%<br>Silt/Clay: 17.0% |
| | SM | 2.5'-3.0' Gray, dense to very dense silty SAND (TILL) with cobbles; moist. | | | | |
| 5 | | Total depth: 3.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Track hoe
Operator: Al

Excavation Date: 12/30/16
ESC Representative: SEW

## TEST PIT SL- 3

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @ 150'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-0.5' Dark brown, forest duff ; moist. | | | | |
| | SM | 0.5'-3.0' Reddish brown, medium dense, silty SAND with cobbles; slightly moist. Branches on sidewalls to 3.0' | SL-3 | Grab | 1.0 | Gravel: 30.1%<br>Sand: 55.1%<br>Silt/Clay: 14.8% |
| | SM | 3.0'-4.0' Gray, dense silty SAND (TILL) with cobbles; moist. | | | | |
| 5 | | Total depth: 4.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Track hoe
Operator: Al

Excavation Date: 12/30/16
ESC Representative: SEW

## TEST PIT SL- 4

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @152'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-0.5' Forest duff ; moist. | | | | |
| | SM | 0.5'-3.0' Reddish brown, medium dense, silty SAND with cobbles and gravels; moist. | SL-4 | Grab | 1.0 | Gravel: 20.6%<br>Sand: 60.6%<br>Silt/Clay: 18.8% |
| | SM | 3.0'-4.0' Gray, dense to very dense silty SAND (TILL) with cobbles; moist. | | | | |
| 5 | | Total depth: 4.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Track hoe
Operator: Al

Excavation Date: 12/30/16
ESC Representative: SEW

## TEST PIT SL- 5

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @ 155'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-0.5' Forest duff with cobbles silty SAND ; moist. | | | | |
| | SM | 0.5'-2.5' Reddish brown, medium dense, fine silty SAND with cobbles; moist. | SL-5 | Grab | 1.0 | Gravel: 19.1%<br>Sand: 71.7%<br>Silt/Clay: 16.9% |
| | SM | 2.5'-3.0' Gray, dense to very dense silty SAND (TILL); moist. | | | | |
| 5 | | Total depth: 3.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Trackhoe
Operator: Al

Excavation Date: 12/30/16
ESC Representative: SEW

## TEST PIT SL- 6

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @ 125'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-1.0' Forest duff , loose, dark brown, silty SAND; moist. | | | | |
| | SM | 1.0'-2.5' Reddish brown, medium dense, silty SAND; moist. | SL-6 | Grab | 1.0 | Gravel: 21.0%<br>Sand: 62.1%<br>Silt/Clay: 16.9% |
| | SM | 2.5'-3.0' Gray, dense to very dense silty SAND (TILL) with cobbles; moist. | | | | |
| 5 | | Total depth: 3.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Trackhoe
Operator: Al

Excavation Date: 12/30/16
ESC Representative: SEW

## TEST PIT SL- 7

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @ 122'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-1.0' Forest duff , loose, dark brown, silty SAND with roots and cobbles; moist. | | | | |
| | SM | 1.0'-2.0' Reddish brown, medium dense, silty SAND; moist. | SL-7 | Grab | 1.0 | Gravel: 16.0%<br>Sand: 62.9%<br>Silt/Clay: 21.1% |
| | SM | 2.0'-4.0' Gray, dense to very dense silty SAND (TILL) with cobbles; moist. | | | | |
| 5 | | Total depth: 4.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Trackhoe
Operator: Al

Excavation Date: 12/30/16
ESC Representative: SEW

# TEST PIT SL- 8

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @ 115'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-1.0' Forest duff , loose, dark brown, silty SAND with roots and cobbles; moist. Debris at 1.0', tubing on sidewall at 1.0'. | | | | |
| | SM | 1.0'-2.5' Reddish brown, medium dense, silty SAND with cobbles; moist. | SL-8 | Grab | 1.0 | Gravel: 16.0%<br>Sand: 61.2%<br>Silt/Clay: 22.8% |
| | SM | 2.5'-3.0' Gray, dense to very dense silty SAND (TILL) with large cobbles; moist. | | | | |
| 5 | | Total depth: 3.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Trackhoe
Operator: Al

Excavation Date: 12/30/16
ESC Representative: SEW

## TEST PIT SL- 9

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation:@115'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-1.0' Forest duff , loose, dark brown, silty SAND with; moist. | | | | |
| | SM | 1.0'-2.5' Reddish brown, medium dense, silty SAND with cobbles; moist. | SL-9 | Grab | 1.0 | Gravel: 26.5%<br>Sand: 50.8%<br>Silt/Clay: 22.7% |
| | SM | 2.5'-3.5' Gray, dense to very dense silty SAND (TILL) with cobbles; moist. | | | | |
| 5 | | Total depth: 3.5'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Trackhoe
Operator: Al

Excavation Date: 12/30/16
ESC Representative: SEW

## TEST PIT SL- 10

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @ 110'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-1.0' Forest duff , loose, dark brown, silty SAND; moist. | | | | |
| | SM | 1.0'-3.5' Medium brown, medium dense, silty SAND with cobbles; moist. | SL-10 | Grab | 1.0 | Gravel: 32.8%<br>Sand: 49.1%<br>Silt/Clay: 18.1% |
| 5 | SM | 3.5'-4.0' Gray, dense to very dense silty SAND (TILL) with cobbles; moist. | | | | |
| | | Total depth: 4.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Trackhoe
Operator: Al

Excavation Date: 12/30/16
ESC Representative: SEW

# TEST PIT SL- 11

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @107'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-1.0' Forest duff , loose, dark brown, silty SAND; moist. | | | | |
| | SM | 1.0'-3.5' Reddish brown, medium dense, silty SAND with cobbles; moist. | SL-11 | Grab | 1.0 | Gravel: 51.0%<br>Sand: 36.6%<br>Silt/Clay: 12.4% |
| 5 | SM | 3.5'-4.0' Gray, dense to very dense, fine silty SAND (TILL) with cobbles; moist. | | | | |
| | | Total depth: 4.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Trackhoe
Operator: Al

Excavation Date: 12/30/16
ESC Representative: SEW

# TEST PIT SL- 12

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation:@105'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-1.0' Forest duff , loose, dark brown, silty SAND; moist. | | | | |
| | SM | 1.0'-3.0' Reddish brown, medium dense, silty SAND with cobbles; moist. | SL-12 | Grab | 1.0 | Gravel: 14.7%<br>Sand: 59.8%<br>Silt/Clay: 25.5% |
| | SM | 3.0'-4.0' Gray, dense to very dense, fine silty SAND (TILL); moist. | | | | |
| 5 | | Total depth: 4.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Trackhoe
Operator: Al

Excavation Date: 12/30/16
ESC Representative: SEW

## TEST PIT SL- 13

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation:@115'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-1.0' Forest duff , loose, dark brown, silty SAND; moist. | | | | |
| | SM | 1.0'-3.5' Reddish brown, medium dense, silty SAND; moist. | SL-13 | Grab | 1.0 | Gravel: 46.0%<br>Sand: 39.5%<br>Silt/Clay: 14.5% |
| 5 | SM | 3.0'-4.0' Gray, dense to very dense, fine silty SAND (TILL); moist. | | | | |
| | | Total depth: 4.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Trackhoe
Operator: Al

Excavation Date: 12/30/16
ESC Representative: SEW

## TEST PIT SL- 14

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @125'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-1.0' Forest duff , loose, dark brown, silty SAND; moist. | | | | |
| | SM | 1.0'-3.0' Reddish brown, medium dense, silty SAND; moist. | SL-14 | Grab | 1.0 | Gravel: 26.9%<br>Sand: 51.5%<br>Silt/Clay: 21.6% |
| | SM | 3.0'-4.0' Gray, dense to very dense, silty SAND (TILL) with cobbles; slightly moist. | | | | |
| 5 | | Total depth: 4.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Trackhoe
Operator: Todd

Excavation Date: 12/31/16
ESC Representative: SEW

## TEST PIT SL- 15

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @ 155'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-1.0' Forest duff , loose, dark brown, silty SAND; moist. | | | | |
| | SM | 1.0'-3.0' Reddish brown, medium dense, silty SAND with gravels and cobbles; moist. | SL-15 | Grab | 1.0 | Gravel: 24.6%<br>Sand: 50.0%<br>Silt/Clay: 25.4% |
| | SM | 3.0'-4.0' Gray, dense to very dense, silty SAND (TILL) with cobbles; slightly; moist. | | | | |
| 5 | | Total depth: 4.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Trackhoe
Operator: Todd

Excavation Date: 12/31/16
ESC Representative: SEW

## TEST PIT SL- 16

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @170'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-1.0' Forest duff , loose, dark brown, silty SAND with roots; moist. | | | | |
| | SM | 1.0'-2.5' Reddish brown, medium dense, silty SAND with roots; moist. | SL-16 | Grab | 1.0 | Gravel: 26.5%<br>Sand: 50.7%<br>Silt/Clay: 22.8% |
| | SM | 2.5'-3.0' Gray, dense to very dense, silty SAND (TILL) with cobbles; moist. | | | | |
| 5 | | Total depth: 3.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Trackhoe
Operator: Todd

Excavation Date: 12/31/16
ESC Representative: SEW

## TEST PIT SL- 17

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @155'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-1.0' Forest duff , loose, dark brown, silty SAND with roots; moist. | | | | |
| | SM | 1.0'-3.0' Reddish brown, medium dense, silty SAND; moist. | SL-17 | Grab | 1.0 | Gravel: 23.5%<br>Sand: 53.4%<br>Silt/Clay: 23.1% |
| | SM | 3.0'-4.0' Gray, dense to very dense, silty SAND (TILL) with cobbles; moist. | | | | |
| 5 | | Total depth: 4.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Trackhoe
Operator: Todd

Excavation Date: 12/31/16
ESC Representative: SEW

## TEST PIT SL- 18

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @ 172'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-1.5' Forest duff , loose, dark brown, silty SAND with roots; moist. | | | | |
| | SM | 1.5'-3.5' Reddish brown, medium dense, silty SAND; moist. | SL-18 | Grab | 1.0 | Gravel: 17.7%<br>Sand: 56.8%<br>Silt/Clay: 25.5% |
| 5 | SM | 3.5'-4.0' Gray, dense to very dense, silty SAND (TILL) with cobbles; moist. | | | | |
| | | Total depth: 4.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Trackhoe
Operator: Todd

Excavation Date: 12/31/16
ESC Representative: SEW

# TEST PIT SL- 19

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @172'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-0.5' Forest duff , loose, dark brown, silty SAND with roots; moist. | | | | |
| | SM | 0.5'-2.0' Reddish brown, medium dense, silty SAND with roots; moist. | SL-19 | Grab | 1.0 | Gravel: 24.1%<br>Sand: 53.2%<br>Silt/Clay: 22.7% |
| | SM | 2.0'-3.0' Gray, medium dense, silty SAND; moist. At 3.0' Very dense cemented TILL. | | | | |
| 5 | | Total depth: 3.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Trackhoe
Operator: Todd

Excavation Date: 12/31/16
ESC Representative: SEW

# TEST PIT SL- 20

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @ 177'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-0.5' Forest duff , loose, dark brown, silty SAND with roots; moist. | | | | |
| | SM | 0.5'-2.0' Reddish TAN, medium dense, silty SAND with gravels and roots; moist. | SL-20 | Grab | 1.0 | Gravel: 28.0%<br>Sand: 50.2%<br>Silt/Clay: 21.8% |
| | SM | 2.0'-3.5' Gray, medium dense, silty SAND; moist. | | | | |
| | SM | 3.5'-4.0' Dense cemented TILL. | | | | |
| 5 | | Total depth: 4.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Trackhoe
Operator: Todd

Excavation Date: 12/31/16
ESC Representative: SEW

# TEST PIT SL- 21

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @190'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-0.5' Forest duff , loose, dark brown, silty SAND with roots; moist. | | | | |
| | SM | 0.5'-2.0' Reddish tan, medium dense, silty SAND with roots; moist. | SL-21 | Grab | 1.0 | Gravel: 27.2%<br>Sand: 49.5%<br>Silt/Clay: 23.3% |
| | SM | 2.0'-3.0' Gray, medium dense, silty SAND; moist. | | | | |
| | SM | 3.0'-4.0' Very dense cemented silty SAND (TILL). | | | | |
| 5 | | Total depth: 4.0'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Trackhoe
Operator: Todd

Excavation Date: 12/31/16
ESC Representative: SEW

## TEST PIT SL- 22

Project Name: Oslo Bay Apartments
Client: Edward Rose & Sons
Project Number: ESC19-G047

Test Pit Elevation: @190'
Test Pit Location: See Site Plan.
Depth to Groundwater: Not Encountered.

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | PT | 0-0.5' Forest duff , loose, dark brown, silty SAND with scattered roots; moist. | | | | |
| | SM | 0.5'-1.0' Reddish tan, medium dense, silty SAND; moist. | SL-22 | Grab | 1.0 | Gravel: 26.5%<br>Sand: 47.5%<br>Silt/Clay: 26.0% |
| | SM | 1.0'-3.9' Gray, medium dense, silty SAND with gravels; moist. At 3.9' very dense cemented TILL. | | | | |
| 5 | | Total depth: 3.9'<br>Groundwater: None encountered<br>No mottling | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: Bull's Eye Excavation
Excavation Equipment: Trackhoe
Operator: Todd

Excavation Date: 12/31/16
ESC Representative: SEW

## Log of Test Boring B-1

Project Name: Oslo Bay Apartments
Client: Edward Rose and Sons
Project Number: ESC19-G047

Boring Elevation: @160'
Boring Location: See Site Plan
Depth to Groundwater: None Encountered

| DEPTH (FT.) | USCS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | DEPTH (FEET) | SAMPLE TYPE | BLOW COUNTS PER 6 INCHES | N VALUE | RECOVERY (INCHE) | LAB TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | Forest duff, tan silty SAND | | | | | | | |
| | SM | Tan, medium dense, silty SAND. Cobbles at 3.0' and 5.0' | | | | | | | |
| 5 | SM | Gray, very dense, gravelly silty SAND (TILL) with cobbles; slightly moist. | S-1 | 5.0 | SPT | 26,40,38 | 78 | 17 | |
| 10 | SM | Dark gray, very dense, gravelly silty SAND, trace cobbles; slightly moist. | S-2 | 10.0 | SPT | 18,46,50/6 | 50+ | 20 | |
| 15 | SM | Gray, very dense silty SAND, trace clay, trace gravels in upper 3"; slightly moist. | S-3 | 15.0 | SPT | 13,21,30 | 51 | 18 | |

Drill Contractor: Geologic Drill
Equipment: Track Mounted
Sampling Method: SPT
Driller: Wade

Excavation Date: 01-04-2017
ESC Representative: S. Williams

## Log of Test Boring B-1

Project Name: Oslo Bay Apartments
Client: Edward Rose and Sons
Project Number: ESC19-G047

Boring Elevation: @160'
Boring Location: See Site Plan
Depth to Groundwater: None Encountered

| DEPTH (FT.) | USCS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | DEPTH (FEET) | SAMPLE TYPE | BLOW COUNTS PER 6 INCHES | N VALUE | RECOVERY (INCH) | LAB TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|---|---|---|
| 20 | SM | Gray, very dense, fine to medium SAND, moisture increasing with depth. | S-4 | 20.0 | SPT | 22,32,36 | 68 | 15 | |
| | | Total depth: 21.5'<br>Groundwater: None encountered | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

Drill Contractor: Geologic Drill
Equipment: Track Mounted
Sampling Method: SPT
Driller: Wade

Excavation Date: 01-04-2017
ESC Representative: S. Williams

## Log of Test Boring B-2

Project Name: Oslo Bay Apartments
Client: Edward Rose and Sons
Project Number: ESC19-G047

Boring Elevation: @217'
Boring Location: See Site Plan
Depth to Groundwater: None Encountered

| DEPTH (FT.) | USCS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | DEPTH (FEET) | SAMPLE TYPE | BLOW COUNTS PER 6 INCHES | N VALUE | RECOVERY (INCHE) | LAB TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | Forest duff, tan silty SAND | | | | | | | |
| | SM | Gray, dense silty SAND, gravels at 15.0', moist. | | | | | | | |
| 5 | SM | Dark gray, dense, silty SAND, trace gravels; moist. | S-1 | 5.0 | SPT | 13,17,26 | 43 | 17 | |
| 10 | SM | Gray, very dense, silty SAND (TILL); moist. | S-2 | 10.0 | SPT | 27,35,40 | 75 | 19 | |
| 15 | SM | Dark gray, very dense, silty SAND (TILL), trace gravels; slightly moist. | S-3 | 15.0 | SPT | 39, 50/3 | 50+ | 16 | |

Drill Contractor: Geologic Drill
Equipment: Track Mounted
Sampling Method: SPT
Driller: Wade

Excavation Date: 01-04-2017
ESC Representative: S. Williams

## Log of Test Boring B-2

Project Name: Oslo Bay Apartments
Client: Edward Rose and Sons
Project Number: ESC19-G047

Boring Elevation: @217'
Boring Location: See Site Plan
Depth to Groundwater: None Encountered

| DEPTH (FT.) | USCS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | DEPTH (FEET) | SAMPLE TYPE | BLOW COUNTS PER 6 INCHES | N VALUE | RECOVERY (INCH) | LAB TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|---|---|---|
| 20 | SM | Dark gray, very dense, silty SAND (TILL) with gravels; slightly moist. | S-4 | 20.0 | SPT | 42 50/4 | 50+ | 16 | |
| | | Total depth: 21.5'<br>Groundwater: None encountered | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

Drill Contractor: Geologic Drill
Equipment: Track Mounted
Sampling Method: SPT
Driller: Wade

Excavation Date: 01-04-2017
ESC Representative: S. Williams

## Log of Test Boring B-3

Project Name: Oslo Bay Apartments
Client: Edward Rose and Sons
Project Number: ESC19-G047

Boring Elevation: @170'
Boring Location: See Site Plan
Depth to Groundwater: None Encountered

| DEPTH (FT.) | USCS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | DEPTH (FEET) | SAMPLE TYPE | BLOW COUNTS PER 6 INCHES | N VALUE | RECOVERY (INCHE) | LAB TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | Forest duff, tan silty SAND | | | | | | | |
| | SM | Gray, dense silty SAND | | | | | | | |
| 5 | SM | Dark gray, dense, silty SAND, trace clay; slightly moist. | S-1 | 5.0 | SPT | 9,15,23 | 38 | 19 | |
| 10 | SM | Gray, very dense, silty SAND, trace gravels; slightly moist. | S-2 | 10.0 | SPT | 14,24,28 | 52 | 17 | |
| 15 | SM | Gray, very dense, silty SAND (TILL), trace gravels; slightly moist. | S-3 | 15.0 | SPT | 30,46,38 | 84 | 21 | |

Drill Contractor: Geologic Drill
Equipment: Track Mounted
Sampling Method: SPT
Driller: Wade

Excavation Date: 01-04-2017
ESC Representative: S. Williams

## Log of Test Boring B-3

Project Name: Oslo Bay Apartments
Client: Edward Rose and Sons
Project Number: ESC19-G047

