associated earth sciences incorporated

Subsurface Exploration, Geologic Hazard, and Preliminary Geotechnical Engineering Report

FLOYD ASSEMBLAGE

Sammamish, Washington

Prepared For:

TOLL BROS., INC.

Project No. 190151E001
June 25, 2019

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June 25, 2019
Project No. 190151E001

Toll Bros., Inc.
8815 122nd Avenue
Kirkland, Washington 98033

Attention: Mr. Jeff Peterson

Subject: Subsurface Exploration, Geologic Hazard, and
Preliminary Geotechnical Engineering Report
Floyd Assemblage
King County, Washington

Dear Mr. Peterson:

We are pleased to present the enclosed copy of the referenced report. This report summarizes the results of our subsurface exploration, geologic hazard, and geotechnical engineering studies and offers preliminary recommendations for the design and development of the proposed project.

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

Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

Kurt D. Merriman, P.E.
Senior Principal Engineer

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SUBSURFACE EXPLORATION, GEOLOGIC HAZARD, AND PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

FLOYD ASSEMBLAGE

King County, Washington

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I. PROJECT AND SITE CONDITIONS

1.0 INTRODUCTION

This report presents the results of our subsurface exploration, geologic hazard, and preliminary geotechnical engineering study for the proposed new residential subdivision referred to as the Floyd Assemblage. The site location is shown on the "Vicinity Map," Figure 1. The approximate locations of explorations completed for this study are shown on the "Site and Exploration Plan," Figure 2. Interpretive exploration logs are included in Appendix A. This report is based on an untitled, undated site plan provided by Toll Bros., Inc. (Toll). The conclusions and recommendations contained in this report should be reviewed by Associated Earth Sciences, Inc. (AESI) and modified, or verified, if project plans change substantially.

1.1 Purpose and Scope

The purpose of this study was to provide subsurface data to be used in the design of the project. Our study included a review of selected geologic literature, excavating exploration pits, and performing geologic studies to assess the type, thickness, distribution, and physical properties of the subsurface sediments and shallow groundwater. Geotechnical engineering studies were completed to formulate our recommendations for site preparation and grading, the type of suitable foundations and floors, allowable foundation soil bearing pressure, anticipated foundation and floor settlement, pavement recommendations, and drainage and infiltration considerations. This report summarizes our fieldwork and offers preliminary recommendations for development based on our present understanding of the project. We recommend that we be allowed to review project plans prior to finalization and update the recommendations in this report as needed.

1.2 Authorization

This report has been prepared for the exclusive use of Toll and its agents for specific application to this project. Our work was performed in accordance with our scope of work and cost proposal, dated April 19, 2019. We were authorized to proceed by means of a consultant agreement. Within the limitations of scope, schedule, and budget, our services have been performed in accordance with generally accepted geotechnical engineering and engineering geology practices in effect in this area at the time our report was prepared. No other warranty, express or implied, is made.

2.0 PROJECT AND SITE DESCRIPTION

The subject site consists of three residential parcels with a combined area of about 5.9 acres in the Sammamish area of King County, Washington (King County Parcel Nos. 2625069055, 2625069029, and 2625069007). The site is bounded to the north by NE 18th Street and on all other sides by single-family, residential development. Two existing, single-family residences occupy the site. Allen Creek traverses the site near the eastern boundary and a wetland complex occupies the southern half of the eastern parcel. The terrain is relatively flat across the site except near the western boundary, which slopes up to the west. Vegetation across the site varies from grass lawn and landscaping to forested. At the time of our visit, Allen Creek was flowing. Standing surface water was not observed onsite in readily visible areas of the wetlands near our exploration locations; some wetland areas onsite were not accessed or were obscured by vegetation.

Based on the draft site plan, we understand that the project will consist of removal of the existing residences and construction of about 17 new, single-family residences, an access road, and a stormwater detention vault. The wetland and stream areas will remain undeveloped.

3.0 SUBSURFACE EXPLORATION

Our field study included observation of the excavation of five exploration pits and installing one groundwater monitoring piezometer. The locations of the exploration pits shown on the "Site and Exploration Plan" (Figure 2) were surveyed by Toll and superimposed on a site survey, "24407 NE 18th, ALTA/NSPS Land Title Survey," dated August 29, 2018, by Mead Gilman Land Surveyors. Interpretive exploration logs are presented in Appendix A. The various types of sediments, as well as the depths where characteristics of the sediments changed, are indicated on the exploration logs presented in Appendix A. The depths indicated on the logs where conditions changed may represent gradational variations between sediment types in the field.

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

3.1 Exploration Pits

The exploration pits, EP-1 through EP-5, were excavated using a tracked excavator under subcontract to AESI. The pits permitted direct, visual observation of subsurface conditions. Materials encountered in the exploration pits were studied and classified in the field by an engineer from our firm. All exploration pits were backfilled after examination and logging. Selected samples were then transported to our laboratory for further visual classification and testing, as necessary.