Boring Elevation: @170'
Boring Location: See Site Plan
Depth to Groundwater: None Encountered

| DEPTH (FT.) | USCS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | DEPTH (FEET) | SAMPLE TYPE | BLOW COUNTS PER 6 INCHES | N VALUE | RECOVERY (INCH) | LAB TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|---|---|---|
| 20 | SM | Brown, very dense, silty SAND-sandy SILT, trace clay, trace gravels; wet. | S-4 | 20.0 | SPT | 15,30,43 | 73 | 19 | |
| | | Total depth: 21.5'<br>Groundwater: None encountered | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

Drill Contractor: Geologic Drill
Equipment: Track Mounted
Sampling Method: SPT
Driller: Wade

Excavation Date: 01-04-2017
ESC Representative: S. Williams

## Log of Test Boring B-4

Project Name: Oslo Bay Apartments
Client: Edward Rose and Sons
Project Number: ESC19-G047

Boring Elevation: @132'
Boring Location: See Site Plan
Depth to Groundwater: None Encountered

| DEPTH (FT.) | USCS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | DEPTH (FEET) | SAMPLE TYPE | BLOW COUNTS PER 6 INCHES | N VALUE | RECOVERY (INCHE) | LAB TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | Forest duff, tan silty SAND | | | | | | | |
| | SM | Gray, dense silty SAND, with gravels and scattered cobbles, moist. | | | | | | | |
| 5 | SM | Gray, very dense, silty SAND, trace gravels (TILL); slightly moist. | S-1 | 5.0 | SPT | 22,30,29 | 59 | 21 | |
| 10 | | | S-2 | 10.0 | SPT | 7,19,31 | 50 | 16 | |
| 15 | SM | Very dense, gray, silty SAND with gravels (TILL),very moist to wet. | S-3 | 15.0 | SPT | 16,28,50 | 78 | 16 | |

Drill Contractor: Geologic Drill
Equipment: Track Mounted
Sampling Method: SPT
Driller: Wade

Excavation Date: 01-04-2017
ESC Representative: S. Williams

## Log of Test Boring B-4

Project Name: Oslo Bay Apartments
Client: Edward Rose and Sons
Project Number: ESC19-G047

Boring Elevation: @132'
Boring Location: See Site Plan
Depth to Groundwater: None Encountered

| DEPTH (FT.) | USCS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | DEPTH (FEET) | SAMPLE TYPE | BLOW COUNTS PER 6 INCHES | N VALUE | RECOVERY (INCH) | LAB TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|---|---|---|
| 20 | SM | Gray, dense, medium SAND; very moist to wet | S-4 | 20.0 | SPT | 17,23,26 | 49 | 19 | |
| | | Total depth: 21.5'<br>Groundwater: None encountered | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

Drill Contractor: Geologic Drill
Equipment: Track Mounted
Sampling Method: SPT
Driller: Wade

Excavation Date: 01-04-2017
ESC Representative: S. Williams

## Log of Test Boring B-5

Project Name: Oslo Bay Apartments
Client: Edward Rose and Sons
Project Number: ESC19-G047

Boring Elevation: @107'
Boring Location: See Site Plan
Depth to Groundwater: @ 37.0'

| DEPTH (FT.) | USCS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | DEPTH (FEET) | SAMPLE TYPE | BLOW COUNTS PER 6 INCHES | N VALUE | RECOVERY (INCHE) | LAB TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|---|---|---|
| 0 | PT | Forest duff | | | | | | | |
| | SM | Reddish brown, medium dense to dense, silty SAND, with cobbles, moist | | | | | | | |
| 5 | SM | Gray, medium dense, silty SAND, trace gravels; moist to very moist. | S-1 | 5.0 | SPT | 8,12,14 | 26 | 16 | |
| 10 | SP-SM | Gray, very dense, medium SAND, trace gravels; moist to very moist. | S-2 | 10.0 | SPT | 18,28,50/5 | 50+ | 16 | Gravel: 20.5%<br>Sand: 68.7%<br>Silt/Clay: 10.8% |
| 15 | SM | Gray, very dense, slightly silty SAND (TILL), trace gravels; moist. | S-3 | 15.0 | SPT | 41, 50/6 | 50+ | 14 | |

Drill Contractor: Geologic Drill
Equipment: Track Mounted
Sampling Method: SPT
Driller: Wade

Excavation Date: 01-04-2017
ESC Representative: S. Williams

## Log of Test Boring B-5

Project Name: Oslo Bay Apartments
Client: Edward Rose and Sons
Project Number: ESC19-G047

Boring Elevation: @107'
Boring Location: See Site Plan
Depth to Groundwater: @ 37.0'

| DEPTH (FT.) | USCS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | DEPTH (FEET) | SAMPLE TYPE | BLOW COUNTS PER 6 INCHES | N VALUE | RECOVERY (INCH) | LAB TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|---|---|---|
| 20 | SM | Gray, very dense, gravelly slightly silty SAND (TILL), trace gravels; moist. | S-4 | 20.0 | SPT | 29, 50/4 | 50+ | 14 | |
| 25 | SM | Gray, very dense, medium to coarse SAND; very moist to wet. | S-5 | 25.0 | SPT | 23,46,50/4 | 50+ | 19 | Gravel: 1.3%<br>Sand: 84.0%<br>Silt/Clay: 14.7% |
| 30 | SM | Gray, very dense, silty SAND (TILL), trace gravels; slightly moist. | S-6 | 30 | SPT | 42, 50/4 | 50+ | 12 | |
| 35 | SM | Gray, very dense, SAND with scattered gravels, lensed silt; wet. | S-7 | 35 | SPT | 22,46,50/5.5 | 50+ | 16 | |

Drill Contractor: Geologic Drill
Equipment: Track Mounted
Sampling Method: SPT
Driller: Wade

Excavation Date: 01-04-2017
ESC Representative: S. Williams

## Log of Test Boring B-5

Project Name: Oslo Bay Apartments
Client: Edward Rose and Sons
Project Number: ESC19-G047

Boring Elevation: @107'
Boring Location: See Site Plan
Depth to Groundwater: @ 37.0'

| DEPTH (FT.) | USCS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | DEPTH (FEET) | SAMPLE TYPE | BLOW COUNTS PER 6 INCHES | N VALUE | RECOVERY (INCH) | LAB TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|---|---|---|
| 40 | SM | Gray, very dense, medium to coarse SAND; wet. | S-8 | 40.0 | SPT | 25,30,50/5.5 | 50+ | 18 | |
| | | Total depth : 41.5'<br>Groundwater: @ 37.0' | | | | | | | |
| 45 | | | | | | | | | |
| 50 | | | | | | | | | |
| 55 | | | | | | | | | |

Drill Contractor: Geologic Drill
Equipment: Track Mounted
Sampling Method: SPT
Driller: Wade

Excavation Date: 01-04-2017
ESC Representative: S. Williams

## Log of Test Boring B-6

Project Name: Oslo Bay Apartments
Client: Edward Rose and Sons
Project Number: ESC19-G047

Boring Elevation: @120'
Boring Location: See Site Plan
Depth to Groundwater: None Encountered

| DEPTH (FT.) | USCS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | DEPTH (FEET) | SAMPLE TYPE | BLOW COUNTS PER 6 INCHES | N VALUE | RECOVERY (INCHE) | LAB TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | Forest duff, tan silty SAND | | | | | | | |
| | SM | Reddish brown, medium dense, silty SAND, moist | | | | | | | |
| 5 | SM | Gray, medium dense, silty SAND with sand lense, trace gravels; slightly moist. | S-1 | 5.0 | SPT | 11,13,13 | 26 | 12 | |
| 10 | SM | Brown, very dense, silty SAND (TILL), trace gravels; slightly moisy. | S-2 | 10.0 | SPT | 12,35,42 | 87 | 10 | Gravel: 12.3%<br>Sand: 57.6%<br>Silt/Clay: 30.1% |
| 15 | | | S-3 | 15.0 | SPT | 42,50/4 | 50+ | 11 | |

Drill Contractor: Geologic Drill
Equipment: Track Mounted
Sampling Method: SPT
Driller: Wade

Excavation Date: 01-04-2017
ESC Representative: S. Williams

## Log of Test Boring B-6

Project Name: Oslo Bay Apartments
Client: Edward Rose and Sons
Project Number: ESC19-G047

Boring Elevation: @120'
Boring Location: See Site Plan
Depth to Groundwater: None Encountered

| DEPTH (FT.) | USCS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | DEPTH (FEET) | SAMPLE TYPE | BLOW COUNTS PER 6 INCHES | N VALUE | RECOVERY (INCH) | LAB TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|---|---|---|
| 20 | - | No recovery | S-4 | 20.0 | SPT | 50/3 | 50+ | 19 | |
| | | Total depth: 21.5'<br>Groundwater: None encountered | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

Drill Contractor: Geologic Drill
Equipment: Track Mounted
Sampling Method: SPT
Driller: Wade

Excavation Date: 01-04-2017
ESC Representative: S. Williams

## Log of Test Boring B-7

Project Name: Oslo Bay Apartments
Client: Edward Rose and Sons
Project Number: ESC19-G047

Boring Elevation: @120'
Boring Location: See Site Plan
Depth to Groundwater: None Encountered

| DEPTH (FT.) | USCS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | DEPTH (FEET) | SAMPLE TYPE | BLOW COUNTS PER 6 INCHES | N VALUE | RECOVERY (INCHE) | LAB TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | Forest duff, tan silty SAND | | | | | | | |
| | SM | Reddish brown, medium dense to dense, silty SAND, with cobbles, moist. | | | | | | | |
| 5 | SM | Gray, very dense, silty medium SAND with sand lense, trace gravels; slightly moist. | S-1 | 5.0 | SPT | 22,43,50/5 | 50+ | 17 | |
| 10 | SM | Brown, very dense, silty SAND (TILL), trace gravels; slightly moist. | S-2 | 10.0 | SPT | 36,26,25 | 51 | 16 | |
| 15 | | | S-3 | 15.0 | SPT | 50/3 | 50+ | NR | |

Drill Contractor: Geologic Drill
Equipment: Track Mounted
Sampling Method: SPT
Driller: Andy

Excavation Date: 01-05-2017
ESC Representative: S. Williams

## Log of Test Boring B-7

Project Name: Oslo Bay Apartments
Client: Edward Rose and Sons
Project Number: ESC19-G047

Boring Elevation: @120'
Boring Location: See Site Plan
Depth to Groundwater: None Encountered

| DEPTH (FT.) | USCS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | DEPTH (FEET) | SAMPLE TYPE | BLOW COUNTS PER 6 INCHES | N VALUE | RECOVERY (INCH) | LAB TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|---|---|---|
| 20 | - | Till becomes more gray in color. | S-4 | 20.0 | SPT | NA* | | 6.0 | |
| | | Total depth: 21.5'<br>Groundwater: None encountered<br>*California Sampler used to collect sample. | | | | | | | |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

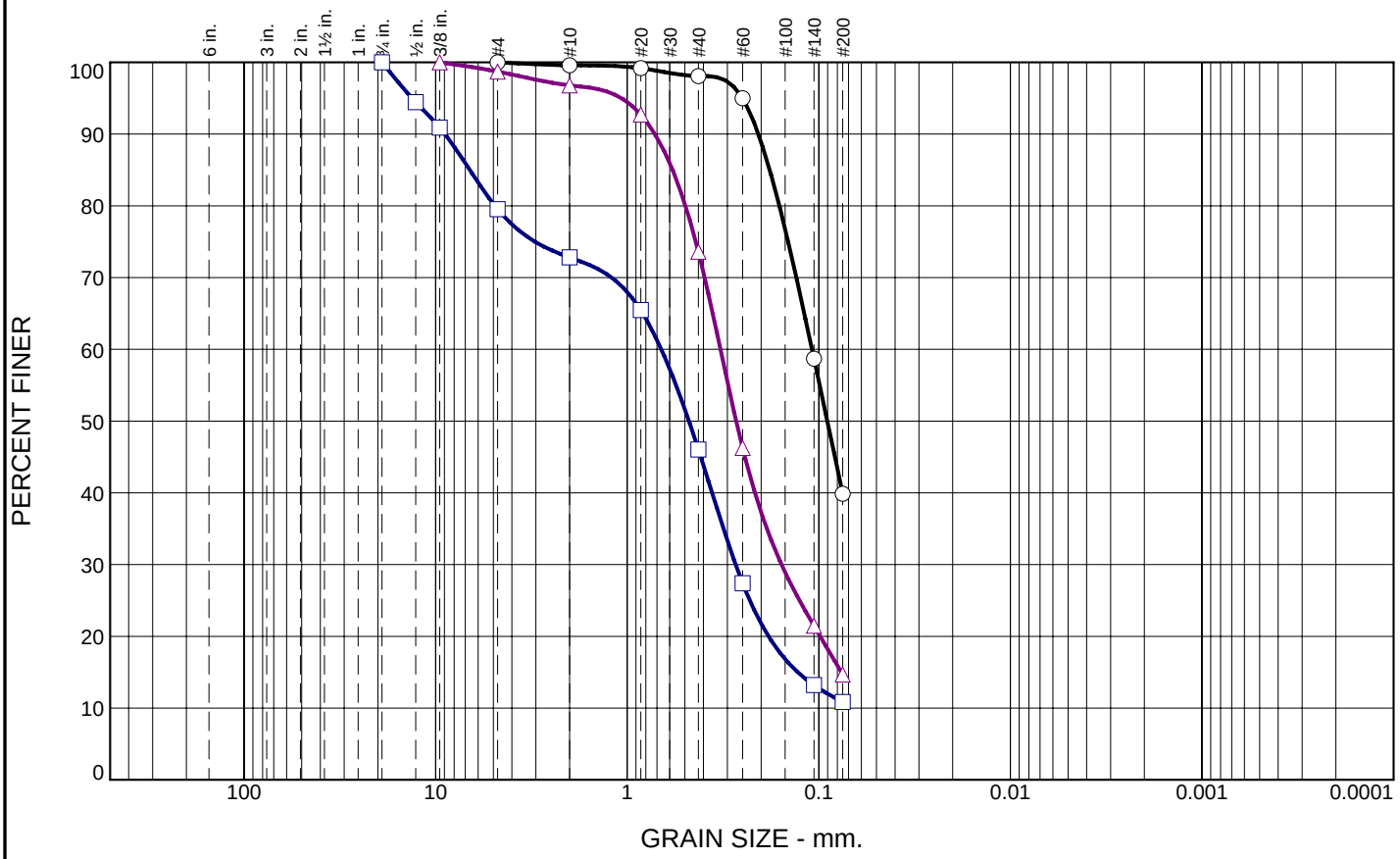
Drill Contractor: Geologic Drill
Equipment: Track Mounted
Sampling Method: SPT
Driller: Andy

Excavation Date: 01-05-2017
ESC Representative: S. Williams

# APPENDIX B

## Laboratory Test Reports

# Particle Size Distribution Report




| | +3" | % GRAVEL | % SAND | % SILT | % CLAY | USCS | AASHTO | PL | LL |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 0.0 | 0.0 | 60.1 | 39.9 | | SM | A-4(0) | NP | NV |
| □ | 0.0 | 20.5 | 68.7 | 10.8 | | SP-SM | A-1-b | NP | NV |
| △ | 0.0 | 1.3 | 84.0 | 14.7 | | SM | A-2-4(0) | NP | NV |

| SIEVE inches size | PERCENT FINER ○ | □ | △ |
|---|---|---|---|
| .75 | | 100.0 | |
| .5 | | 94.4 | |
| .375 | | 90.9 | 100.0 |
| | GRAIN SIZE | | |
| $D_{60}$ | 0.1086 | 0.6640 | 0.3261 |
| $D_{30}$ | | 0.2717 | 0.1566 |
| $D_{10}$ | | | |
| | COEFFICIENTS | | |
| $C_c$ | | | |
| $C_u$ | | | |

| SIEVE number size | PERCENT FINER ○ | □ | △ |
|---|---|---|---|
| #4 | 100.0 | 79.5 | 98.7 |
| #10 | 99.6 | 72.8 | 96.8 |
| #20 | 99.2 | 65.5 | 92.7 |
| #40 | 98.1 | 46.0 | 73.6 |
| #60 | 95.0 | 27.4 | 46.3 |
| #140 | 58.7 | 13.2 | 21.5 |
| #200 | 39.9 | 10.8 | 14.7 |

Material Description

○ silty sand

□ poorly graded sand with silt and gravel

△ silty sand

REMARKS:

○

□

△

○ Source of Sample: Boring Depth: 20.0 Sample Number: B4 S5

□ Source of Sample: Boring Depth: 10.0 Sample Number: B5 S2

△ Source of Sample: Boring Depth: 25.0 Sample Number: B5 S5

**Phoenix Soil Research**

**Kingston, WA**

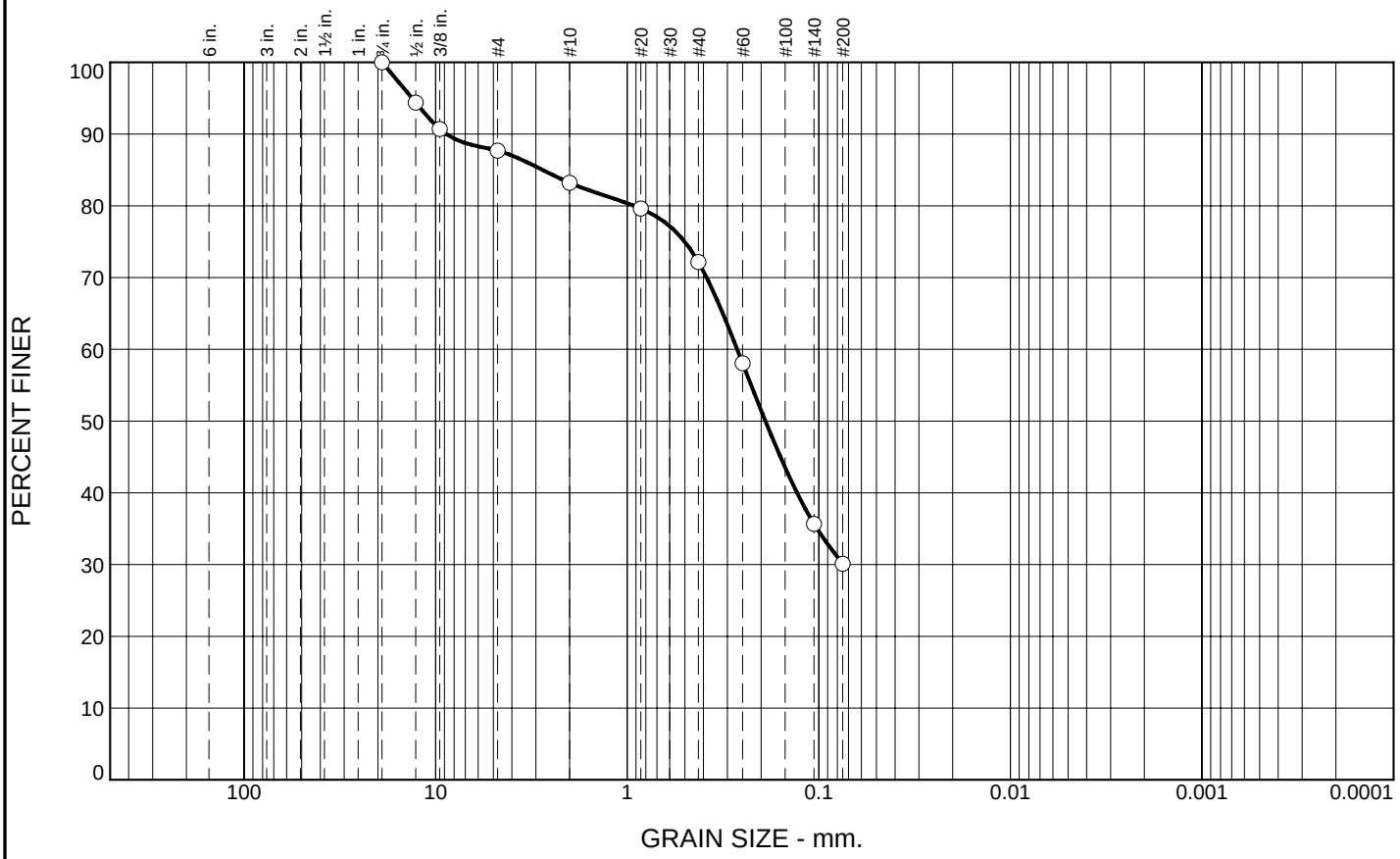
Client: EnviroSound Consulting

Project: Poulsbo Apartments
ESC16-G104

Project No.: PSR17-9-0104

Figure 12

# Particle Size Distribution Report




| | +3" | % GRAVEL | % SAND | % SILT | % CLAY | USCS | AASHTO | PL | LL |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 0.0 | 12.3 | 57.6 | 30.1 | | SM | A-2-4(0) | NP | NV |
| | | | | | | | | | |
| | | | | | | | | | |

| SIEVE inches size | PERCENT FINER ○ | | |
|---|---|---|---|
| .75 | 100.0 | | |
| .5 | 94.4 | | |
| .375 | 90.7 | | |
| | GRAIN SIZE | | |
| $D_{60}$ | 0.2668 | | |
| $D_{30}$ | | | |
| $D_{10}$ | | | |
| | COEFFICIENTS | | |
| $C_c$ | | | |
| $C_u$ | | | |

| SIEVE number size | PERCENT FINER ○ | | |
|---|---|---|---|
| #4 | 87.7 | | |
| #10 | 83.2 | | |
| #20 | 79.6 | | |
| #40 | 72.2 | | |
| #60 | 58.1 | | |
| #140 | 35.7 | | |
| #200 | 30.1 | | |

Material Description

○ silty sand

REMARKS:

○

○ Source of Sample: Boring Depth: 10.0 Sample Number: B6 S2

**Phoenix Soil Research**

**Kingston, WA**

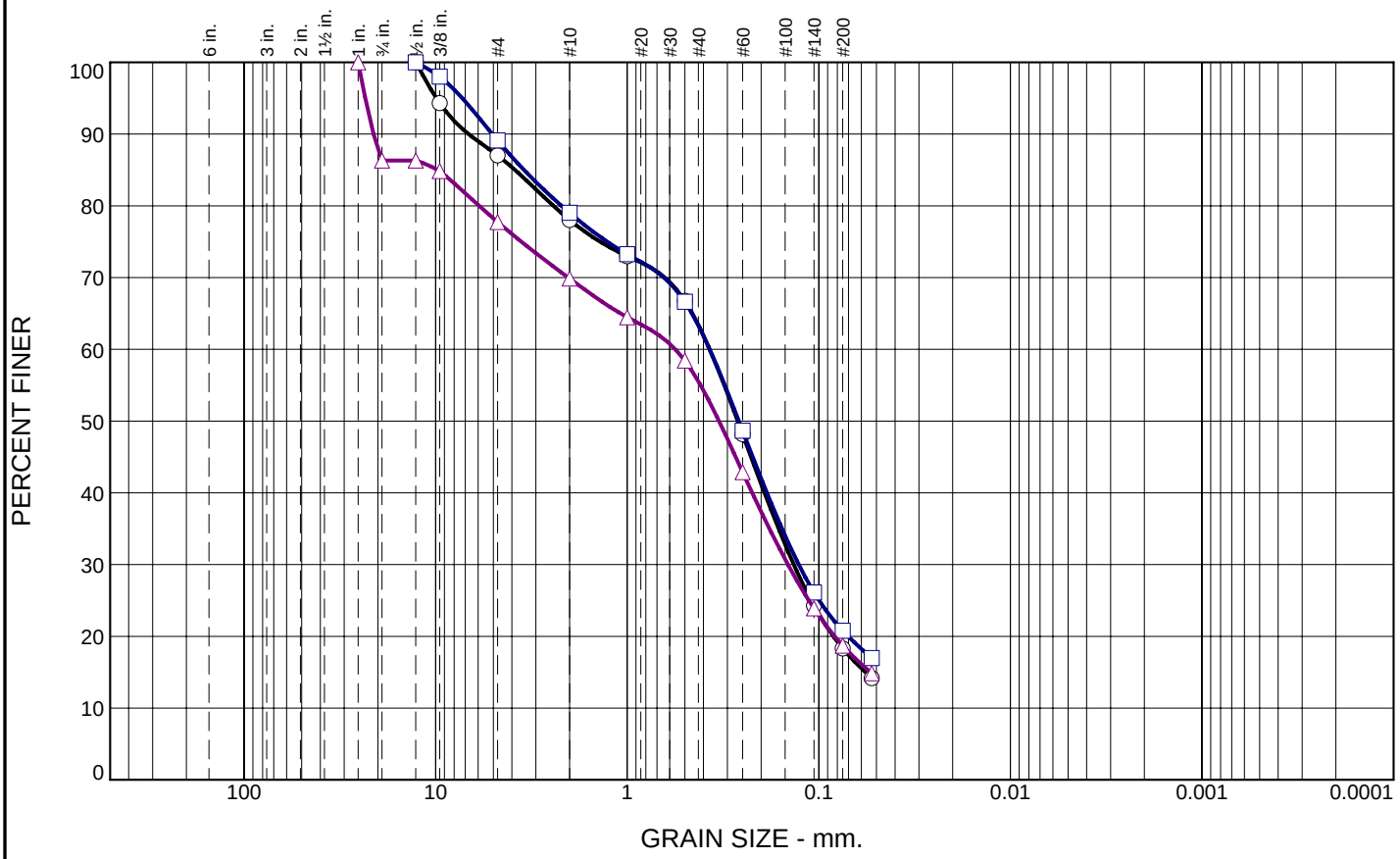
Client: EnviroSound Consulting

Project: Poulsbo Apartments
ESC16-G104

Project No.: PSR17-9-0104

Figure 13

# Particle Size Distribution Report




| | +3" | % GRAVEL | % SAND | % SILT | % CLAY | USCS | AASHTO | PL | LL |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 0.0 | 22.0 | 63.8 | 14.2 | | | | | |
| □ | 0.0 | 21.0 | 62.0 | 17.0 | | | | | |
| △ | 0.0 | 30.1 | 55.1 | 14.8 | | | | | |

| SIEVE inches size | PERCENT FINER ○ | □ | △ |
|---|---|---|---|
| 1 | | | 100.0 |
| .75 | | | 86.3 |
| .5 | 100.0 | 100.0 | 86.3 |
| .375 | 94.3 | 98.0 | 84.8 |
| GRAIN SIZE | | | |
| $D_{60}$ | 0.3713 | 0.3709 | 0.5606 |
| $D_{30}$ | 0.1351 | 0.1273 | 0.1448 |
| $D_{10}$ | | | |
| COEFFICIENTS | | | |
| $C_c$ | | | |
| $C_u$ | | | |

| SIEVE number size | PERCENT FINER ○ | □ | △ |
|---|---|---|---|
| #4 | 87.0 | 89.1 | 77.7 |
| #10 | 78.0 | 79.0 | 69.9 |
| #18 | 73.0 | 73.3 | 64.5 |
| #35 | 66.8 | 66.6 | 58.4 |
| #60 | 48.2 | 48.7 | 42.9 |
| #140 | 24.3 | 26.1 | 23.9 |
| #200 | 18.3 | 20.8 | 18.7 |
| #270 | 14.2 | 17.0 | 14.8 |

Material Description

○

□

△

REMARKS:

○

□

△

○ Depth: 1 Sample Number: SL1
□ Depth: 1 Sample Number: SL2
△ Depth: 1 Sample Number: SL3

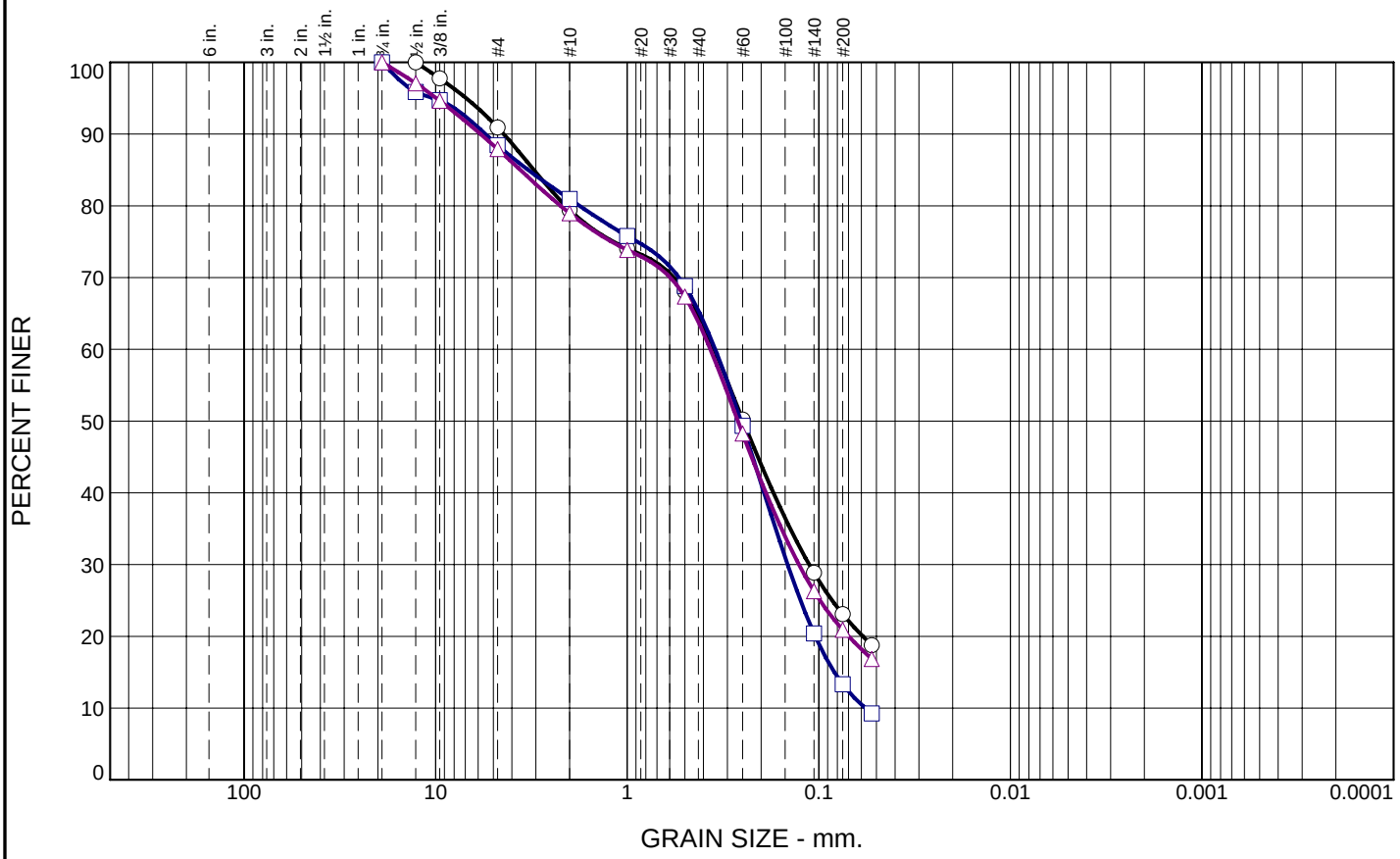
**Phoenix Soil Research**

**Kingston, WA**

Client: EnviroSound Consulting
Project: Poulsbo Apartments
ESC16-G104
Project No.: PSR17-9-0104

Figure 1

# Particle Size Distribution Report




| | +3" | % GRAVEL | % SAND | % SILT | % CLAY | USCS | AASHTO | PL | LL |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 0.0 | 20.6 | 60.6 | 18.8 | | | | | |
| □ | 0.0 | 19.1 | 71.7 | 9.2 | | | | | |
| △ | 0.0 | 21.0 | 62.1 | 16.9 | | | | | |

| SIEVE inches size | PERCENT FINER ○ | □ | △ |
|---|---|---|---|
| .75 | | 100.0 | 100.0 |
| .5 | 100.0 | 95.9 | 97.1 |
| .375 | 97.8 | 94.7 | 94.6 |
| | GRAIN SIZE | | |
| $D_{60}$ | 0.3515 | 0.3471 | 0.3679 |
| $D_{30}$ | 0.1123 | 0.1455 | 0.1271 |
| $D_{10}$ | | 0.0571 | |
| | COEFFICIENTS | | |
| $C_c$ | | 1.07 | |
| $C_u$ | | 6.08 | |

| SIEVE number size | PERCENT FINER ○ | □ | △ |
|---|---|---|---|
| #4 | 90.9 | 88.5 | 87.9 |
| #10 | 79.4 | 80.9 | 79.0 |
| #18 | 74.0 | 75.8 | 73.8 |
| #35 | 68.1 | 68.8 | 67.4 |
| #60 | 50.2 | 49.3 | 48.3 |
| #140 | 28.9 | 20.4 | 26.3 |
| #200 | 23.1 | 13.3 | 20.9 |
| #270 | 18.8 | 9.2 | 16.9 |

Material Description

○

□

△

REMARKS:

○

□

△

○ Depth: 1 Sample Number: SL4
□ Depth: 1 Sample Number: SL5
△ Depth: 1 Sample Number: SL6

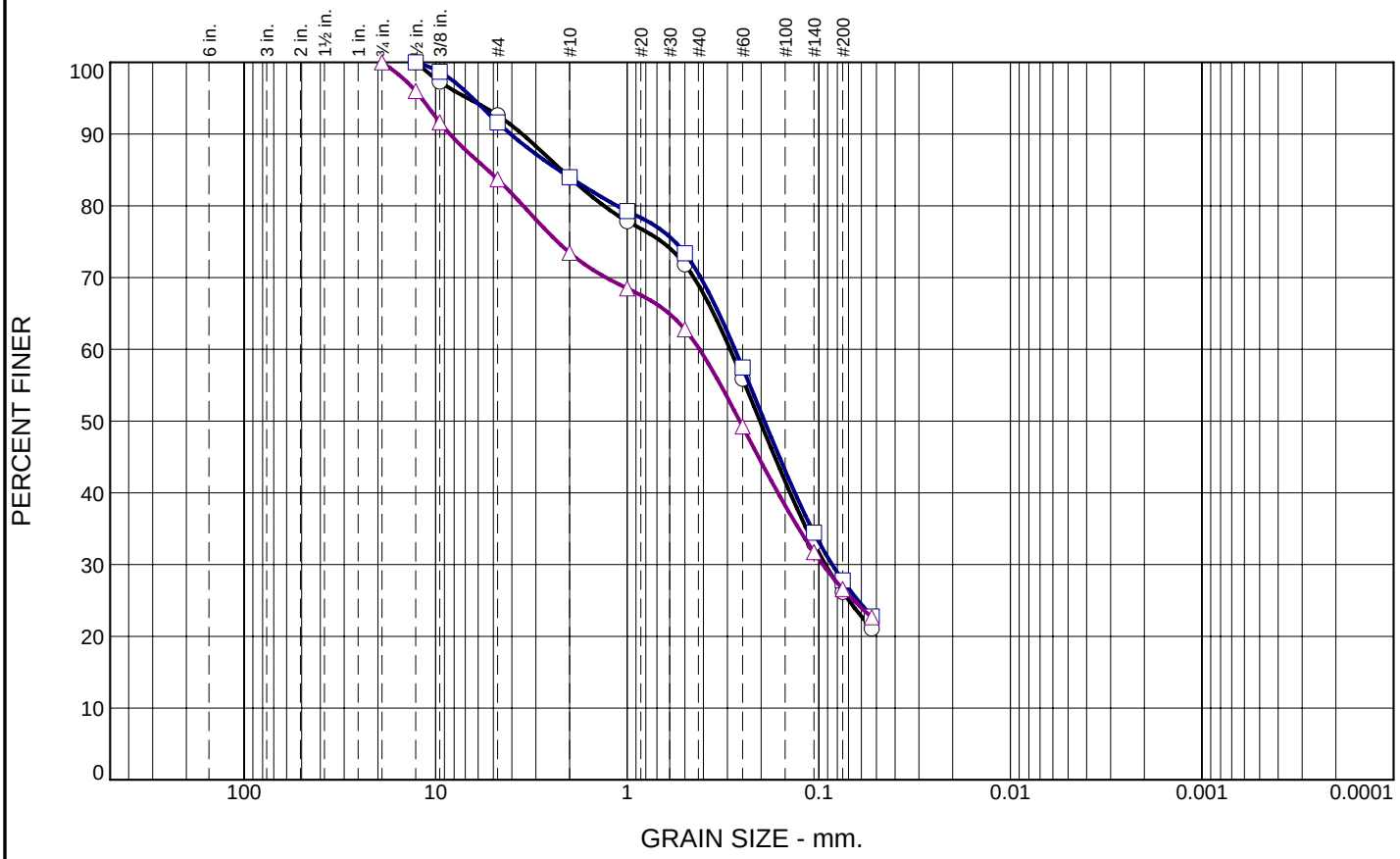
**Phoenix Soil Research**

**Kingston, WA**

Client: EnviroSound Consulting
Project: Poulsbo Apartments
ESC16-G104
Project No.: PSR17-9-0104

Figure 2

# Particle Size Distribution Report




| | +3" | % GRAVEL | % SAND | % SILT | % CLAY | USCS | AASHTO | PL | LL |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 0.0 | 16.0 | 62.9 | 21.1 | | | | | |
| □ | 0.0 | 16.0 | 61.2 | 22.8 | | | | | |
| △ | 0.0 | 26.5 | 50.8 | 22.7 | | | | | |

| SIEVE inches size | PERCENT FINER ○ | □ | △ |
|---|---|---|---|
| .75 | | | 100.0 |
| .5 | 100.0 | 100.0 | 96.0 |
| .375 | 97.3 | 98.7 | 91.7 |
| | GRAIN SIZE | | |
| $D_{60}$ | 0.2905 | 0.2741 | 0.4193 |
| $D_{30}$ | 0.0923 | 0.0852 | 0.0953 |
| $D_{10}$ | | | |
| | COEFFICIENTS | | |
| $C_c$ | | | |
| $C_u$ | | | |

| SIEVE number size | PERCENT FINER ○ | □ | △ |
|---|---|---|---|
| #4 | 92.6 | 91.6 | 83.7 |
| #10 | 84.0 | 84.0 | 73.5 |
| #18 | 77.9 | 79.3 | 68.5 |
| #35 | 71.8 | 73.4 | 62.8 |
| #60 | 55.9 | 57.5 | 49.2 |
| #140 | 32.9 | 34.4 | 31.7 |
| #200 | 26.2 | 27.8 | 26.6 |
| #270 | 21.1 | 22.8 | 22.7 |