3.2 Well Point Piezometer

A well point is a piezometer that is less than 10 feet deep relative to existing grade. Because the well point is less than 10 feet in depth, the installation is exempt from the requirements of Chapter 173-160 *Washington Administrative Code* (WAC) – Minimum Standards for Construction and Maintenance of Wells. We installed one well point piezometer, WP-1, in EP-3 before backfilling. The piezometer consisted of a 10-foot-long, 2-inch inside-diameter, polyvinyl chloride (PVC) pipe, 2 feet long, 20-slot screen, and a punctured, glued-on end cap. The piezometer was set with the screened end at approximately the center of the bottom of the exploration pit and then the pit was backfilled with the excavated soils. The top of the piezometer was covered with a PVC slip cap. Several hours after installing the piezometer, the groundwater in the piezometer was measured at approximately 8 feet below the ground surface. The piezometer was then developed. Development consisted of adding approximately 1 liter of water to the piezometer and then immediately measuring the water level, which was 8 feet below the ground surface.

The well point WP-1 was dry when measured on May 31, 2019.

4.0 SUBSURFACE CONDITIONS

Subsurface conditions at the project site were inferred from the field explorations accomplished for this study, visual reconnaissance of the site, and review of selected geologic literature. The general distribution of geologic units is shown on the exploration logs. The explorations encountered native materials consisting of loose to medium dense Vashon recessional outwash, overlain in areas by topsoil or artificial fill and underlain at one exploration location by dense Vashon lodgement till sediments.

4.1 Stratigraphy

The following section presents more detailed subsurface information organized from the youngest (shallowest) to the oldest (deepest) soil types.

Topsoil

A surficial topsoil soil layer was encountered in EP1, EP-3, and EP-4 and generally consisted of loose, silty sand with abundant organic material. The topsoil layer ranged from approximately 1 to 12 inches in thickness; observed topsoil thickness is shown on the exploration logs. In EP-1 and EP-3, the topsoil appears to be the product of the in-place weathering of underlying native soils. In EP-4, the topsoil layer included approximately 3 inches of sod. Due to its high organic content, topsoil is not considered suitable for foundation, roadway, or slab-on-grade floor support, or for use in a structural fill.

Artificial Fill

At the surface in EP-2 and EP-5 and underlying the topsoil in EP-4, we observed highly variable sediments interpreted as artificial fill sediments (those not naturally placed). In EP-2, fill consisted of loose grading to dense, brown to black, silty, fine to medium sand with wood debris and occasional cobbles, and extended to a depth of approximately 4 feet. In EP-4, fill consisted of medium dense, reddish brown, gravelly, silty, medium sand with abundant cobbles, and extended to a depth of approximately 4 feet. In EP-5, fill consisted of gray, gravelly, sandy silt and a thin layer of organic-rich soil interpreted as buried topsoil. In EP-5, fill extended to a depth of approximately 2 feet. Artificial fill should be expected locally throughout the site, such as in utility trenches and around existing foundations. Due to their potentially high organic content and variable density, existing artificial fill is not considered suitable for foundation support.

Vashon Recessional Outwash

Underlying the topsoil or fill in all explorations except EP-4, sediments encountered typically consisted of loose to medium dense, fine to medium sand ranging to sandy to very sandy gravel, areas of occasional to frequent cobbles. The recessional outwash was stratified, with layers of trace silt to silty, trace gravel to gravelly, and, in EP-1, occasional clasts of consolidated soil. Recessional outwash was observed to the full depths explored of 9-, 8-, 9-, and 7 feet in EP-1, EP-2, EP-3, and EP-5, respectively. In EP-1, EP-3, and EP-5, the upper 1 to 2 feet of recessional outwash was weathered, characterized by an orange color, a looser density, and higher silt content. Vashon recessional outwash sediments were deposited by meltwater streams flowing from the receding Vashon glacier approximately 10,000 years ago. The weathered condition was created by natural processes of freeze-thaw and bioturbation by roots and animals. Recessional outwash is typically suitable for reuse in structural fill and, if it can be compacted to medium dense or denser, for support of lightly-loaded structures such as roadways and slabs-on-grade.

Vashon Lodgement Till

Underlying the artificial fill in EP-4, we observed about 1 foot of native sediments beneath the fill. However, the excavator operator encountered refusal due to difficult digging. The limited exposure consisted of dense, silty, gravelly, fine to medium sand with abundant cobbles tentatively interpreted as Vashon-age lodgement till.

Lodgement till was deposited at the base of an active ice sheet and was subsequently compacted by the weight of the overlying glacial ice. Lodgement till typically possesses high-strength and low-compressibility attributes that are favorable for support of foundations, floor slabs, and paving, with proper preparation. Lodgement till is silty and moisture-sensitive. Careful management of moisture-sensitive soils, as recommended in this report, will be needed to reduce the potential for disturbance of wet lodgement till soils and costs associated with repairing disturbed soils.

4.2 Review of Published Geologic and Soils Literature

We reviewed published geologic maps of the project area, the *Geologic Map of the East Half of the Bellevue South 7.5' x 15' Quadrangle, Issaquah Area, King County, Washington*, by D.B. Booth, T.J. Walsh, K.G. Troost, and S.A. Shimel, 2012 and the *Geologic Map of the Redmond Quadrangle, King County, Washington*, by J.P. Minard and D.B. Booth, 1988. The referenced maps indicate that the site is expected to be underlain at shallow depths by Vashon lodgement recessional outwash deposits, with Vashon lodgement till mapped at higher elevations nearby. Our on-site explorations and interpretations are generally consistent with the conditions depicted on the published map.

4.3 Laboratory Testing

Two laboratory grain-size (sieve) analyses were performed by AESI's in-house laboratory on representative samples collected during our subsurface explorations. The sieves were conducted on Vashon recessional outwash from EP-2 and EP-5 from depths of approximately 6.5 to 7 feet and 7 feet, respectively. The sieve results are presented in Appendix B. Based on the *American Society for Testing and Materials* (ASTM) D-2487 Unified Soil Classification System (USCS), the grain-size analysis test results indicate that the recessional outwash correlates to a sandy to very sandy gravel with trace silt. The fines content in the recessional outwash in the sample from EP-2 was 2.4 percent and in the sample from EP-5 was 2.8 percent.

4.4 Hydrology

All explorations except EP-4 encountered groundwater and groundwater seepage within the recessional outwash at the depths of 6 to 9 feet noted on the exploration logs, corresponding to approximate elevations 333 to 334 feet. Approximate elevations are based on a untitled, undated spot survey provided by ESE Consultants, Inc. by email on May 8, 2019. We interpret the observed groundwater as an unconfined aquifer within the recessional outwash, likely perched on underlying glacial till. We interpret that Allen Creek and the on-site wetlands may interact directly with groundwater in the recessional outwash. Based on our observations onsite and other experience in the area, we interpret groundwater flow as being to the north.

It should be noted that fluctuations in the level of groundwater may occur due to time of year and variations in the amount of rainfall. The quantity and duration of groundwater will vary depending on season, topography, and soil grain size.

II. GEOLOGIC HAZARDS AND MITIGATIONS

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

5.0 LANDSLIDE HAZARDS

The referenced topographic survey shows that the site is generally characterized by flat areas with isolated slopes of gentle to moderate inclination and low slope heights. We reviewed the King County iMap web application and no portion of the site or adjacent properties are mapped as a landslide hazard area, potential landslide hazard area, or potential steep slope hazard area. Based on the absence of significant slopes at or near the site, the risk to the proposed project by landsliding is considered low.

6.0 SEISMIC HAZARDS AND MITIGATIONS

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

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

6.1 Surficial Ground Rupture

Generally, the largest earthquakes that have occurred in the Puget Sound area are sub-crustal events with epicenters ranging from 50 to 70 kilometers in depth. Earthquakes that are generated at such depths usually do not result in fault rupture at the ground surface. Current research indicates that surficial ground rupture is possible in areas close to the Seattle and South Whidbey Island Fault Zones. Although our current understanding of these fault zones is limited and an active area of research, the site lies approximately 2 miles north of the nearest, currently mapped trace of the Seattle Fault Zone and approximately 7 miles south of the nearest trace of the South Whidbey Island Fault Zone. Therefore, based on current information, the risk of damage to planned improvements as a result of surface rupture due to faulting is low, in our opinion.

6.2 Seismically Induced Landslides

Based on the absence of significant slopes at or near the site, the risk to the proposed project by seismically induced landsliding is considered low.

6.3 Liquefaction

Liquefaction is a process through which unconsolidated soil loses strength as a result of vibrations, such as those which occur during a seismic event. During normal conditions, the weight of the soil is supported by both grain-to-grain contacts and by the fluid pressure within the pore spaces of the soil below the water table. Extreme vibratory shaking can disrupt the grain-to-grain contact, increase the pore pressure, and result in a temporary decrease in soil shear strength. The soil is said to be liquefied when nearly all of the weight of the soil is supported by pore pressure alone. Liquefaction can result in deformation of the sediment and settlement of overlying structures. Areas most susceptible to liquefaction include those areas underlain by non-cohesive silt and sand with low relative densities and uniform grain size, accompanied by a shallow water table.

Our explorations encountered artificial fill, recessional outwash, and lodgement till soils. The artificial fill and lodgement till were not saturated and therefore are not considered susceptible to liquefaction. The recessional outwash consisted of unconsolidated, granular sediments and was observed in some explorations to be below the groundwater table (saturated) and may be considered potentially susceptible to liquefaction. However, the recessional outwash generally graded from looser density near the ground surface to medium dense with depth and was observed in our field explorations and grain-size analyses to be well-graded. Based on the increasing density with the depth and the well-graded characteristic of the recessional outwash, it is our opinion that the risk of damage to the proposed development by liquefaction of the sediments is low.

On the King County *Liquefaction Susceptibility Map* (2004), the site is mapped within an area of “very low” liquefaction susceptibility.

6.4 Ground Motion/Seismic Site Class (2015 *International Building Code*)

Structural design of the buildings should follow 2015 *International Building Code* (IBC) standards. We recommend that the project be designed in accordance with Site Class “D,” as defined in IBC Table 20.3-1 of *American Society of Civil Engineers* (ASCE) *7 – 10 Minimum Design Loads for Buildings and Other Structures*.

6.5 Erosion Control

Some of the site soils, such as topsoil, artificial fill, and lodgement till, have significant silt content and are considered susceptible to erosion when disturbed or exposed to surface water. In order to mitigate erosion hazard at the site, project plans should include implementation of temporary erosion controls in accordance with local standards of practice. Control methods should include limiting earthwork to seasonally drier periods, typically April 1 to October 31, use of perimeter silt fences, and straw mulch in exposed areas. Removal of existing vegetation should be limited to those areas that are required to construct the project, and new landscaping and vegetation with equivalent erosion mitigation potential should be established as soon as possible after grading is complete. During construction, surface water should be collected as close as possible to the source to minimize silt entrainment that could require treatment or detention prior to discharge. Timely implementation of permanent drainage control measures should also be a part of the project plans and will help reduce erosion and generation of silty surface water onsite.