Material Description

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REMARKS:

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○ Depth: 1 Sample Number: SL7
□ Depth: 1 Sample Number: SL8
△ Depth: 1 Sample Number: SL9

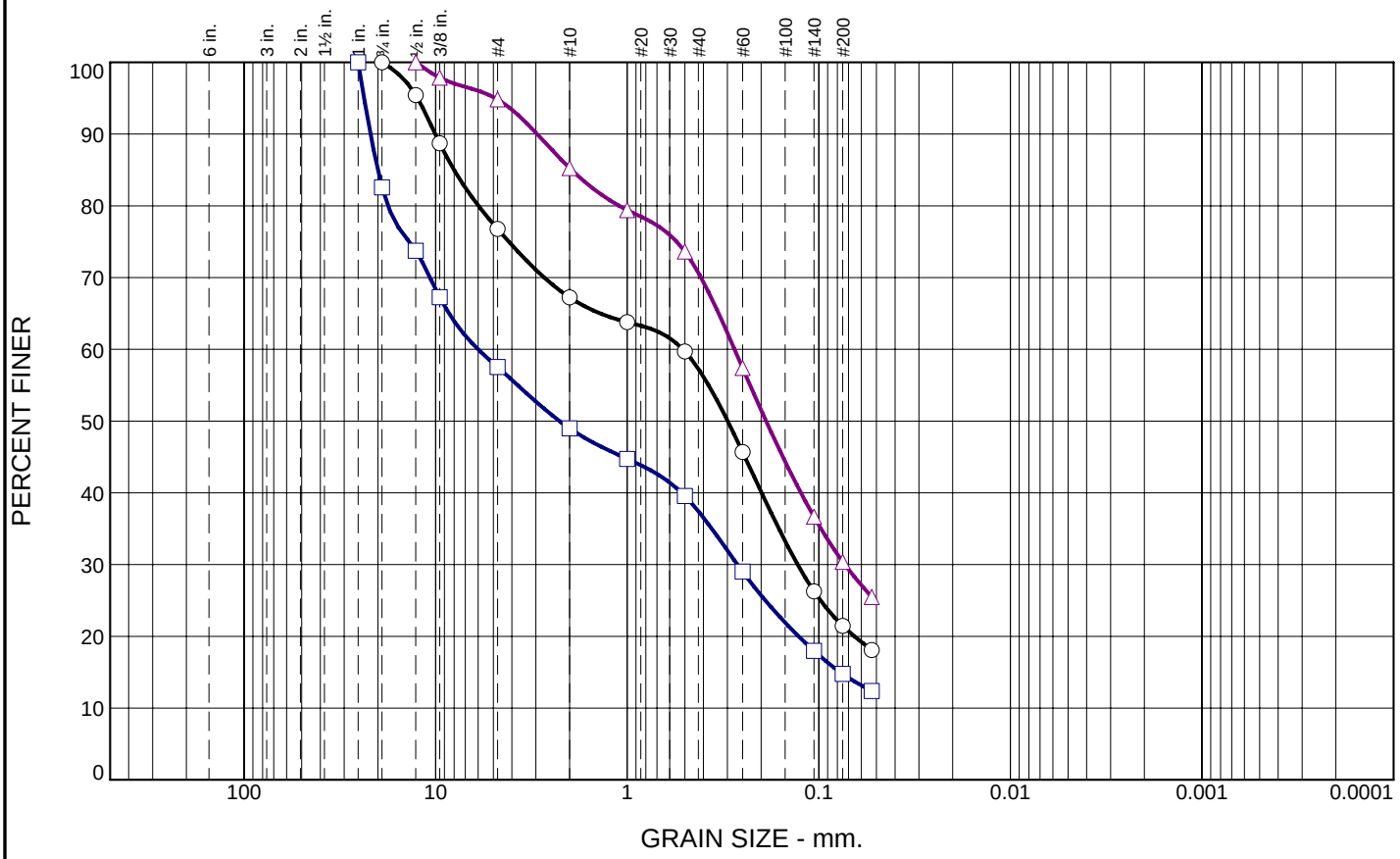
**Phoenix Soil Research**

**Kingston, WA**

Client: EnviroSound Consulting
Project: Poulsbo Apartments
ESC16-G104
Project No.: PSR17-9-0104

Figure 3

# Particle Size Distribution Report




| | +3" | % GRAVEL | % SAND | % SILT | % CLAY | USCS | AASHTO | PL | LL |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 0.0 | 32.8 | 49.1 | 18.1 | | | | | |
| □ | 0.0 | 51.0 | 36.6 | 12.4 | | | | | |
| △ | 0.0 | 14.7 | 59.8 | 25.5 | | | | | |

| SIEVE inches size | PERCENT FINER ○ | □ | △ |
|---|---|---|---|
| 1 | | 100.0 | |
| .75 | 100.0 | 82.6 | |
| .5 | 95.4 | 73.7 | 100.0 |
| .375 | 88.7 | 67.3 | 97.9 |
| | GRAIN SIZE | | |
| $D_{60}$ | 0.5119 | 6.0035 | 0.2755 |
| $D_{30}$ | 0.1290 | 0.2658 | 0.0732 |
| $D_{10}$ | | | |
| | COEFFICIENTS | | |
| $C_c$ | | | |
| $C_u$ | | | |

| SIEVE number size | PERCENT FINER ○ | □ | △ |
|---|---|---|---|
| #4 | 76.8 | 57.5 | 94.8 |
| #10 | 67.2 | 49.0 | 85.3 |
| #18 | 63.8 | 44.7 | 79.4 |
| #35 | 59.7 | 39.6 | 73.6 |
| #60 | 45.7 | 29.0 | 57.4 |
| #140 | 26.3 | 18.0 | 36.7 |
| #200 | 21.5 | 14.8 | 30.4 |
| #270 | 18.1 | 12.4 | 25.5 |

Material Description

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REMARKS:

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○ Depth: 1 Sample Number: SL10
□ Depth: 1 Sample Number: SL11
△ Depth: 1 Sample Number: SL12

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**Kingston, WA**

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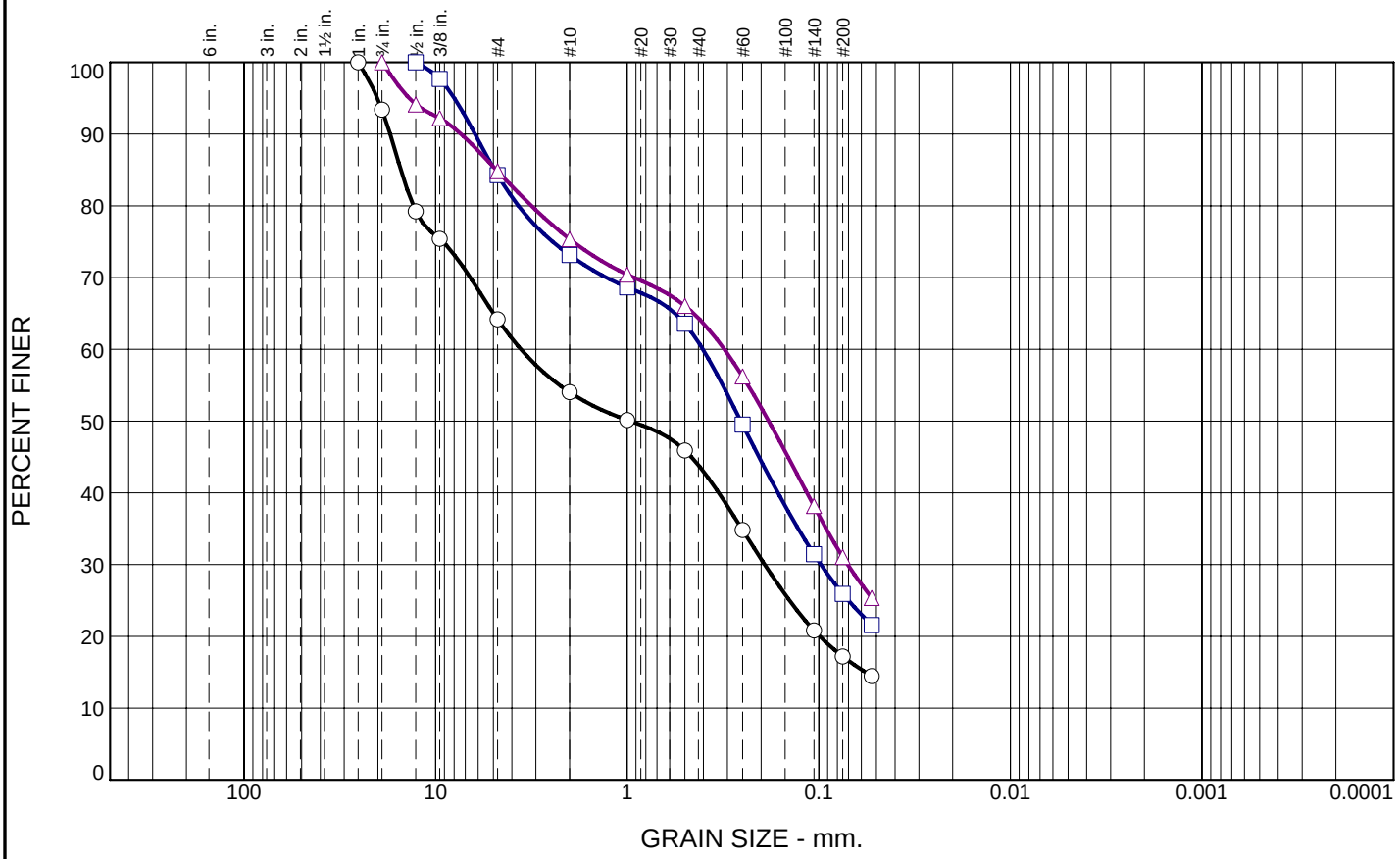
Project: Poulsbo Apartments
ESC16-G104
Project No.: PSR17-9-0104

Figure 4

# Particle Size Distribution Report




| | +3" | % GRAVEL | % SAND | % SILT | % CLAY | USCS | AASHTO | PL | LL |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 0.0 | 46.0 | 39.5 | 14.5 | | | | | |
| □ | 0.0 | 26.9 | 51.5 | 21.6 | | | | | |
| △ | 0.0 | 24.6 | 50.0 | 25.4 | | | | | |

| SIEVE inches size | PERCENT FINER ○ | □ | △ |
|---|---|---|---|
| 1 | 100.0 | | |
| .75 | 93.4 | | 100.0 |
| .5 | 79.2 | 100.0 | 94.1 |
| .375 | 75.4 | 97.7 | 92.2 |
| | GRAIN SIZE | | |
| $D_{60}$ | 3.5859 | 0.4028 | 0.3112 |
| $D_{30}$ | 0.1916 | 0.0975 | 0.0707 |
| $D_{10}$ | | | |
| | COEFFICIENTS | | |
| $C_c$ | | | |
| $C_u$ | | | |

| SIEVE number size | PERCENT FINER ○ | □ | △ |
|---|---|---|---|
| #4 | 64.2 | 84.3 | 84.8 |
| #10 | 54.0 | 73.1 | 75.4 |
| #18 | 50.1 | 68.6 | 70.4 |
| #35 | 45.9 | 63.6 | 66.1 |
| #60 | 34.8 | 49.5 | 56.2 |
| #140 | 20.8 | 31.5 | 38.2 |
| #200 | 17.2 | 25.9 | 31.1 |
| #270 | 14.5 | 21.6 | 25.4 |

Material Description

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REMARKS:

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○ Depth: 1 Sample Number: SL13
□ Depth: 1 Sample Number: SL14
△ Depth: 1 Sample Number: SL15

**Phoenix Soil Research**

**Kingston, WA**

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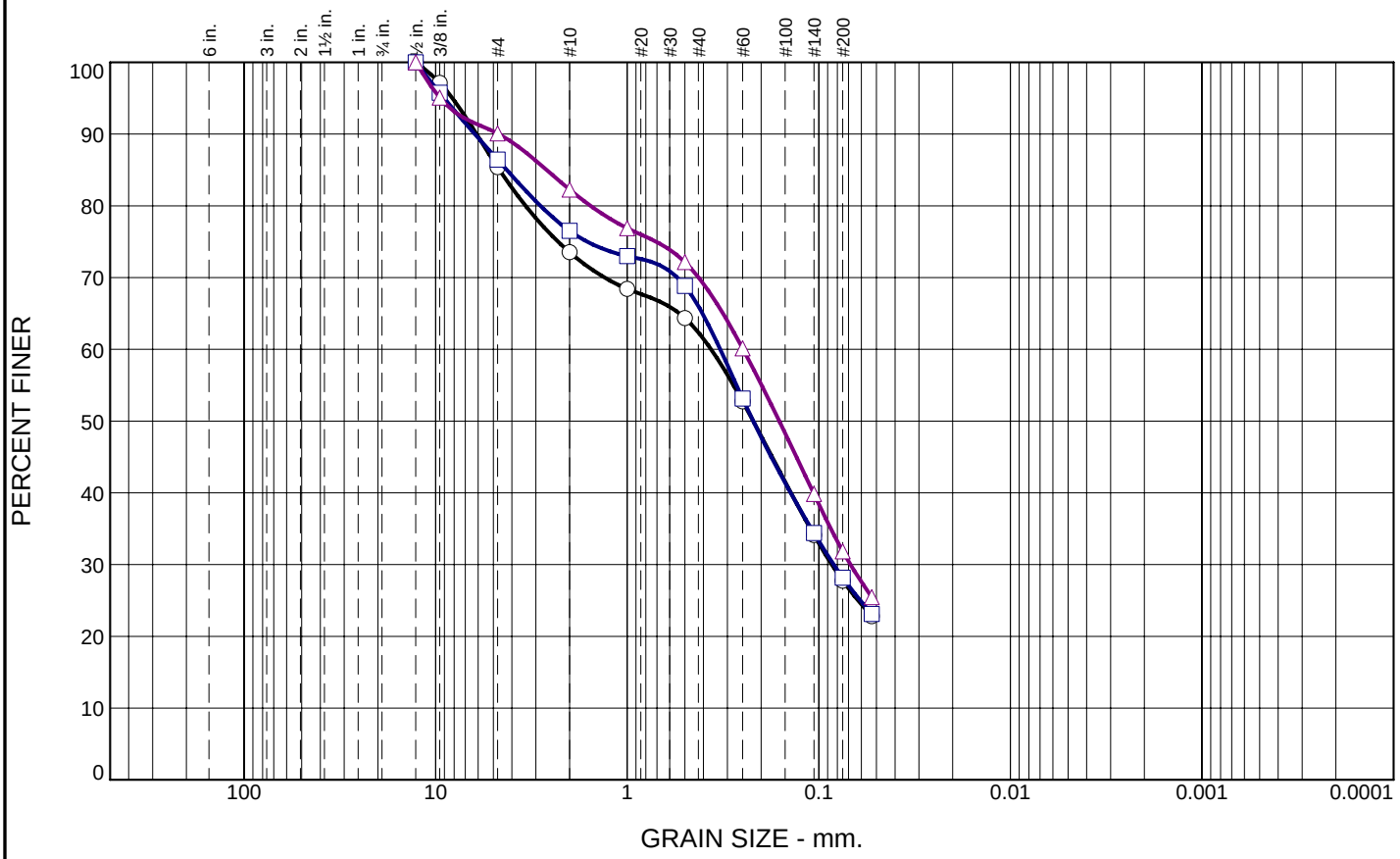
Project: Poulsbo Apartments
ESC16-G104
Project No.: PSR17-9-0104

Figure 5

# Particle Size Distribution Report




| | +3" | % GRAVEL | % SAND | % SILT | % CLAY | USCS | AASHTO | PL | LL |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 0.0 | 26.5 | 50.7 | 22.8 | | | | | |
| □ | 0.0 | 23.5 | 53.4 | 23.1 | | | | | |
| △ | 0.0 | 17.7 | 56.8 | 25.5 | | | | | |

| SIEVE inches size | PERCENT FINER ○ | □ | △ |
|---|---|---|---|
| .5 | 100.0 | 100.0 | 100.0 |
| .375 | 97.1 | 95.8 | 95.1 |
| | GRAIN SIZE | | |
| $D_{60}$ | 0.3649 | 0.3270 | 0.2484 |
| $D_{30}$ | 0.0856 | 0.0836 | 0.0683 |
| $D_{10}$ | | | |
| | COEFFICIENTS | | |
| $C_c$ | | | |
| $C_u$ | | | |

| SIEVE number size | PERCENT FINER ○ | □ | △ |
|---|---|---|---|
| #4 | 85.4 | 86.4 | 90.1 |
| #10 | 73.5 | 76.5 | 82.3 |
| #18 | 68.4 | 73.0 | 76.9 |
| #35 | 64.4 | 68.8 | 72.2 |
| #60 | 52.7 | 53.2 | 60.1 |
| #140 | 34.1 | 34.4 | 39.8 |
| #200 | 27.7 | 28.2 | 31.9 |
| #270 | 22.8 | 23.1 | 25.5 |

Material Description

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REMARKS:

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○ Depth: 1 Sample Number: SL16
□ Depth: 1 Sample Number: SL17
△ Depth: 1 Sample Number: SL18

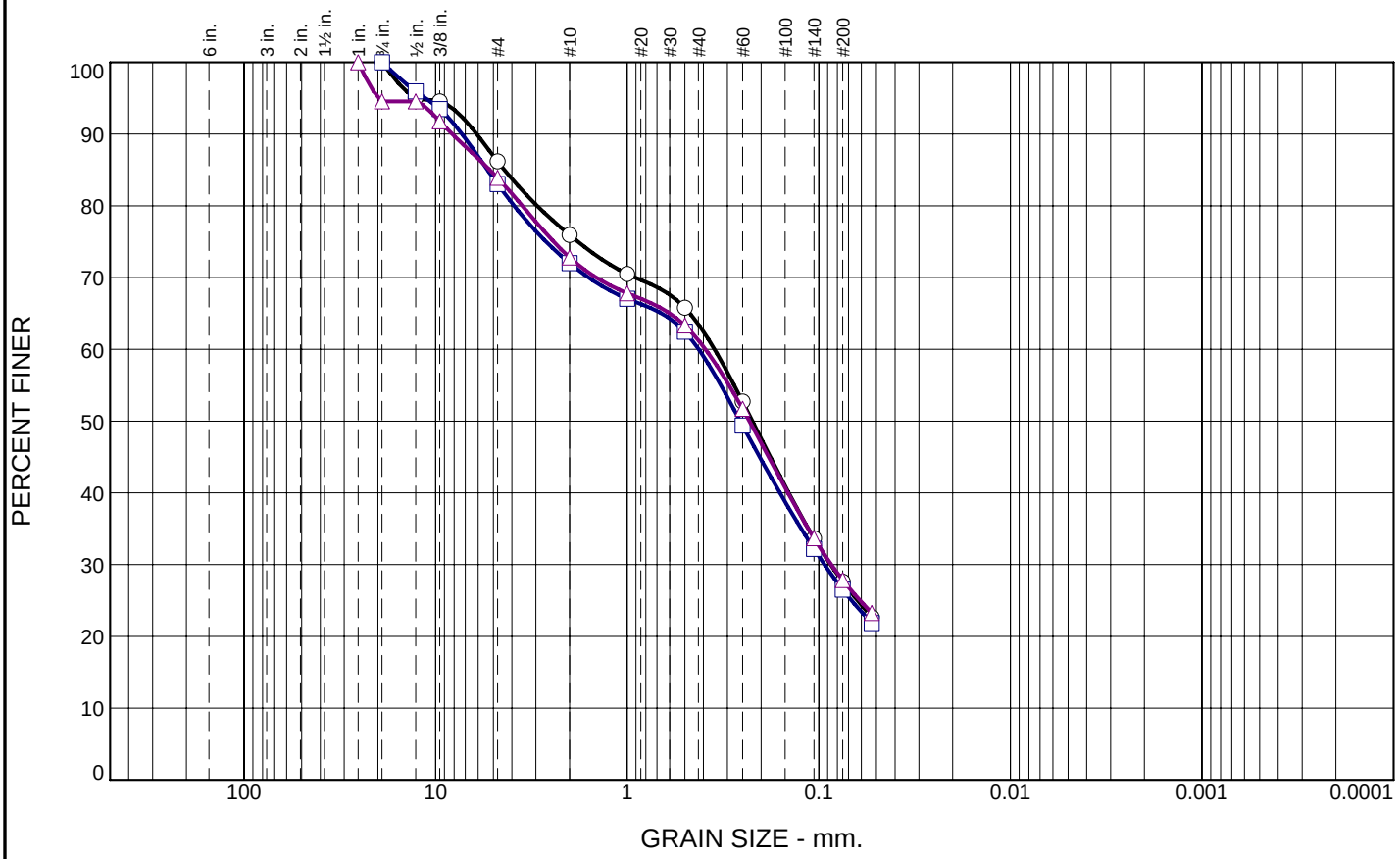
**Phoenix Soil Research**

**Kingston, WA**

Client: EnviroSound Consulting
Project: Poulsbo Apartments
ESC16-G104
Project No.: PSR17-9-0104