III. PRELIMINARY DESIGN RECOMMENDATIONS

7.0 INTRODUCTION

Our exploration indicates that, from a geotechnical engineering standpoint, the proposed project is feasible provided the recommendations contained herein are properly followed. Shallow foundation can bear on native soils prepared as described herein. Stormwater infiltration may be feasible into the recessional outwash; additional subsurface explorations and analyses would be required to determine a design infiltration rate and seasonal high groundwater. The following report sections provide additional recommendations regarding site preparation, grading, foundations, floor support, drainage, paving, and stormwater vault construction.

8.0 SITE PREPARATION

Site preparation of building and paving areas should include removal of all grass, trees, brush, debris, demolition debris, and any other deleterious materials. Existing fill should be removed from below planned foundation areas. Buried utilities should be removed from foundation areas, and should be abandoned in place or removed from below planned new paving. Any depressions below planned final grades should be backfilled with structural fill, as discussed under the "Structural Fill" section of this report.

Existing topsoil should be stripped from structural areas. The actual observed in-place depth of topsoil and grass at the exploration locations is presented on the exploration logs in Appendix A. After stripping, remaining roots and stumps should be removed from structural areas. All native soils disturbed by stripping and grubbing operations should be recompacted as recommended in the "Structural Fill" section of this report.

Once excavation to subgrade elevation is complete, the resulting surface should be proof-rolled with a loaded dump truck or other suitable equipment. Any soft, loose, yielding areas should be excavated to expose suitable bearing soils. The subgrade should then be compacted to at least 95 percent of the modified Proctor maximum dry density, as determined by the ASTM D-1557 test procedure. Structural fill can then be placed to achieve desired grades, if needed.

8.1 Temporary Cut Slopes

In our opinion, stable construction slopes should be the responsibility of the contractor and should be determined during construction. For estimating purposes, however, temporary, unsupported cut slopes can be planned at 1.5H:1V (Horizontal:Vertical) in unsaturated existing fill and recessional outwash sediments. Temporary slopes of 1.0H:1V can be planned in unsaturated lodgement till sediments.

These slope angles are for areas where groundwater seepage is not present at the faces of the slopes, which may require temporary dewatering in the form of pumped sumps or other measures. If ground or surface water is present when the temporary excavation slopes are exposed, flatter slope angles may be required. Groundwater was encountered at the depths noted on the exploration logs in Appendix A and was discussed in the "Hydrology" section in this report. As is typical with earthwork operations, some sloughing and raveling may occur, and cut slopes may have to be adjusted in the field. In addition, WISHA/OSHA regulations should be followed at all times.

8.2 Excavation Dewatering

We anticipate that construction of the vault and remaining buried utilities may require excavation below depths where groundwater seepage was observed in our subsurface explorations. We anticipate that groundwater seepage will be controllable with conventional dewatering methods such as trenches and pumped sumps. Dewatering considerations should be addressed as the grading and utility plans are developed. Dewatering plans are outside of the scope of this study.

8.3 Site Disturbance

The existing fill, portions of the recessional outwash, and the lodgement till soils contain fine-grained material, which makes them moisture-sensitive and subject to disturbance when wet. The contractor must use care during site preparation and excavation operations so that the underlying soils are not softened. If disturbance occurs, the softened soils should be removed and the area brought to grade with structural fill.

8.4 Wet Weather and Winter Construction

The existing fill and lodgement till sediments contain substantial silt and are considered highly moisture-sensitive. Soils excavated onsite may require drying during favorable dry weather conditions to allow their reuse in structural fill applications. Care should be taken to seal all earthwork areas during mass grading at the end of each workday by grading all surfaces to drain and sealing them with a smooth-drum roller. Stockpiled soils that will be reused in structural fill applications should be covered whenever rain is possible.

If winter construction is expected, crushed rock fill could be used to provide construction staging areas. The stripped subgrade should be observed by the geotechnical engineer, and should then be covered with a geotextile fabric, such as Mirafi 500X or equivalent. Once the fabric is placed, we recommend using a crushed rock fill layer at least 10 inches thick in areas where construction equipment will be used.

9.0 STRUCTURAL FILL

All references to structural fill in this report refer to subgrade preparation, fill type, placement, and compaction of materials, as discussed in this section. If a percentage of compaction is specified under another section of this report, the value given in that section should be used. For backfill of buried utilities in the right-of-way, the backfill should be placed and compacted in accordance with the King County codes and standards.

After stripping, planned excavation, and any required overexcavation have been performed to the satisfaction of the geotechnical engineer/engineering geologist, the surface of the exposed ground should be recompacted to a firm and unyielding condition. If the subgrade contains too much moisture, adequate recompaction may be difficult or impossible to obtain, and should probably not be attempted. In lieu of recompaction, the area to receive fill should be blanketed with washed rock or quarry spalls to act as a capillary break between the new fill and the wet subgrade. Where the exposed ground remains soft and further overexcavation is impractical, placement of an engineering stabilization fabric may be necessary to prevent contamination of the free-draining layer by silt migration from below.

After recompaction of the exposed ground is tested and approved, or a free-draining rock course is laid, structural fill may be placed to attain desired grades. Structural fill is defined as non-organic soil, acceptable to the geotechnical engineer, placed in maximum 8-inch loose lifts, with each lift being compacted to 95 percent of ASTM D-1557. The top of the compacted fill should extend horizontally outward a minimum distance of 3 feet beyond the locations of the perimeter footings or roadway edges before sloping down at a maximum angle of 2H:1V.

The contractor should note that any proposed fill soils should be evaluated by AESI prior to their use in fills. This would require that we have a sample of the material at least 72 hours in advance to perform a Proctor test and determine its field compaction standard.

Soils in which the amount of fine-grained material (smaller than the No. 200 sieve) is greater than approximately 5 percent (measured on the minus No. 4 sieve size) should be considered moisture-sensitive. Portions of the recessional outwash, and lodgement till soils are estimated to contain substantially more than 5 percent fine-grained material. Use of moisture-sensitive soil in structural fills should be limited to favorable dry weather and dry subgrade conditions. Construction equipment traversing the site when the soils are wet can cause considerable disturbance.

If fill is placed during wet weather or if proper compaction cannot be obtained, a select, import material consisting of a clean, free-draining gravel and/or sand should be used. Free-draining fill consists of non-organic soil, with the amount of fine-grained material limited to 5 percent by weight when measured on the minus No. 4 sieve fraction, and at least 25 percent retained on the No. 4 sieve.

In order to reuse excavated on-site soils in structural fill applications, it will be necessary to moisture-condition wet site soils by aeration and drying during favorable dry weather conditions. Alternatives to drying site soils include using imported granular soils suitable for use in structural fill, or possibly treating wet soils with Portland cement.

10.0 INFILTRATION FEASIBILITY

The feasibility of stormwater infiltration depends upon the presence of a suitable receptor soil of sufficient thickness, extent, permeability, and vertical separation from groundwater. Site soils were observed to consist of existing fill, recessional outwash, and lodgement till. Existing fill is not considered suitable for infiltration. Lodgement till generally has low permeability due to its high fines content and high density and is not considered suitable as an infiltration receptor. Recessional outwash is typically permeable and was observed in several areas of the site. Limited infiltration may be feasible into recessional outwash provided the minimum required separation between the bottom of any proposed infiltration facility and seasonal high groundwater can be maintained. The depth to groundwater ranged from 6 to 9 feet at the time of our exploration. Groundwater would be shallower during the wetter, winter months. Additional field studies would be necessary to determine whether sufficient unsaturated thickness is present, to estimate a design infiltration rate and monitor seasonal high groundwater levels. We understand that a stormwater detention vault is proposed for the project.

11.0 FOUNDATIONS

Spread footings may be used for building support when they are founded on approved structural fill placed as described above, or on undisturbed recessional outwash or lodgement till soils that are prepared as recommended in this report. Based on our observations, suitable foundation bearing soils are expected to be up to about 5 feet below existing grade in some areas.

Recommendations for stormwater vault foundations are presented later in this report. For residential structures, footings may be designed for an allowable foundation soil bearing pressure of 2,500 pounds per square foot (psf), including both dead and live loads. An increase of one-third may be used for short-term wind or seismic loading. Perimeter footings should be buried at least 18 inches into the surrounding soil for frost protection. However, all foundations must penetrate to the prescribed bearing strata, and no foundations should be constructed in or above loose, organic, or existing fill soils.

Anticipated settlement of footings founded as recommended should be on the order of 1 inch or less, with differential settlement of ½ inch or less. However, disturbed material not removed from footing trenches prior to footing placement could result in increased settlements. All footing areas should be inspected by AESI prior to placing concrete to verify that the foundation subgrades are undisturbed and construction conforms to the recommendations contained in this report. Such inspections may be required by King County. Perimeter footing drains should be provided as discussed under the “Drainage Considerations” section of this report.

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

12.0 FLOOR SUPPORT

If crawl-space floors are used, an impervious moisture barrier should be provided above the soil surface within the crawl space. Slab-on-grade floors may be used over medium dense to dense native soils, or over structural fill placed as recommended in the “Site Preparation” and “Structural Fill” sections of this report. Slab-on-grade floors should be cast atop a minimum of 4 inches of washed pea gravel or washed crushed “chip” rock with less than 3 percent passing the U.S. No. 200 sieve to act as a capillary break. The floors should also be protected from dampness by covering the capillary break layer with an impervious moisture barrier at least 10 mils in thickness.

13.0 DRAINAGE CONSIDERATIONS

All footings, basement walls, and retaining walls should be provided with a drain at the footing elevation. Drains should consist of rigid, perforated, PVC pipe surrounded by washed pea gravel. The level of the perforations in the pipe should be set downward and at the bottom of the footing at all locations, and the drain collectors should be constructed with sufficient gradient to allow gravity discharge away from the buildings. In addition, all foundation walls taller than 3 feet should be lined with a minimum, 12-inch-thick, washed gravel blanket drain provided to within 1 foot of finish grade that ties into the footing drain. A prefabricated drainage mat is not an acceptable alternative to the gravel blanket drain unless the entire excavation backfill consists of free-draining structural fill. Roof and surface runoff should not discharge into the footing drain system, but should be handled by a separate, rigid, tightline drain.