Figure 6

# Particle Size Distribution Report




| | +3" | % GRAVEL | % SAND | % SILT | % CLAY | USCS | AASHTO | PL | LL |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 0.0 | 24.1 | 53.2 | 22.7 | | | | | |
| □ | 0.0 | 28.0 | 50.2 | 21.8 | | | | | |
| △ | 0.0 | 27.2 | 49.5 | 23.3 | | | | | |

| SIEVE inches size | PERCENT FINER ○ | □ | △ |
|---|---|---|---|
| 1 | | | 100.0 |
| .75 | 100.0 | 100.0 | 94.5 |
| .5 | 95.1 | 96.0 | 94.5 |
| .375 | 94.6 | 93.5 | 91.8 |
| GRAIN SIZE | | | |
| $D_{60}$ | 0.3503 | 0.4230 | 0.3904 |
| $D_{30}$ | 0.0868 | 0.0934 | 0.0861 |
| $D_{10}$ | | | |
| COEFFICIENTS | | | |
| $C_c$ | | | |
| $C_u$ | | | |

| SIEVE number size | PERCENT FINER ○ | □ | △ |
|---|---|---|---|
| #4 | 86.2 | 83.0 | 83.9 |
| #10 | 75.9 | 72.0 | 72.8 |
| #18 | 70.5 | 67.0 | 67.8 |
| #35 | 65.8 | 62.5 | 63.3 |
| #60 | 52.7 | 49.4 | 51.7 |
| #140 | 33.7 | 32.2 | 33.7 |
| #200 | 27.6 | 26.5 | 27.8 |
| #270 | 22.7 | 21.8 | 23.3 |

Material Description

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REMARKS:

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○ Depth: 1 Sample Number: SL19
□ Depth: 1 Sample Number: SL20
△ Depth: 1 Sample Number: SL21

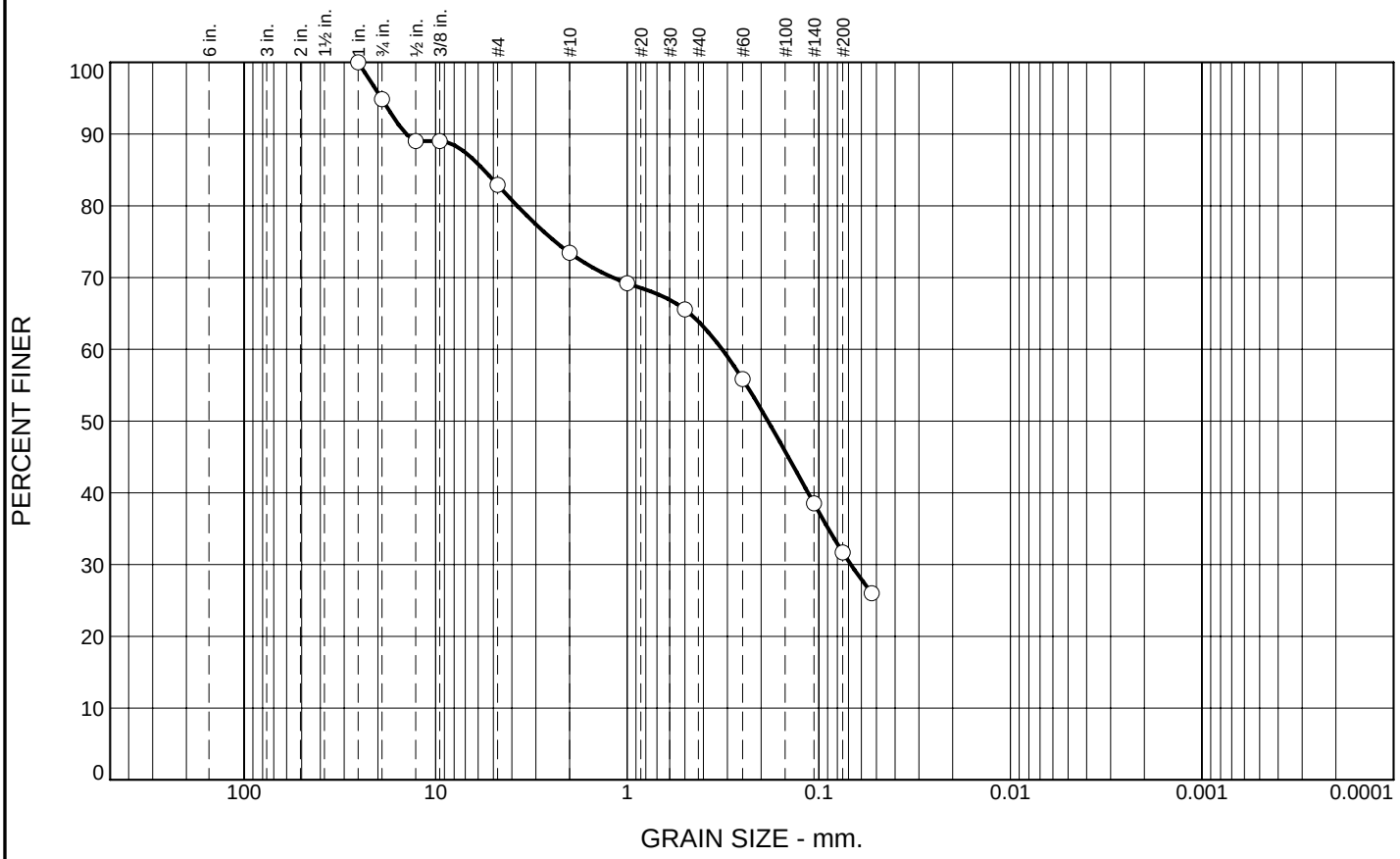
**Phoenix Soil Research**

**Kingston, WA**

Client: EnviroSound Consulting
Project: Poulsbo Apartments
ESC16-G104
Project No.: PSR17-9-0104

Figure 7

# Particle Size Distribution Report




| | +3" | % GRAVEL | % SAND | % SILT | % CLAY | USCS | AASHTO | PL | LL |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 0.0 | 26.5 | 47.5 | 26.0 | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

| SIEVE inches size | PERCENT FINER ○ | | |
|---|---|---|---|
| 1 | 100.0 | | |
| .75 | 94.9 | | |
| .5 | 89.0 | | |
| .375 | 89.0 | | |
| | GRAIN SIZE | | |
| $D_{60}$ | 0.3198 | | |
| $D_{30}$ | 0.0680 | | |
| $D_{10}$ | | | |
| | COEFFICIENTS | | |
| $C_c$ | | | |
| $C_u$ | | | |

| SIEVE number size | PERCENT FINER ○ | | |
|---|---|---|---|
| #4 | 82.9 | | |
| #10 | 73.5 | | |
| #18 | 69.2 | | |
| #35 | 65.6 | | |
| #60 | 55.9 | | |
| #140 | 38.5 | | |
| #200 | 31.7 | | |
| #270 | 26.0 | | |

Material Description
○

REMARKS:
○

○ Depth: 1 Sample Number: SL22

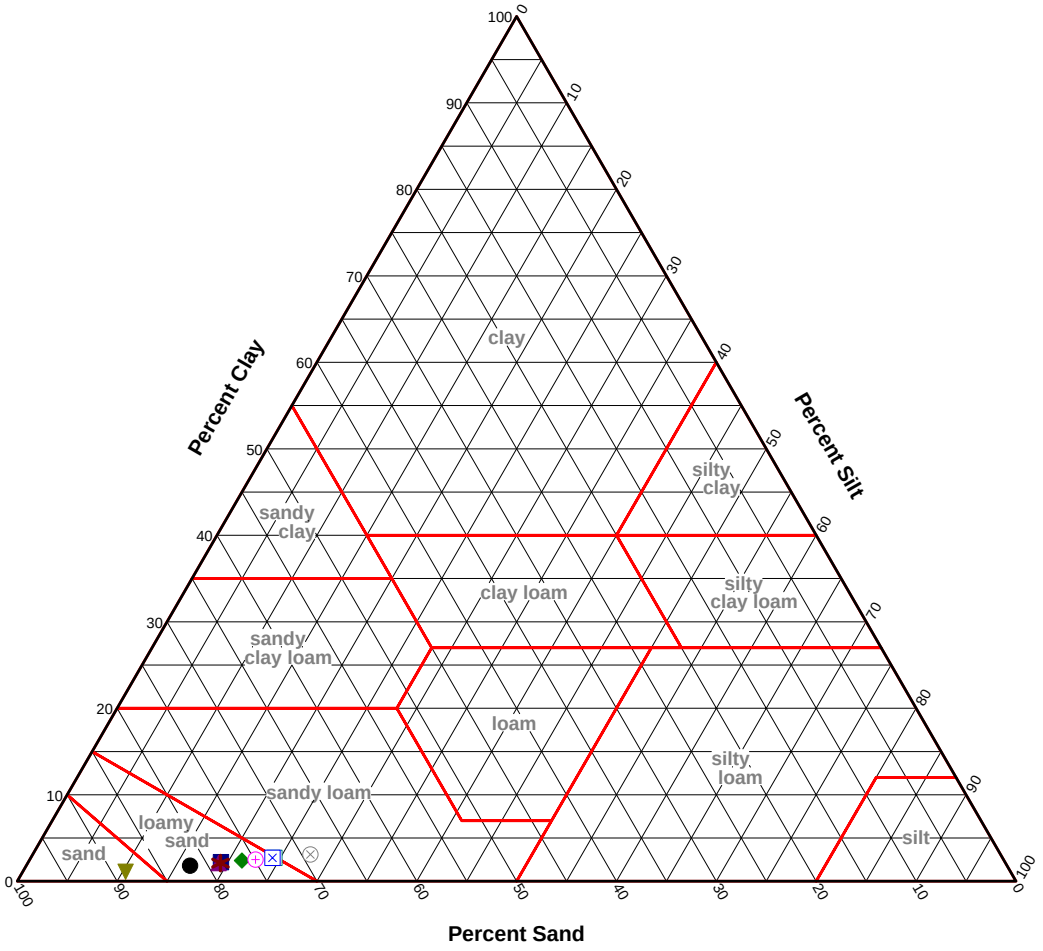
**Phoenix Soil Research**

**Kingston, WA**

Client: EnviroSound Consulting
Project: Poulsbo Apartments
ESC16-G104
Project No.: PSR17-9-0104

Figure 8

# USDA Soil Classification




## SOIL DATA

| | Source | Sample No. | Depth | Percentages From Material Passing a #10 Sieve | | | Classification |
|---|---|---|---|---|---|---|---|
| | | | | Sand | Silt | Clay | |
| ● | | SL1 | 1 | 81.8 | 16.4 | 1.8 | Loamy sand |
| ■ | | SL2 | 1 | 78.5 | 19.4 | 2.2 | Loamy sand |
| ▲ | | SL3 | 1 | 78.8 | 19.1 | 2.1 | Loamy sand |
| ◆ | | SL4 | 1 | 76.3 | 21.3 | 2.4 | Loamy sand |
| ▼ | | SL5 | 1 | 88.6 | 10.2 | 1.1 | Sand |
| ✱ | | SL6 | 1 | 78.6 | 19.3 | 2.1 | Loamy sand |
| ⊕ | | SL7 | 1 | 74.9 | 22.6 | 2.5 | Loamy sand |
| ⊞ | | SL8 | 1 | 72.9 | 24.4 | 2.7 | Loamy sand |
| ⊗ | | SL9 | 1 | 69.1 | 27.8 | 3.1 | Sandy loam |
| ⊠ | | SL10 | 1 | 73.1 | 24.2 | 2.7 | Loamy sand |

**Phoenix Soil Research**

**Kingston, WA**

**Client:** EnviroSound Consulting

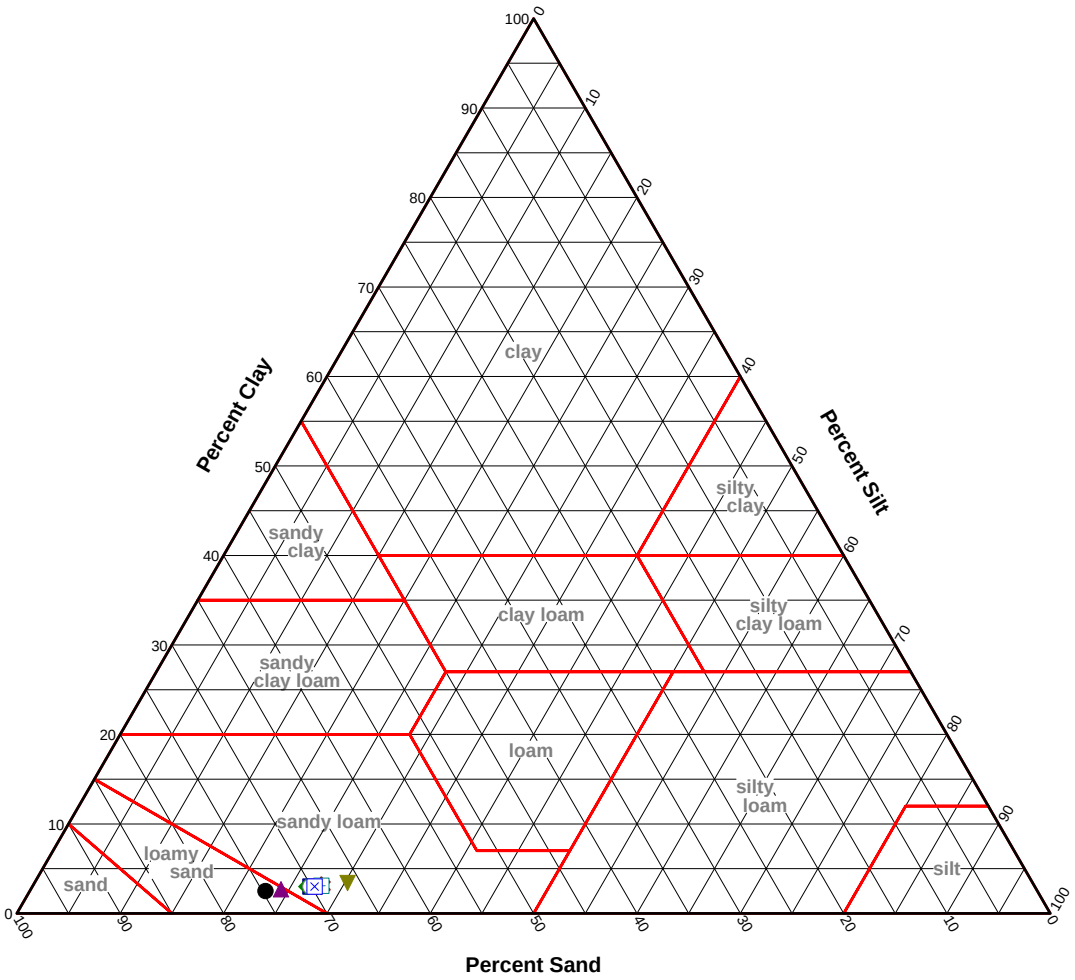
**Project:** Poulsbo Apartments
ESC16-G104

**Project No.:** PSR17-9-0104

**Figure** 9

**Checked By:** _____

# USDA Soil Classification




## SOIL DATA

| | Source | Sample No. | Depth | Percentages From Material Passing a #10 Sieve | | | Classification |
|---|---|---|---|---|---|---|---|
| | | | | Sand | Silt | Clay | |
| ● | | SL11 | 1 | 74.7 | 22.8 | 2.5 | Loamy sand |
| ■ | | SL12 | 1 | 70.1 | 26.9 | 3.0 | Sandy loam |
| ▲ | | SL13 | 1 | 73.1 | 24.2 | 2.7 | Loamy sand |
| ◆ | | SL14 | 1 | 70.5 | 26.6 | 3.0 | Sandy loam |
| ▼ | | SL15 | 1 | 66.3 | 30.3 | 3.4 | Sandy loam |
| ✱ | | SL16 | 1 | 69.0 | 27.9 | 3.1 | Sandy loam |
| ⊕ | | SL17 | 1 | 69.8 | 27.2 | 3.0 | Sandy loam |
| ⊞ | | SL18 | 1 | 69.0 | 27.9 | 3.1 | Sandy loam |
| ⊗ | | SL19 | 1 | 70.1 | 26.9 | 3.0 | Sandy loam |
| ⊠ | | SL20 | 1 | 69.7 | 27.2 | 3.0 | Sandy loam |