In planning, exterior grades adjacent to foundations should be sloped downward away from the structures to achieve surface drainage. These recommendations apply to conventional shallow foundation walls and landscape walls less than about 4 feet tall. One should refer to the following section for walls up to 10 feet tall.

14.0 CAST-IN-PLACE RETAINING WALLS AND BASEMENT WALLS

All backfill behind foundation walls or around foundation units should be placed as per our recommendations for structural fill and as described in this section of the report. Horizontally backfilled walls that are free to yield laterally at least 0.1 percent of their height may be designed using an equivalent fluid pressure equal to 35 pounds per cubic foot (pcf). Fully restrained, horizontally backfilled, rigid walls that cannot yield should be designed for an equivalent fluid pressure of 50 pcf. Walls with sloping backfill up to a maximum gradient of 2H:1V should be designed using an equivalent fluid pressure of 55 pcf for yielding conditions or 75 pcf for fully restrained conditions. If parking areas are adjacent to walls, a surcharge equivalent to 2 feet of soil should be added to the wall height in determining lateral design forces.

As required by the 2015 IBC, retaining wall design should include a seismic surcharge pressure in addition to the equivalent fluid pressures presented above. Considering the site soils and the recommended wall backfill materials, we recommend a seismic surcharge pressure of 5H and 10H psf, where H is the wall height in feet for the “active” and “at-rest” loading conditions, respectively. The seismic surcharge should be modeled as a rectangular distribution with the resultant applied at the midpoint of the walls.

The lateral pressures presented above are based on the conditions of a uniform backfill consisting of excavated on-site soils, or imported structural fill compacted to 90 percent of ASTM D-1557. A higher degree of compaction is not recommended, as this will increase the pressure acting on the walls. A lower compaction may result in settlement of the slab-on-grade or other structures supported above the walls. Thus, the compaction level is critical and must be tested by our firm during placement. Surcharges from adjacent footings or heavy construction equipment must be added to the above values. Perimeter footing drains should be provided for all retaining walls, as discussed under the “Drainage Considerations” section of this report.

It is imperative that proper drainage be provided so that hydrostatic pressures do not develop against the walls. This would involve installation of a minimum 1-foot-wide blanket drain to within 1 foot of finish grade for the full wall height using imported, washed gravel against the walls. If situations exist where a footing drain is not feasible for a foundation wall or retaining wall, the wall should be designed for saturated lateral earth pressures and a hydrostatic surcharge. We should be allowed to offer situation-specific recommendations if this situation arises. The use of drainage improvements as recommended herein does not alleviate the need for waterproofing where finished spaces are planned on the interior side of basement walls. Backfilled walls with finished interior space should be waterproofed in accordance with recommendations of the building designer.

14.1 Passive Resistance and Friction Factors

Lateral loads can be resisted by friction between the foundation and the native soils or supporting structural fill soils, and by passive earth pressure acting on the buried portions of the foundations. The foundations must be backfilled with structural fill and compacted to at least 95 percent of the maximum dry density to achieve the passive resistance provided below. We recommend the following allowable design parameters:

- Passive equivalent fluid = 250 pcf
- Coefficient of friction = 0.35

15.0 PAVEMENT RECOMMENDATIONS

We understand that the proposed project will include construction of a paved access road and driveways. Pavement areas should be prepared in accordance with the “Site Preparation” section of this report. If the stripped native soil or existing fill pavement subgrade can be compacted to a firm and unyielding condition as determined by the geotechnical engineer, no additional overexcavation is required. Soft or yielding areas should be overexcavated to provide a suitable subgrade and backfilled with structural fill.

The pavement sections included in this report section are for streets and parking areas onsite and are not applicable to right-of-way improvements. If any new paving of public streets is required, we should be allowed to offer situation-specific recommendations.

The exposed ground should be recompacted to 95 percent of ASTM D-1557. If required, structural fill may then be placed to achieve desired base subgrades. Upon completion of the recompaction and structural fill, a pavement section consisting of 2½ inches of asphaltic concrete pavement (ACP) underlain by 4 inches of 1¼-inch crushed surfacing base course is the recommended minimum in areas of planned passenger car driving and parking. In heavy traffic areas, a minimum pavement section consisting of 3 inches of ACP underlain by 2 inches of

$^5/_8$-inch crushed surfacing top course and 4 inches of 1¼-inch crushed surfacing base course is recommended. The crushed rock courses must be compacted to 95 percent of the maximum density, as determined by ASTM D-1557. All paving materials should meet gradation criteria contained in the current Washington State Department of Transportation (WSDOT) Standard Specifications.

Depending on construction staging and desired performance, the crushed base course material may be substituted with asphalt treated base (ATB) beneath the final asphalt surfacing. The substitution of ATB should be as follows: 4 inches of crushed rock can be substituted with 3 inches of ATB, and 6 inches of crushed rock may be substituted with 4 inches of ATB. ATB should be placed over a native or structural fill subgrade compacted to a minimum of 95 percent relative density, and a 1½- to 2-inch thickness of crushed rock to act as a working surface. If ATB is used for construction access and staging areas, some rutting and disturbance of the ATB surface should be expected. The general contractor should remove affected areas and replace them with properly compacted ATB prior to final surfacing.