**Phoenix Soil Research**

**Kingston, WA**

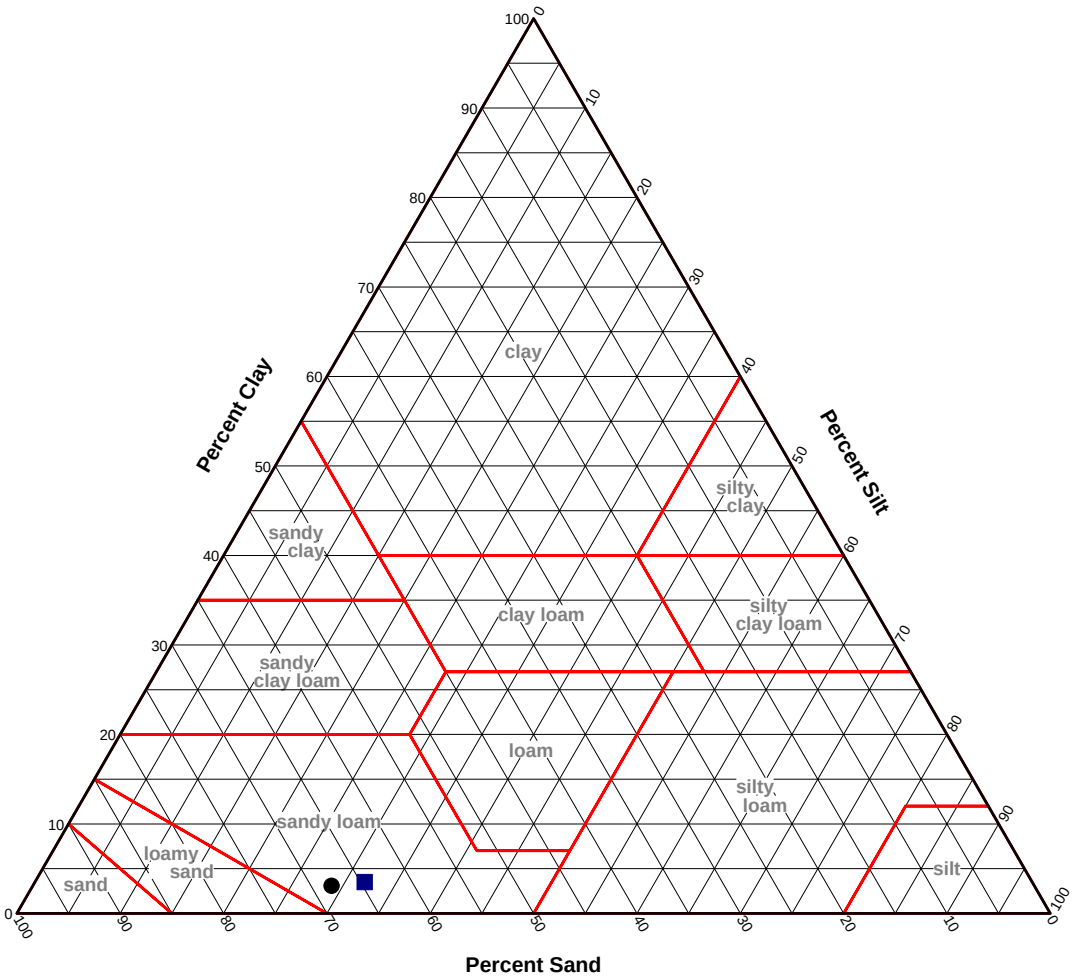
**Client:** EnviroSound Consulting

**Project:** Poulsbo Apartments
ESC16-G104

**Project No.:** PSR17-9-0104

**Figure** 10

# USDA Soil Classification




## SOIL DATA

| | Source | Sample No. | Depth | Percentages From Material Passing a #10 Sieve | | | Classification |
|---|---|---|---|---|---|---|---|
| | | | | Sand | Silt | Clay | |
| ● | | SL21 | 1 | 68.0 | 28.9 | 3.1 | Sandy loam |
| ■ | | SL22 | 1 | 64.6 | 31.8 | 3.5 | Sandy loam |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
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| | | | | | | | |

**Phoenix Soil Research**

**Kingston, WA**

**Client:** EnviroSound Consulting

**Project:** Poulsbo Apartments
ESC16-G104

**Project No.:** PSR17-9-0104

**Figure** 11

# APPENDIX C

# 2010 ESC Geotechnical Report

# GEOTECHNICAL ENGINEERING REPORT

ROSE MASTER PLAN
VETTER ROAD
POULSBO, WASHINGTON

**Prepared for:**
EDWARD ROSE & SONS
30057 ORCHARD LAKE ROAD STE #100
FARMINGTON HILLS, MICHIGAN

**Prepared by:**
ENVIROSOUND CONSULTING, INC.
3388 BYRON STREET NW STE 200
SILVERDALE, WASHINGTON 98383

**Project No. ESC10-G031**
**November 12, 2010**

EnviroSound Consulting Geotechnical & Environmental Consulting

November 12, 2010

Project: ESC10-G031

Mr. Michael Colman
Edward Rose & Sons
30057 Orchard Lake Road, Suite #100
Farmington Hills, Michigan 48333-9070

**Geotechnical Engineering Report**
**Rose Master Plan**
**Vetter Road**
**Poulsbo, Washington**

Dear Mr. Colman

Submitted herewith is a report for EnviroSound Consulting's geotechnical engineering investigation for the subject project. This investigation was conducted in accordance with our signed contract agreement dated September 29, 2010. The report presents findings from our geotechnical engineering investigation and provides recommendations for geotechnical engineering aspects of project design.

We appreciate the opportunity to work with you on this project. If we can be of further assistance, or if you have any questions regarding this project, please contact our office.

Sincerely,

Shawn E. Williams, L.E.G.
Senior Engineering Geologist

Enclosures

State of Washington
Engineering Geologist
2203
Licensed Geologist
Shawn E. Williams

11-12-10

Michael J. Wolczko, P.E.
Senior Geotechnical Engineer
Sound Geotechnical, PLLC.

MICHAEL JOHN WOLCZKO
STATE OF WASHINGTON
REGISTERED
PROFESSIONAL ENGINEER
11/13/10
EXPIRES 2011

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| 2 | Parcels Map |
| 3 | Proposed Development & Exploration Plan |
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# 1.0 INTRODUCTION

EnviroSound Consulting (ESC) was retained by Mr. Michael Colman with Edward Rose & Sons to conduct a geotechnical engineering investigation and a Phase I Environmental Site Assessment (ESA) for Tax Parcel Numbers 112601-3-006-2000, 112601-3-008-2008, 112601-3-021-2001and 102601-4-022-2009 in Poulsbo, Washington. The site is currently referred to as the Edward Rose & Son's Development. The Phase I ESA is being submitted under separate cover. The geotechnical report was done in general compliance with geological report requirements outlined in the City of Poulsbo Critical Areas Ordinance, sections 16.20.735, Geologically Hazardous Areas, Geotechnical/Geological Report.

## 1.1 Site Location

This site consists of four parcels located on the northern side of State Highway 305 between Viking Way and Bond Road in Poulsbo, Washington. According to the United States Geologic Survey (USGS), 7.5 minute Poulsbo, Washington topographic quadrangle map, the property is located in Kitsap County in Sections 10 and 11, Township 26 North, Range 1 East, W.M. and at Longitude 122.646 degrees W and Latitude 47.756 degrees N. The site location is shown on the Site Vicinity Map, Figure 1.

The subject property consists of three parcels comprising approximately 49.0 acres located on the east side of Vetter Road (Kyodai Parcels) and one parcel comprising 6.67 acres west of an easement for Vetter Road and adjacent to State Route 305 (Maddocks Parcel) (Figure 2).

## 1.2 Proposed Construction

Based on our discussions and review of preliminary plans, we understand that the proposed development may consist of fourteen 2-story apartment buildings with building footprints ranging in size from 12,000 square feet to 15,840 square feet, one large senior living center with a building footprint of approximately 79,200 square feet, a club house with a building footprint of 6,425 square feet and a retail building with a 10,500 square foot building foot print (See Site Development & Exploration Plan Figure 3). The preliminary plans indicate that the development of the property will also include associated parking, access off of Bond Road and State Route 305 and landscaping. We expect that the installation of utilities will also be included in the planned development of the site.

The plans are in a preliminary stage. Final building elevations and configurations have not been determined. The preliminary plans indicate that the apartment buildings will be 2-stories in height and that the senior living facility will range from one to three stories in height. The final planned elevations will be important in evaluating the most suitable procedures for temporary excavation and foundation construction. ESC should review plans, once these details are established, so that we can provide additional recommendations for finalizing earthwork and foundation construction specifications. We recommend that ESC be involved in the process of developing the plan details, so that we can assist with developing the most suitable and cost-effective building configurations.

## 1.3 Purpose

The purpose of this investigation is to determine the subsurface soils and groundwater conditions at the site. This evaluation has been completed to develop geotechnical engineering recommendations for earthwork, foundation and retaining wall construction. It should be noted that this investigation does not include a long term program of monitoring groundwater conditions.

The investigation also addresses portions of the project that are near known geo hazard areas as identified by the City of Poulsbo or in areas designated as aquifer recharge areas.

## 2.0 SITE INVESTIGATION

### 2.1 Site Description

The Kyodai Parcels are bordered by forested areas to the north and east with scattered single family residences, to the west by the Vetter Road easement and to the south by State Route 305 and State Highway 307 (Bond Road). The Maddocks Parcel is bordered by the Vetter Road easement to the east, by State Route 305 to the south, by a single family residence and North Kitsap Recycling Center to the west and vacant forested land to the north.

The majority of the Kyodai Parcels are relatively level gently sloping toward the south (generally less than 5 degree slopes). There is an elevation change of approximately 210 feet across the property from the north to the south. The southern portion of the parcels have moderately steep slopes approximately 25 degrees (2H:1V) or flatter) ranging from approximately 50 feet to 80 feet in height and descending to the south toward Dogfish Creek. Dogfish Creek flows toward the southwest in a drainage swale area on the southern edge of the parcels. The parcels are forested with some trails and former logging roads meandering through the parcels. Vegetation consisted of mature cedar, fir, maple and alder trees with an understory of salal, ferns and blackberries. A rockery is along a portion of the south property line adjacent to State Route 305.

The Maddocks Parcel is relatively level sloping toward the south and west. There is an elevation change of approximately 35 feet across the parcel from the northeast corner of the parcel to a swale area on the southwestern portion of the parcel. A type 5 stream flows in a southerly direction on the western portion of the parcel. The majority of the parcel is relatively cleared of vegetation with scattered trees and scotch broom, the north portion of the parcel is more heavily forested. A driveway provides access off of State Route 305. A single family residence formerly occupied the parcel. A portion of south property line adjacent to State Route 305is supported by a rockery wall.

### 2.2 Geologic Setting

The Washington Division of Geology and Earth Resource (WDGER), Geologic Map of Washington - Northwest Quadrant indicates that the site is underlain by Glacial Till (Qgt) composed of poorly sorted clay, silt, sand and gravel that has been compacted into an impermeable cement-like material.

The United States Department of Agriculture (USDA) Soil Survey of Kitsap County Area, Washington, information indicates the following soil types exist on the project site as shown on Figure 4:

- Norma fine sandy loam in the western portion of the Maddocks parcel and southern portion of the Kyodai parcels.
- Poulsbo gravelly sandy loam (0-6% slopes) in the eastern portion of the Maddocks parcel, and on the eastern and western edges of the Kyodai parcels.
- Poulsbo gravelly loamy sand (6-15% slopes) in the central portion of the Kyodai parcels.
- Poulsbo gravelly sandy loam (15-30% slopes) in the southern and eastern portions of the Kyodai parcels.

The soil survey descriptions of these soil types are summarized in the following table.

| USDA Soil Survey Name | **37 Norma fine sandy loam** | **39—Poulsbo gravelly sandy loam, 0 to 6 percent slopes** | **40-Poulsbo gravelly sandy loam, 6 to 15 percent slopes.** | **41-Poulsbo gravelly sandy loam, 15 to 30 percent slopes.** |
|---|---|---|---|---|

| USDA Soil Survey Name | **37 Norma fine sandy loam** | **39—Poulsbo gravelly sandy loam, 0 to 6 percent slopes** | **40-Poulsbo gravelly sandy loam, 6 to 15 percent slopes.** | **41-Poulsbo gravelly sandy loam, 15 to 30 percent slopes.** |
|---|---|---|---|---|
| USDA Textural Classification & USCS Soil Type | *0-8 inches:* Fine sandy loam SM *8-22 inches:* Sandy loam, fine sandy loam, silt loam SM *22-60 inches:* Stratified loamy sand to silty clay loam. SM-SC | *0-2 inches:* Gravelly sandy loam. SM *2-24 inches:* Gravelly sandy loam, gravelly loam. SM *24- 60 inches:* Cemented. | *0-2 inches:* Gravelly sandy loam SM *2-24 inches: Gravelly sandy* loam, gravelly loam. SM *24-60 inches:* Cemented | *0-2 inches:* Gravelly sandy loam. SM *2-24 inches:* Gravelly sandy loam, gravelly loam. SM *24-60 inches:* Cemented |
| Origination | Mixed Glacial Alluvium | Glacial till. | Glacial till. | Glacial till. |
| Permeability | Moderate rapid. | Moderately rapid above the hardpan and very slow through it. | Moderately rapid above the hardpan and very slow through it. | rapid to a depth of 19 inches and very rapid in the substratum |
| Drainage | Moderately well | Moderately well | Moderately well | Moderately well. |
| Surface Runoff | Medium | Slow. | Slow | Medium. |
| Erosion Hazard | Slight. | Slight. | Slight | Moderate. |

The map of "Slope Stability, Kitsap County, Washington", by Jerry Deeter, 1979, indicates that portions of the subject property and surrounding area have intermediate and intermediate steep phase slopes. Intermediate slopes are generally steeper than 15 percent but do not exceed 30 percent. Intermediate steep phase slopes are steeper than 30 percent. It should be noted that the mapping was performed in the 1970's and does not reflect more recent slide activity that may have occurred.

### 2.3 **Subsurface Exploration**

Twenty five test pits were excavated on November 4 and 5, 2010 on the Kyodai parcels. Three test pits were excavated on the Maddocks parcel on November 6, 2010 for a total of twenty eight test pits. The approximate test pit locations are shown on the Site & Exploration Plan, Figure 3. The test pit were located by GPS and existing monuments in the field. The test pits were excavated with a Caterpillar 315 track mounted track-hoe, provided by SAW Enterprises LLC of Poulsbo, Washington. Existing access roads, trails or former logging roads were utilized as much as possible to minimize damage to trees. The test pits reached depths of about 4 to 5 feet below existing grades with all test pits terminated in very dense cemented glacial till. The test pits were logged by a senior engineering geologist with our firm and representative subsurface soil samples were obtained and transported to our office for further evaluation. Selected samples were submitted to subcontracted laboratories for soil classification and strength testing. Logs of the test pits can be found in Appendix A. All test pits were backfilled upon completion of logging.

#### 2.3.1 **Soil**

The soils encountered within the test pits were for the most part consistent. The majority of the test pits had a 2 to 6-inch cap of forest duff material often with roots and rootlets. The duff was typically underlain by a medium dense reddish tan, silty SAND with scattered gravels and cobbles (some oversized). The sand was underlain by a foot layer of medium

dense weathered glacial till, which in turn was underlain by dense to very dense cemented glacial till. Test Pit, TP-28 on the Maddocks Parcel encountered a thin layer of glacial outwash directly above the till. Detailed descriptions of the soils encountered in the test pits are presented in the Logs of Test Pits in Appendix A.

### 2.3.2 Groundwater

Groundwater was not encountered within the test pit excavations. No piezometers were installed for long term groundwater monitoring, as part of this investigation.

Water table elevations can fluctuate with time. Groundwater levels are typically influenced by seasonal precipitation, irrigation, land use, and climatic conditions, as well as other factors. Groundwater level observations at the time of the field investigation may vary from those encountered during the construction phase of the project.

There are two streams located within 1,000 feet of the proposed development as indentified in a 2008 Wiltermood & Associates Wetland Delineation Report. Dogfish Creek flows in a southwest direction through the southern edge of the parcels adjacent to Bond Road. A Type 5 stream flows in a southerly direction through the western portion of the Maddocks Parcel.

### 2.3.3 Laboratory Testing

To aid in classifying the soils and to evaluate the strength characteristics and for potential infiltration, laboratory tests were performed on selected samples. Test method references are shown in the following table. Phoenix Soil Research of Kingston, Washington was retained to provide geotechnical laboratory analysis.

| Parameter | Testing Method Reference |
|---|---|
| Particle Size Analysis | ASTM D422 |
| Moisture Content | ASTM D2216 |
| U.S. Standard No. 200 Sieve Wash | ASTM D1140 |

The results of the laboratory testing are provided in Table 1 in Appendix B.

## 2.4 Seismic Information

ESC has reviewed table 1613.5.2 of the 2006 International Building Code (IBC). Site specific data is not available to a depth of 100 feet. The site soils consist primarily of fine to coarse sand with varying amounts of gravel and silt. The subsurface exploration program did not include drilling and Standard Penetration Test (SPT) blow count data, and the maximum depth of exploration was on the order of about 5 feet. Based on our experience with soils similar to those encountered on this site and the blow count data obtained, we estimate that the average Standard Penetration Resistance for the upper 100 feet of site soils is greater than 50. Therefore, for seismic design of structures the site should be considered class C, "very dense soil and soft rock", as defined in the IBC.

Ground motion accelerations for the site were obtained from the USGS Earthquake Hazards Program website and are presented in the following table. The latitude/longitude method was used to obtain the ground motions with latitude of 47.756 degrees and a longitude of 122.646 degrees using the 2002 data tables.

| Probability of Exceedance | 2% in 50 years |
|---|---|
| Peak Ground Acceleration (PGA) | 0.610 g |
| 0.2 second period ($S_s$) | 1.370 g |
| 1 second period ($S_1$) | 0.484 g |

In addition to the spectral acceleration values noted in the table above, we have provided the seismic design parameters $F_a$ and $F_v$ in accordance with the 2003 NEHRP Seismic Design Provisions.

| | | |
|---|---|---|
| $F_a$ | 1.000 | From Table 1613.5.2(1) of the 2006 IBC |
| $F_v$ | 1.316 | From Table 1613.5.2(2) of the 2006 IBC |

### 2.5 Seattle Fault Zone

Based on our review of the United States Geological Survey (USGS) information for the Seattle Fault Zone and available LIDAR (Puget Sound LIDAR Consortium) information for the Silverdale area, the proposed building site lies within the generally delineated area of the Seattle Fault Zone. Although fault surface ruptures have not been mapped or observed in the Silverdale area, surface ruptures of Seattle Fault strands have been observed and mapped on south Bainbridge Island.

## 3.0 CONCLUSIONS AND RECOMMENDATIONS

### 3.1 General

Based on the findings of this investigation and previous geotechnical experience in the area of this project, it is our opinion that the proposed commercial buildings could be supported on shallow foundation systems bearing on compacted structural fill pads placed over dense to very dense, native soil. We recommend that ESC be involved in the process of planning the construction, configurations and elevations for the proposed structures. We also recommend that ESC review updated plans, as these documents become available, to verify that geotechnical recommendations are being incorporated.

The native soils in the upper six inches at the site contain organic material in the form of roots and root mats that will need to be removed prior to development of the site. The high fines content of the upper soils make them moisture sensitive and difficult to use during the winter season. The dense to very dense cemented till encountered in all of the test pits will be difficult for excavating utility trenches.

Due to the overall size of the development and the proposed size of the buildings it is recommended that a representative of EnviroSound view all foundations for proposed structures. Soil conditions can vary on parcels and the presence of a burn pit in test pit TP-2 is an example of potential exceptions.

### 3.2 Slope Stability

Building B and the east wing of the Senior Living Center are the only two structures that potentially encroach upon slope buffers associated with steep slopes. The presence of the cemented glacial till near surface with slopes less than 25 degrees (2H:1V) minimizes any potential impact to the overall stability of the moderately steep slopes.