16.0 DETENTION STRUCTURE CONSIDERATIONS

We understand that a stormwater detention vault is under consideration near the north-central portion of the site. The detention vault foundations are expected to be supported entirely on medium dense recessional outwash and may be designed using an allowable foundation soil bearing pressure of 3,000 psf. The detention vault may be designed to resist at-rest lateral earth pressures as described in Section 14.0 of this report assuming drained conditions. If it is not possible to construct the vault with a foundation drain, or if the vault bottom elevation is below the groundwater table, hydrostatic surcharges must be incorporated and a lateral pressure of 90 pcf (equivalent fluid) should be assumed, representing combined soil and hydrostatic loads, under active conditions. If paved surfaces are to be constructed above the backfill soils, lateral pressures should include a uniform traffic surcharge of equivalent to 2 additional feet of soil depth.

17.0 PROJECT DESIGN AND CONSTRUCTION MONITORING

This report is based on a site plan that was current at the time this report was written. We are available to provide additional geotechnical consultation as the project design develops and possibly changes from that upon which this report is based. We recommend that AESI perform a geotechnical review of the plans prior to construction. In this way, our earthwork and foundation recommendations may be properly interpreted and implemented in the design.

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

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

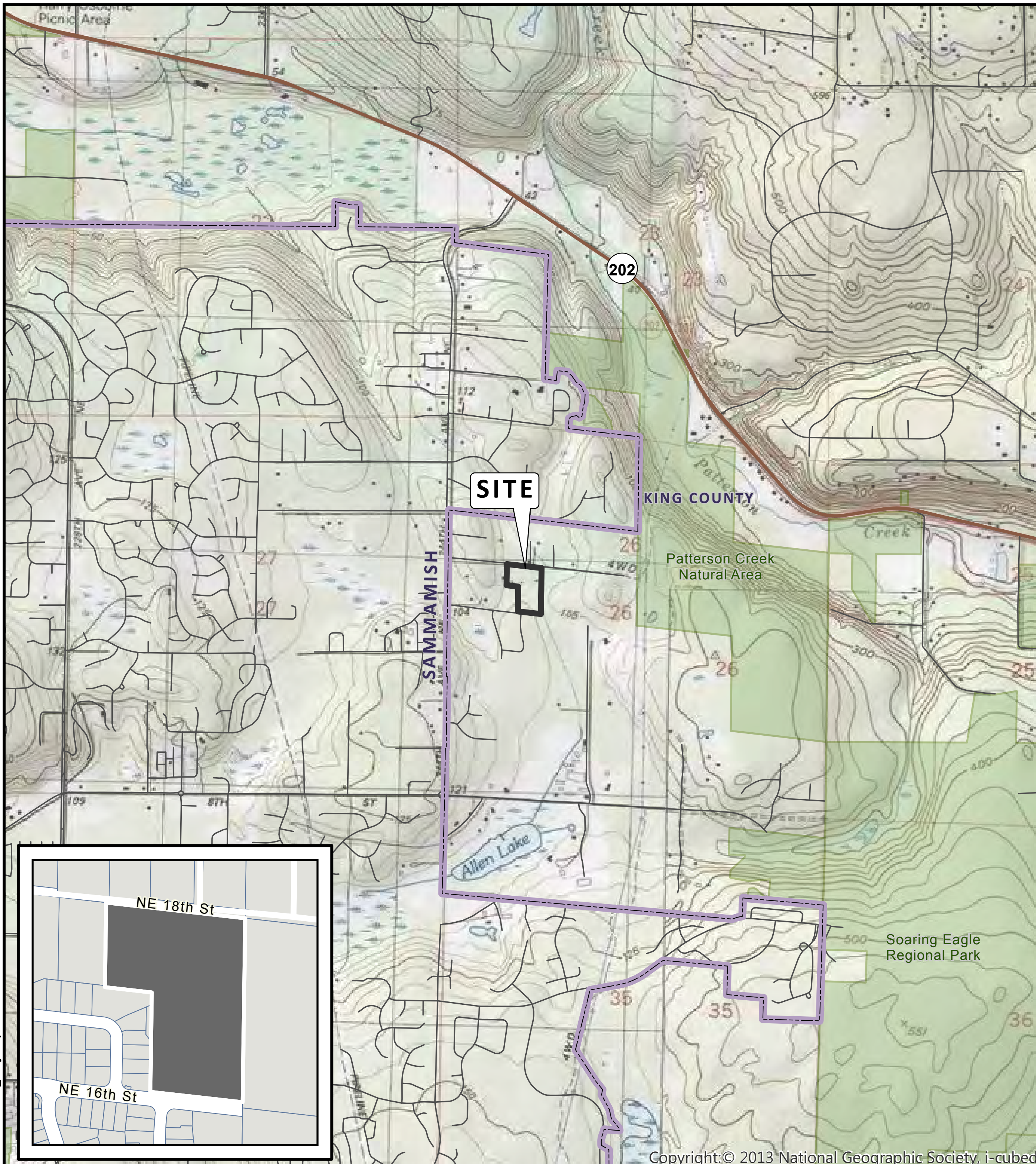
Sincerely,
ASSOCIATED EARTH SCIENCES, INC.
Kirkland, Washington