Based on our review of the slope soils encountered in the exploratory test pits, and the angle of the slope (2H:1V), it is our opinion that the slope can be safely developed. We recommend that ESC review all available grading and construction plans to verify that the factors of safety can be maintained. In developing the grading plan, we recommend that the new grades be kept as near to the existing grades as possible, with the exception of the expected basement excavations, which will primarily embed the structures into the existing topography. Retaining walls (not rockeries) will need to be constructed in areas where fill is placed on the slope. Specific recommendations will need to be provided and followed for significant fill slope construction.

### 3.3 Erosion Control

The soils on the slope may erode in the disturbed state or under conditions of channelized water flow. Therefore, best management practices for erosion control including silt fences, hay bales, etc. should be used to prevent sediment from leaving the site and entering storm water sewer systems or surface waters. Water should not be allowed to flow over the slope in a concentrated manner. Stripping of vegetation on the steep slopes should be limited to the extent possible for the proposed construction. We further recommend that vegetation be replanted on the slopes as soon as practical following completion of grading. Stripped slope areas should be protected from weather with a plastic visqueen cover when construction will not be occurring on them for more than one to two days.

The Washington State Department of Ecology (DOE) has three publications, which may be helpful in developing long-term slope vegetation maintenance/protection and landscape plans:

- "Slope Stabilization and Erosion Control Using Vegetation: A Manual of Practice for Coastal Property Owners", May 1993, Publication 93-30.
- "Vegetation Management: A Guide for Puget Sound Bluff Property Owners", May 1993, Publication 93-31.
- "Surface Water and Ground Water on Coastal Bluffs: A Guide for Puget Sound Property Owners", June 1995, Publication 95-107.

### 3.4 Drainage

Runoff from buildings and impervious surfaces should be directed into an appropriately designed stormwater disposal system. Ground surfaces should be sloped a minimum of 3 percent for a minimum distance of 10 feet away from structures in accordance with Section 1803.3 in the 2006 International Building Code (IBC). Surface water should be collected by permanent catch basins and drain lines, and be discharged into a storm drain system. Design of stormwater disposal systems is primarily the responsibility of a civil engineer. Proper drainage of surface water runoff, in accordance with these recommendations, will be an important factor in maintaining long term stability of the site slopes. Surface water should not be allowed to flow freely over slopes and we recommend that no slope areas be left open and exposed to wet weather, following the completion of construction. All exposed slope areas should be covered with impervious surfaces or re-planted with appropriate vegetation.

We recommend that footing drains be installed around the commercial structures. Installing footing drains at least 1 foot below the planned finished floor slab elevation will provide drainage for the slab subgrade.

Where used, footing drains should consist of 4-inch-diameter, perforated PVC pipe that is surrounded by free-draining material, such as pea gravel. Footing drains should discharge into tight-lines leading to an appropriate collection and discharge point. For slabs-on-grade, a drainage path should be provided from the capillary break material to the footing drain system. Roof drains should not be connected to wall or footing drains.

### 3.5 Foundations

The proposed structures can be supported on perimeter foundations founded on the undisturbed, dense glacier till present at relatively shallow depths (5 feet or less). In order to minimize differential settlement it is not recommended that portions of the building foundations be founded on both fill and glacial till. Some over excavation of footings may be necessary due to the length of the buildings.

We recommend that the proposed structure be founded upon column or continuous wall footings bearing in the undisturbed, competent native soils or on compacted structural fill that has been placed over the undisturbed, competent native soils. Footings founded upon the medium dense or denser native soils could be designed for an allowable soil bearing pressure of 3.0 ksf. This soil pressure may also be used for footings founded upon structural fill compacted as recommended in the fill placement and compaction section of this report. Minimum footing widths should be 24 inches for individual square footings and 12 inches for continuous footings. Footings should have adequate embedment for local

frost penetration requirements. In the area of this project, the minimum depths are typically 18 inches for exterior footings and 12 inches for interior footings. If footings are supported by structural fill, the fill should extend beyond the outer edges of footings a minimum distance equal to the thickness of the fill beneath the footing. Based on the results of our explorations it is anticipated that the top of the bearing layer (medium dense or denser) will be encountered between roughly 1 to 5 feet below the existing ground surface within the proposed building footprint.
The allowable bearing pressures given could be increased by one-third for wind or earthquake loads.

Footing excavations should be cleaned of all loose soil, leveled, and protected from water. The site soils contain a sufficient quantity of fines to become soft and spongy when subjected to water and disturbance. If construction is to take place during wet conditions, we recommend that a thin layer (2 to 3 inches thick) of lean concrete or compacted clean crushed rock be placed immediately after excavating to suitable foundation soils to serve as a working surface. Footing excavations should be kept free of water at all times.

Each footing excavation should be evaluated by a qualified geotechnical engineer to confirm suitable bearing conditions and to determine that all loose materials have been removed. This should be accomplished prior to placement of concrete or the working surface.

Assuming compliance with the above recommendations, we expect settlements to be less than 3/4 inch, with differential settlements (between adjacent footings or over a 20-foot span of continuous footing) less than 1/2 inch.

Lateral footing displacement can be resisted by friction along the base of the foundation and passive pressure acting against the appropriate footing faces. We recommend an allowable friction factor of 0.4 and an allowable equivalent fluid passive pressure of 240 psf/ft of depth. These values include a factor of safety of 1.5 for the allowable friction factor and 2.0 for the allowable equivalent fluid passive pressure.

### 3.6 Floor Slabs

Floor slabs for the proposed commercial buildings should be constructed over suitable subgrade surfaces. The subgrade should consist of medium dense to dense, native soil or structural fill placed over suitable native soil. Floor slab subgrade areas should be evaluated by a representative of the geotechnical engineer. Replacement of in place, moisture sensitive soils, with aggregate or a sand and gravel mixture may be recommended for subgrade improvement. The layer should consist of at least 4 inches of clean, free-draining coarse sand or gravel. A capillary break consisting of at least 4 inches of clean, pea gravel or 5/8 inch of crushed rock should placed beneath the floor slabs.

We recommend that concrete slab-on-grade floors be underlain by a water vapor barrier in areas where it is critical to reduce moisture intrusion, such as those with moisture sensitive floor coverings. The moisture barrier system should be installed in accordance with ASTM guidelines.

Any loose soil encountered beneath slab areas should be removed and replaced with structural fill. Because ground surfaces may be unintentionally disturbed during construction activities, we recommend that all slab subgrades be compacted prior to slab construction.

### 3.7 Lateral Earth Pressures & Retaining Walls

Lateral pressures will be exerted on below grade (basement) and retaining walls by backfill soils, surcharge loads, and hydrostatic pressures caused by groundwater. Lateral earth pressures on walls depend upon the type of wall, type of backfill material and allowable wall movements. For walls that are restrained at the top, lateral earth pressures should be estimated for an "at rest" condition. For walls that are free to rotate away from the retained soil, lateral earth pressures should be estimated for an "active" earth pressure. For walls that are compressing the retained soil, lateral earth pressures should be estimated for a "passive" earth pressure. Recommended lateral earth pressures coefficients are provided in the following table along with equivalent fluid pressures. These pressures are calculated assuming a moist unit weight for the backfill soil of 110 pounds per cubic foot (pcf) and an angle of internal friction of 25 degrees. These values are representative of the on site materials, however we recommend that imported structural fill be used for wall backfill.

| Lateral Earth Pressures, no slope above or below the wall | | | | | |
|---|---|---|---|---|---|
| "Active" Condition | | "At Rest" Condition | | "Passive" Condition | |
| Coefficient (Ka) | Equivalent Fluid Unit Weight (pcf) | Coefficient (Ko) | Equivalent Fluid Unit Weight (pcf) | Coefficient (Kp) | Equivalent Fluid Unit Weight (pcf) |
| 0.41 | 45 | 0.59 | 65 | 1.28 | 140 |

The recommended equivalent fluid unit weights do not include hydrostatic pressure due to groundwater accumulated behind walls. The recommended fluid pressures assume a horizontal ground surface above and below the wall and do not include seismic loading, or any surcharge due to nearby loading from structures, equipment or traffic. The passive pressure has been reduced by a factor of 2 to limit wall translation.

The potential seismic force on the wall can be modeled as a uniform pressure on the back of the wall equal to 7H (H is the height of the wall (in feet)), for active conditions, with no slope above the wall. For walls designed for at rest conditions, with no slope above the wall, the uniform pressure for the seismic increase should be increased to 18H. The units for this pressure are pounds per square foot (psf).

Continuous drains with cleanouts should be installed at the base of retaining walls to prevent the buildup of hydrostatic pressure behind the structure. These drains should consist of a minimum 4-inch diameter perforated rigid pipe (with perforations placed down) with a minimum thickness of 6 inches of pea gravel around the pipe. The pipe and pea gravel should be wrapped in filter fabric to reduce the migration of fines into the drainage zone. The backfill soils within 1 foot of the walls should consist of free-draining sand and gravel material. This drainage system should be designed to transport water away from the structure and discharge into an appropriate area.

### 3.8 **Infiltration**

The encountered in the test pits generally consisted of silty sands underlain by cemented Glacial Till. The silty sands ranged from one to two feet in thickness. No groundwater seepage was encountered in the test pits. The proximity of the cemented Till to the surface soils makes the use of on site stormwater infiltration in-practical as a method to handle stormwater runoff. The stratigraphy of the soils encountered across all 4 parcels was relatively consistent. The test pits indicate that the proposed areas of the site to be developed are not Aquifer Recharge Areas of Concern (ARAC).

Grain size distribution tests were performed on five test pits from various areas of the parcels to estimate the USDA Textural Classification of the soils encountered. A total of five grain size distribution tests were performed. The results of these tests are attached to this report in Appendix B. Three of the test pit sample results were "Loamy Sand" and two of the test sample results were "Sandy Loam" under the USDA textural classification system.

Based on the results of the test pits and laboratory testing, it appears that the infiltration rates for "Loamy Sand" are likely to be the most appropriate for design. The short term infiltration rate given for Loamy Sand in the SWMM is 2 inch per hour. The Kitsap SWDM indicates a short term infiltration rate for Loamy Sand of 15 minutes per inch. Note the different units for the two design manuals and that the Kitsap Manual consistently gives a higher infiltration rate.

### 3.9 **Asphalt Pavement**

Preliminary recommendations for asphalt pavement thicknesses are based on the AASHTO Guide for Design of Pavement Structures. We presume that the primary traffic on the site will be passenger cars. We used the section on Low-Volume Road Design for Flexible Pavement with a 50 percent inherent reliability level, as recommended in the Guide for local roads. We further assumed that the traffic level would be low, corresponding to 50,000 to 100,000 Equivalent Single Axle Load (ESAL) applications over the lifetime of the pavement. Note that one ESAL is for an 18-kip axle load. One passenger car is approximately 0.008 ESALs. Therefore, the low traffic level corresponds to at least 6,250,000 passenger car trips over the pavement. In the test pits, we encountered weathered till consisting of medium dense sand with silt. We assigned this soil a relative quality of "Fair".

Based on the previous assumptions, we preliminarily recommend 2 inches of surface course Asphaltic Concrete (AC) over 6 inches of granular base course. Surface course AC can be substituted for base course and vice versa at a rate of 1 inch of AC per 3 inches of base course. We recommend that the AC thickness not be reduced below 2 inches. The final pavement section can be adjusted based on estimated vehicle loading and desired design life. In consideration of heavier traffic such as garbage trucks or maintenance trucks we recommend 3 inches of AC over 8 inches of base course.

In preparing the preceding recommendations, we assumed that the Elastic Modulus of the Asphaltic Concrete would be at least 400,000 psi, and that the Base Course would be a well graded crushed rock with a California Bearing Ratio (CBR) of 100. If materials with different strengths than presented will be used, we should be contacted to adjust the pavement section recommendations accordingly.

If a porous type of AC is proposed, the available literature indicates that while the pore space of the porous AC is approximately 16 percent, compared to about 2 to 3 percent for conventional AC, the strength properties are similar. It is our opinion that a porous AC section that is similar in depths to the recommended conventional section could be used to attain similar load support and performance over the design life of the pavement section.

Concrete pavement design recommendations are based on an assumed modulus rupture or 600 psi and a minimum compressive strength of 4,000 psi for the concrete. A minimum concrete thickness of 3.5 inches is recommended for the parking areas with a base course of 6 inches. In consideration of heavier traffic such as garbage trucks or maintenance vehicles we recommend 5 inches of concrete over a 6 inch layer of base. Pervious concrete typically has a 15 to 25 percent void structure and can have strengths ranging from 500 psi to 4,000 psi.

Prior to the placement of asphalt we recommend that the subgrade be proof rolled with heavy construction equipment such as a loaded dump truck or water truck to ensure that the subgrade is relatively stiff and unyielding.

### 3.10 **Earthwork Considerations**

During wet weather conditions, which are typically present from October through April, subgrade stability problems and grading difficulties may develop due to high moisture content in the soil, disturbance of sensitive soils and/or the presence of perched groundwater. Therefore, we recommend that earthwork activity be performed during the dry season.

#### 3.10.1 **Site Preparation**

General site clearing should include removal of vegetation, trees and associated root systems, wood, pavement, retaining walls, rubble, and rubbish. Site stripping should extend to a minimum depth of 6 inches, or until all organics in excess of 3 percent by volume or other unsuitable soils are removed. These materials will not be suitable for use as fill for parking or building areas. However, stripped topsoil may be stockpiled and reused in landscape or non-structural areas.

Any buried structures encountered during construction should be properly removed and backfilled. Excavation, depressions, or soft and pliant areas extending below planned finish subgrade level should be cleaned to firm, undisturbed soil and backfilled with structural fill to planned finish subgrade.

#### 3.10.2 **Groundwater Concerns**

Groundwater was not encountered in the test pits. We do not expect that significant groundwater will be encountered during construction, at the currently anticipated excavation depths. Perched groundwater in the near surface soils, particularly on top of the dense to very dense cemented glacial till may develop during the wetter portions of the year. If groundwater is encountered, we should be contacted for further recommendations. Significant groundwater flow, if encountered during construction, would require modifications in the completion of excavation work.

### 3.10.3 Excavations & Constructed Slopes

It is our opinion that the soils encountered in the test pits are a Type B material as defined by the Washington Industrial Safety and Health Act's (WISHA) regulations on excavation, trenching and shoring. Temporary slopes excavated in Type B material should be inclined no steeper than 1H:1V (horizontal: vertical). A representative of our firm should evaluate temporary and permanent slopes to ensure that they are appropriate for the soils encountered during construction. Recommendations to reduce temporary slopes to 2H:1V or flatter may be provided, depending on the observed conditions during construction.

In areas where it is not possible to maintain the recommended slopes due to space constraints, temporary shoring would be required. Such shoring would need to be properly designed by an engineer.

The Contractor should be familiar with applicable local, state, and federal safety regulations, including the current WISHA regulations on excavation, trenching and shoring. Construction site safety is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. ESC is providing this information solely as a service to our client. Under no circumstances should the information provided above be interpreted to mean that ESC is assuming responsibility for construction site safety or the Contractor's activities; such responsibility is not being implied and should not be inferred.

The soils to be penetrated by the proposed excavations may vary significantly across the site. ESC's preliminary soil classification is based solely on the materials encountered in the test pits. The Contractor should continually classify the soils that are encountered as excavation progresses with respect to the WISHA system.

### 3.10.4 Structural Fill

The majority of the on site soil have a high percentage of fines and will not likely be suitable for use as structural fill, due to the high moisture sensitivity of these materials and organic content such as large roots and root mats. If the earthwork is to take place during the normally wet period of the year, provisions should be in place for export of wet, moisture sensitive soil and import of granular structural fill material. Imported structural fill should consist of well-graded gravel and/or sand with a maximum grain size of 3 inches and less than 5 percent fines (material passing the U.S. Standard No. 200 Sieve). If construction occurs during dry periods the fine content can be increased to 20 percent. All material proposed for use as structural fill should be approved by a representative of the geotechnical engineer.

Structural fill should be placed in loose lifts no more than 12 inches thick, moisture conditioned as necessary (moisture content of soil should be within 2 percent of optimum moisture) and compacted to 95 percent of the maximum dry density as determined by ASTM Test Method D-1557. Additional lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable. Note that, although in place density testing of fill is frequently used as the primary criterion for acceptance of fill, it should not be the only criterion. If, in the judgment of the geotechnical engineer or his representative, placed fill is not suitable it should be rejected regardless of in place density test results. As an example, fill that is compacted wet of the optimum moisture content may exhibit "pumping" behavior even if in place density test results indicate greater than 95 percent compaction has been achieved. In such a situation, the fill should be removed and replaced with drier material.

### 3.10.5 Utility Trench Fill

Excavations for utilities should be completed and maintained during utility installation and backfilling, in accordance with Occupational Safety and Health Administration (OSHA) requirements. The utility contractor should be responsible for maintaining safety within open trenches. Care should be taken to reduce surcharge loads and vibrations adjacent to utility excavations. Although no groundwater seepage was encountered only encountered, groundwater flow into trenches could occur, particularly during or following periods of heavy precipitation.

The subsurface soils at this site generally included dense to very dense sand with varying amounts of gravel and silt. We expect that the potential for significant caving within open excavations will be relatively low, however, the utility contractor should exercise caution and be prepared to slope excavation sidewalls at gentler angles or install temporary

shoring, if conditions indicate that caving may occur. The factors that may influence the potential for caving could include the depth and length of trench that is opened at any one time, along with the length of time the trench is to remain open and surface and groundwater conditions. The utility contractor should be aware of these factors and observe the excavation for signs of possible caving, such as heavy seepage and tension cracks within and above the excavation sidewalls.

Backfill for utility trenches should consist of suitable material, as described in the **Structural Fill** section of this report. Utility trench backfill placed beneath building and pavement areas should be compacted to at least 95 percent of the maximum dry density based on ASTM Test Method D-1557. The utility trench backfill placed beneath pavement areas, at depths greater than 2 feet below the final grade may be compacted to a minimum of 90 percent of the maximum dry density, as defined by ASTM Test Method D-1557. The bedding material for utility pipes should be in accordance with the manufacturer's specifications. The utility contractor should use equipment and backfill placement methods, which will reduce the possibility of damage to utilities or structures during placement and compaction.

## 4.0 LIMITATIONS

This report has been prepared for Edward Rose & Sons regarding the subject project. Information presented in this report has been collected and interpreted in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions, and in accordance with sound and generally accepted principles consistent with normal consulting practice. No other warranty, expressed or implied, including (but not limited to) any warranty or merchantability or fitness for a particular use has been made.

Edward Rose & Sons and ESC discussed the risks and rewards associated with this project, as well as ESC's fee for services. Edward Rose & Sons and ESC agreed to allocate certain of the risks so that, to the fullest extent permitted by law, ESC's total aggregate liability to Edward Rose & Sons is limited to $50,000 or the fee, whichever is greater, for any and all injuries, claims (including any claims for costs of defense or other incurred costs), losses, expenses, or damages whatsoever arising out of or in any way related to ESC's services for this project, from any cause or causes whatsoever, including but not limited to, negligence, errors, omissions, strict liability, breach of contract, breach of warranty, negligent misrepresentation, or other acts giving rise to liability based upon contract tort, or statute.

In the event that change in the nature, design, or location of the proposed construction is made, or any physical changes to the site occur, recommendations are not to be considered valid unless the changes are reviewed by ESC and conclusions of this report are modified or verified in writing.

The subsurface exploration logs and related information depicts conditions only at the specific locations and at the particular time designated on the logs. The passage of time may result in a change of subsurface conditions at these exploration locations. Subsurface conditions at other locations may differ from conditions occurring at the exploration locations. The nature and extent of variations of subsurface conditions between explorations are not known. If variations appear during additional explorations or construction, reevaluation of recommendations in this report may be necessary.

Stratification lines designating the interface between soil types in subsurface exploration logs represent approximate boundaries. The transition between materials may be gradual.

Analyses and recommendations provided in this report are based in part upon the data obtained from the subsurface explorations.

The scope of ESC services did not include an environmental assessment for the presence or absence of hazardous and/or toxic materials, in the soil, groundwater, surface water, or atmosphere. Any statements or absence of statements in this report on any subsurface exploration log regarding staining or odor of soil, groundwater, or surface water, unusual or suspicious items, or conditions observed are strictly descriptive information for Edward Rose & Sons.

## REFERENCES

"Wetland Categorization and Mapping for Site Development Feasibility for 3 Parcels....by Wiltermood Associates, Inc. dated April 3, 2008.

"Soil Survey of Kitsap County Washington", United States Department of Agriculture, 1977.

"Slope Stability, Kitsap County, Washington", Jerry Deeter, 1979.

"Geologic map of surficial deposits in the Seattle 30' by 60' quadrangle, Washington", Yount et al., 1993.

"Geologic Map of Washington – Northwest Quadrant", Washington State Department of Natural Resources, Division of Geology and Earth Resources, GM – 50, 2002.

U.S.G.S. 7.5 minute series topographic map "USGS Poulsbo Topographic Map".

# APPENDIX A

## ESC Test Pit Logs

# TEST PIT TP- 1

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 150'
Test Pit Location: Building D
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0-6" Forest Duff with large roots, rootlets, moist to wet | | | | |
| | SM | 6" – 2.5' Medium dense, moist, reddish tan, silty SAND, scattered cobbles and gravels. | S-1 | Grab | 1.0 | M.C. = 11.0 percent<br>Sand 78.4 percent<br>Silt 19.4 percent<br>Clay 2.2 percent |
| | SM | 2.5' – 3.5' Medium dense, moist, mottled reddish tan and gray, silty SAND (Weathered Till). | | | | |
| | SM | 3.5'-5.0' Dense to very dense, moist, gray, cemented silty, gravelly SAND (Glacial Till). | S-2 | Grab | 4.0 | |
| 5 | | TD 5.0'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/4/10
ESC Representative: SEW
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# TEST PIT TP- 2

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 150'
Test Pit Location: Building D
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | SM | 0- 3.0' Mix of burnt tree debris and reddish tan silty SAND, slightly compacted, scattered gravels and cobbles, (appears to be the edge of a former burn pit) | S-1 | Grab | 1.0 | |
| | SM | 3.0'- 4.0' Medium dense, moist, mottled reddish tan and gray silty SAND (Weathered Till). | | | | |
| 5 | SM | 4.0'-5.5' Dense to very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | S-2 | Grab | 5.0 | |
| | | TD 5.5'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/4/10
ESC Representative: SEW

# TEST PIT TP- 3

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 155'
Test Pit Location: Building D Parking
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0-6" Forest Duff with large roots, rootlets, moist to wet | | | | |
| | SM | 6" – 3.0' Medium dense, moist, reddish tan, silty SAND, scattered gravels and cobbles (some oversized). | | | | |
| | SM | 3.0' – 4.0' Medium dense, moist mottled reddish tan and gray silty SAND (Weathered Till). | | | | |
| 5 | SM | 4.0'-5.0' Dense to very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | S-1 | Grab | 4.0 | M.C. = 7.0 percent |
| | | TD 5.0'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/4/10
ESC Representative: SEW
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# TEST PIT TP- 4

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 140'
Test Pit Location: Club House
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | SM | 0– 2.5' Medium dense, moist, reddish tan, silty SAND, scattered gravels and cobbles with roots and rootlets to 2.5' in depth. | | | | |
| | SM | 2.5' – 3.5' Medium dense, moist, mottled reddish tan and gray silty SAND (Weathered Till). | | | | |
| | SM | 3.5'-4.5' Dense to very dense, slightly, gray, cemented silty, gravelly SAND (Glacial Till). | | | | |
| 5 | | TD 4.5'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/4/10
ESC Representative: SEW

# TEST PIT TP- 5

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @120 '
Test Pit Location: Senior Living Center
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0-0.5' Forest Duff with scattered roots and rootlets, moist to wet. | | | | |
| | SM | 0.5'– 3.0' Medium dense, moist, reddish tan, silty SAND, scattered gravels and cobbles some roots to 3.0' in depth. Trace burnt tree debris. | | | | |
| | SM | 3.0' – 3.5'Medium dense, moist, mottled reddish tan and gray silty SAND (Weathered Till). | S-1 | Grab | 3.5 | M.C. = 17 percent<br>Sand 73.1 percent<br>Silt 24.4 percent<br>Clay 2.6 percent |
| 5 | SM | 3.5'-5.0' Dense to very dense, slightly moist, gray cemented silty, gravelly SAND (Glacial Till). | S-2 | Grab | 4.5 | |
| | | TD 5.0'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/4/10
ESC Representative: SEW

# TEST PIT TP- 6

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 125'
Test Pit Location: Senior Living Center
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | SM | 0 – 1.0' Medium dense, moist, reddish tan, silty SAND, trace gravels and cobbles. | | | | |
| | SM | 1.0' – 3.5' Medium dense, moist, mottled reddish tan and gray silty SAND (Weathered Till). | S-1 | Grab | 3.5 | |
| | SM | 3.5'-4.5' Dense to very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | S-2 | Grab | 4.5 | |
| 5 | | TD 4.5'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/4/10
ESC Representative: SEW

# TEST PIT TP- 7

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 115'
Test Pit Location: Senior Living Center
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with roots and rootlets, moist to wet | | | | |
| | SM | 0.5' – 3.0' Medium dense, moist, mottled reddish tan and gray silty SAND (Weathered Till). | S-1 | Grab | 2.5 | |
| | SM | 3.0'-4.5' Dense to very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | S-2 | Grab | 4.0 | |
| 5 | | TD 4.5'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/4/10
ESC Representative: SEW

# TEST PIT TP-8

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 175'
Test Pit Location: Building C
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with roots and rootlets, moist to wet | | | | |
| | SM | 0.5' – 3.75' Medium dense, moist, reddish tan silty SAND, with scattered gravels and cobbles | | | | |
| | SM | 3.75'- 4.25' Medium dense, moist, mottled reddish tan and gray silty SAND (Weathered Till). | S-1 | Grab | 2.5 | M.C. =11.0 percent<br>Sand 69.1 percent<br>Silt 27.9 percent<br>Clay 3.0 percent |
| 5 | SM | 4.25'-5.0' Dense to very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | | | | |
| | | TD 4.5'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/4/10
ESC Representative: SEW

# TEST PIT TP-9

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @165 '
Test Pit Location: Building B
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with roots and rootlets, moist to wet | | | | |
| | SM | 0.5' – 3.0' Medium dense, moist, reddish tan silty SAND, with scattered gravels and cobbles | | | | |
| | SM | 3.0'- 3.5' Medium dense, moist, mottled reddish tan and gray silty SAND (Weathered Till). | S-1 | Grab | 3.0 | M.C. =13 percent |
| 5 | SM | 3.5'- 4.5' Dense to very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | | | | |
| | | TD 4.5'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/4/10
ESC Representative: SEW
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# TEST PIT TP-10

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 160'
Test Pit Location: Building A
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with roots and rootlets, moist to wet | | | | |
| | SM | 0.5' – 3.0' Medium dense, moist, reddish tan silty SAND, with scattered gravels and cobbles | | | | |
| | SM | 3.0'- 4.0' Dense to very dense, slightly moist, gray cemented silty, gravelly SAND (Glacial Till). | S-1 | Grab | 2.0 | M.C. = 14 percent |
| 5 | | TD 4.0'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/4/10
ESC Representative: SEW

# TEST PIT TP-11

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 177'
Test Pit Location: Building H Road
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with roots and rootlets, moist to wet | | | | |
| | SM | 0.5' – 3.0' Medium dense, moist, reddish tan silty SAND, with scattered gravels and cobbles, some oversized. | | | | |
| | SM | 3.0'- 4.0' Dense to very dense, slightly dry, gray, cemented silty, gravelly SAND (Glacial Till). | S-1 | Grab | 2.0 | |
| 5 | | TD 4.0'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/4/10
ESC Representative: SEW

# TEST PIT TP-12

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 180'
Test Pit Location: Building H
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with roots and rootlets, moist to wet | | | | |
| | SM | 0.5' – 3.25' Medium dense, moist, reddish tan silty SAND, with scattered gravels and cobbles, some oversized. | | | | |
| | SM | 3.25'- 4.0' Dense to very dense, dry, gray, cemented silty, gravelly SAND (Glacial Till). | S-1 | Grab | 2.0 | M.C = 12 percent |
| 5 | | TD 4.0'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/4/10
ESC Representative: SEW
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# TEST PIT TP-13

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 195'
Test Pit Location: Building I
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with roots and rootlets, moist to wet | | | | |
| | SM | 0.5' – 2.5'Medium dense, moist, reddish tan silty SAND, with scattered gravels and cobbles, some oversized. | | | | |
| | SM | 2.5'-3.0' Medium dense, moist, mottled reddish tan and gray silty SAND (Weathered Till). | | | | |
| | SM | 3.0'- 4.0' Dense to very dense, dry, gray, cemented silty, gravelly SAND (Glacial Till). | | | | |
| 5 | | TD 4.0' | | | | |
| | | No sloughing | | | | |
| | | No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/4/10
ESC Representative: SEW

## TEST PIT TP-14

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 165'
Test Pit Location: Building F
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with roots and rootlets, moist to wet | S-1 | Grab | S-1 | |
| | SM | 0.5' – 2.5' Medium dense, moist, reddish tan silty SAND, with scattered gravels and cobbles, some oversized with one large rock. | | | | |
| | SM | 2.5'- 4.0' Dense to very dense, dry, gray, cemented silty, gravelly SAND (Glacial Till). | | | | |
| 5 | | TD 4.0'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/4/10
ESC Representative: SEW

# TEST PIT TP-15

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 167'
Test Pit Location: Building E
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with roots and rootlets, moist to wet | S-1 | Grab | 1.5 | M.C. = 10 percent<br>-200 = 18.4 percent |
| | SM | 0.5' – 2.5' Medium dense, moist, reddish tan silty SAND, with scattered gravels and cobbles. | | | | |
| | SM | 2.5'- 4.0' Dense to very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | | | | |
| 5 | | TD 4.0'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/4/10
ESC Representative: SEW

# TEST PIT TP-16

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 180'
Test Pit Location: Building G
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with roots and rootlets, moist to wet | | | | |
| | SM | 0.5' – 3.0' Medium dense, moist, reddish tan silty SAND, with trace gravels and cobbles. | | | | |
| | SM | 3.0'- 4.0' Dense to very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | | | | |
| 5 | | TD 4.0'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/4/10
ESC Representative: SEW

# TEST PIT TP-17

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 140'
Test Pit Location: Building Senior Living Center
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with roots and rootlets, moist to wet | | | | |
| | SM | 0.5' – 2.0' Medium dense, moist, reddish tan silty SAND, with scattered gravels and cobbles, one large rock. | S-1 | Grab | 1.5 | |
| | SM | 2.0'- 2.5' Medium dense, moist, mottled reddish tan and gray silty SAND, (Weathered Till). | | | | |
| | SM | 3.0'- 4.0' Dense to very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | | | | |
| 5 | | TD 4.0' | | | | |
| | | No sloughing | | | | |
| | | No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/5/10
ESC Representative: SEW

# TEST PIT TP-18

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 135'
Test Pit Location: Building Senior Living Center
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with roots and rootlets, moist to wet | | | | |
| | SM | 0.5' – 2.5'Medium dense, moist, reddish tan silty SAND, with scattered gravels and cobbles. | | | | |
| | SM | 2.5'- 3.0' Medium dense, moist, mottled reddish tan and gray silty SAND, (Weathered Till). | S-1 | Grab | 2.0 | |
| | SM | 3.0'- 5.0' Dense to very dense, gray, cemented silty, gravelly SAND (Glacial Till). | | | | |
| 5 | | TD 5.0' | | | | |
| | | No sloughing | | | | |
| | | No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/5/10
ESC Representative: SEW

# TEST PIT TP-19

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 192'
Test Pit Location: Building K
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with roots and rootlets, moist to wet | | | | |
| | SM | 0.5' – 2.5' Medium dense, moist, reddish tan silty SAND, with scattered gravels and cobbles. | S-1 | Grab | 1.0 | M.C. = 13 percent |
| | SM | 2.5'- 3.0' Medium dense, moist, mottled reddish tan and gray silty SAND, (Weathered Till). | | | | |
| | SM | 3.0'- 4.0' Dense to very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | | | | |
| 5 | | TD 4.0'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/5/10
ESC Representative: SEW

# TEST PIT TP-20

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 200'
Test Pit Location: Building L
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with roots and rootlets, moist to wet | | | | |
| | SM | 0.5' – 2.0' Medium dense, moist, reddish tan silty SAND, with trace gravels and cobbles. | S-1 | Grab | 1.0 | M.C. = 16 percent |
| | SM | 2.0'- 2.5' Medium dense, moist, mottled reddish tan and gray silty SAND, (Weathered Till). | | | | |
| | SM | 2.5'- 4.0' Dense to very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | | | | |
| 5 | | TD 4.0' | | | | |
| | | No sloughing | | | | |
| | | No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/5/10
ESC Representative: SEW
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# TEST PIT TP-21

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @205 '
Test Pit Location: Building L Parking
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with roots and rootlets, moist to wet | | | | |
| | SM | 0.5' – 1.5' Medium dense, moist, reddish tan silty SAND, with gravels and oversized rocks, slightly compacted. | | | | |
| | SM | 1.5'- 2.5' Medium dense, moist, mottled reddish tan and gray silty SAND, (Weathered Till). | | | | |
| | SM | 2.5'- 3.5' Very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | | | | |
| 5 | | TD 3.5'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/5/10
ESC Representative: SEW

# TEST PIT TP-22

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 207'
Test Pit Location: Building M
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with thick roots and rootlets, moist to wet | S-1 | Grab | 1.0 | |
| | SM | 0.5' – 2.0' Medium dense, moist, reddish tan silty SAND, with gravels and cobbles, roots to 2.0' in depth. | | | | |
| | SM | 2.0'- 2.5' Medium dense, moist, mottled reddish tan and gray silty SAND, (Weathered Till). | | | | |
| | SM | 2.5'- 4.0' Dense to very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | | | | |
| 5 | | TD 4.0' | | | | |
| | | No sloughing | | | | |
| | | No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/5/10
ESC Representative: SEW

# TEST PIT TP-23

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @220 '
Test Pit Location: Building N
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with scattered roots and rootlets, railroad ballast | | | | |
| | | 0.5' – 3.0'Medium dense, moist, reddish tan silty SAND, with | | | | |
| | SM | gravels and cobbles, roots to 2.5' in depth. | S-1 | Grab | 1.5 | M.C. = 19 percent |
| | SM | 3.0'- 3.5' Medium dense, moist, mottled reddish tan and gray silty SAND, (Weathered Till). | | | | Sand 64.3 percent<br>Silt 29.9 percent |
| | SM | 3.5'- 5.0' Dense to very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | | | | Clay 5.4 percent |
| 5 | | TD 5.0' | | | | |
| | | No sloughing | | | | |
| | | No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/5/10
ESC Representative: SEW
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## TEST PIT TP-24

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @117 '
Test Pit Location: Building N Parking
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with scattered roots and rootlets, moist to wet | | | | |
| | SM | 0.5' – 1.5' Medium dense, moist, reddish tan silty SAND, with trace gravels and cobble. | | | | |
| | SM | 1.5'- 2.0' Medium dense, moist, mottled reddish tan and gray silty SAND, (Weathered Till). | S-1 | Grab | 3.0 | M. C. = 14 percent |
| | SM | 2.0'- 3.0' Dense to very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | | | | |
| 5 | | TD 3.0' | | | | |
| | | No sloughing | | | | |
| | | No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/5/10
ESC Representative: SEW
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# TEST PIT TP-25

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @202 '
Test Pit Location: Building J
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with scattered roots and rootlets | | | | |
| | SM | 0.5' – 2.5'Medium dense, moist, reddish tan silty SAND, with trace gravels and cobbles. | S-1 | Grab | 1.0 | |
| | SM | 2.5'- 4.0' Dense to very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | | | | |
| 5 | | TD 4.0'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/5/10
ESC Representative: SEW

## TEST PIT TP-26

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 120'
Test Pit Location: Retail Building
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with scattered roots and rootlets | | | | M.C. = 13 percent |
| | | 0.5' – 2.0' Medium dense, moist, reddish tan silty SAND, with | | | | Sand 74.8 percent |
| | SM | scattered gravels and cobbles, some oversized. | S-1 | Grab | 1.0 | Silt 22.5 percent |
| | SM | 2.0'- 2.5'Mediumd dense, moist, mottled tan and gray silty SAND (Weathered Till). | | | | Clay 2.7 percent |
| | SM | 2.5'- 4.0' Dense to very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | S-2 | Grab | 3.0 | M.C. = 9.0 percent |
| 5 | | TD 4.0' | | | | |
| | | No sloughing | | | | |
| | | No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/6/10
ESC Representative: SEW

# TEST PIT TP-27

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @115 '
Test Pit Location: Retail Building Parking
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | SM | 0 – 1.0' Medium dense, moist, reddish tan silty SAND, with scattered gravels and cobbles, some broken cinder blocks near surface. | S-1 | Grab | 0.5 | |
| | SM | 1.0'- 3.0' Dense to very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | | | | |
| 5 | | TD 3.0'<br>No sloughing<br>No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/6/10
ESC Representative: SEW
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# TEST PIT TP-28

Project Name: Rose Master Plan
Client: Edward Rose & Sons
Project Number: ESC10-G031

Test Pit Elevation: @ 117'
Test Pit Location: Retail Building
Depth to Groundwater: none encountered

| DEPTH (FT.) | USGS Classification | VISUAL PHYSICAL DESCRIPTION | SAMPLE NO. | SAMPLE TYPE | SAMPLE DEPTH (FT.) | LABORATORY TESTING RESULTS FOR SAMPLE |
|---|---|---|---|---|---|---|
| 0 | OL | 0 – 0.5' Forest Duff with scattered roots and rootlets | | | | |
| | SM | 0.5' – 1.5' Medium dense, moist, reddish tan silty SAND, with scattered gravels and cobbles, some oversized. | | | | |
| | SP | 1.5'- 2.5' Medium dense, moist, tan gravelly, coarse SAND (Glacial Outwash) with cobbles. | S-1 | Grab | 2.0 | |
| | SM | 2.5'- 4.5' Dense to very dense, slightly moist, gray, cemented silty, gravelly SAND (Glacial Till). | | | | |
| 5 | | TD 4.5' | | | | |
| | | No sloughing | | | | |
| | | No seepage | | | | |
| 10 | | | | | | |
| 15 | | | | | | |

Excavation Contractor: SAW Enterprises
Equipment: Track hoe
Operator: Todd

Excavation Date: 11/6/10
ESC Representative: SEW