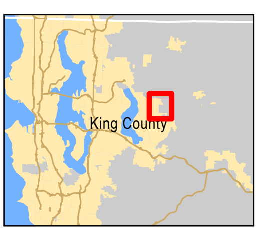
KURT D. MERRIMAN
STATE OF WASHINGTON
23580
REGISTERED
PROFESSIONAL ENGINEER
6-26-19

Nicki Shobert, E.I.T.
Senior Staff Engineer

Kurt D. Merriman, P.E.
Senior Principal Engineer

Attachments: Figure 1: Vicinity Map
Figure 2: Site and Exploration Plan
Appendix A: Exploration Logs
Appendix B: Grain-Size Analyses





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VICINITY MAP

FLOYD ASSEMBLAGE
KING COUNTY, WASHINGTON

PROJ NO.	DATE:	FIGURE:
190151E001	5/19	1

DATA SOURCES / REFERENCES:
USGS: 7.5' SERIES TOPOGRAPHIC MAPS, ESRI/I-CUBED/NGS 2013
KING CO: STREETS, CITY LIMITS 1/19, PARCELS 4/19
LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

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

Document Path: G:\GIS_Projects\aaY2019\VM\190151E001 F1 VM_Floyd.aprx

LEGEND:

EP EXPLORATION PIT

EP PIEZOMETER

CONTOUR INTERVAL = N/A

NOTE: LOCATION AND DISTANCES SHOWN ARE APPROXIMATE.

NOTES:
1. BASE MAP REFERENCE: MEAD GILMAN LAND SURVEYORS, 24407 NE 18TH, ALTA / NSPS LAND TITLE SURVEY, SHEET 2 OF 2, 8/29/18

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

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SITE AND EXPLORATION PLAN

FLOYD RESIDENCE
KING COUNTY, WASHINGTON

PROJ NO.	DATE:	FIGURE:
190151E001	5/19	2

190151 Floyd \ 190151E001 F2 S-E.cdr

APPENDIX A

Exploration Logs

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

Terms Describing Relative Density and Consistency

	Density	SPT[2] blows/foot
Coarse-Grained Soils	Very Loose	0 to 4
	Loose	4 to 10
	Medium Dense	10 to 30
	Dense	30 to 50
	Very Dense	>50
	Consistency	**SPT[2] blows/foot**
Fine-Grained Soils	Very Soft	0 to 2
	Soft	2 to 4
	Medium Stiff	4 to 8
	Stiff	8 to 15
	Very Stiff	15 to 30
	Hard	>30

Test Symbols

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

Component Definitions

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

(3) Estimated Percentage

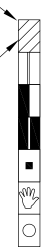
Component	Percentage by Weight
Trace	<5
Some	5 to <12
Modifier (silty, sandy, gravelly)	12 to <30
Very *modifier* (silty, sandy, gravelly)	30 to <50

Moisture Content

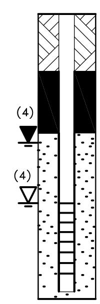
Dry - Absence of moisture, dusty, dry to the touch
Slightly Moist - Perceptible moisture
Moist - Damp but no visible water
Very Moist - Water visible but not free draining
Wet - Visible free water, usually from below water table

Symbols

Sampler Type
Blows/6" or portion of 6"
2.0" OD Split-Spoon Sampler (SPT)
Bulk sample
Grab Sample



Sampler Type Description
3.0" OD Split-Spoon Sampler
3.25" OD Split-Spoon Ring Sampler
3.0" OD Thin-Wall Tube Sampler (including Shelby tube)
Portion not recovered



Cement grout surface seal
Bentonite seal
Filter pack with blank casing section
Screened casing or Hydrotip with filter pack
End cap

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

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

LOG OF EXPLORATION PIT NO. EP-1

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered. **DESCRIPTION** Elev: 343 ft
	Topsoil / Forest Duff Loose, moist, brown to black, silty, fine to medium SAND, some gravel; abundant organics (SM).
1	**Weathered Vashon Recessional Outwash** Loose, moist, orangish brown, fine to medium SAND, some silt to silty, some gravel to gravelly; scattered roots (SP-SM).
2	**Vashon Recessional Outwash** Loose, moist, brownish gray, medium to coarse SAND, some gravel to gravelly, trace silt; scattered to frequent cobbles; weakly bedded (SP).
3	
4	Weakly bedded 2 to 7 feet.
5	Becomes grayish brown and gravelly with a small boulder and frequent cobbles.
6	
7	Becomes silty with iron oxide staining with a silty lens and small till like clasts at 7 feet.
8	Becomes very moist to wet.
9	Bottom of exploration pit at depth 9 feet Minor seepage from SE pit wall at 9 feet. Minor to moderate caving 1.5 to 7 feet.
10	
11	
12	
13	

KCTP3 190151.GPJ June 17, 2019

Floyd Assemblage
King County, WA

Logged by: NS

Approved by: JHS

associated earth sciences incorporated

Project No. 190151E001

4/24/19

LOG OF EXPLORATION PIT NO. EP-2

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered. **DESCRIPTION** Elev: 340 ft
	Wood Chips - 2 inches
	Fill
1	Loose, moist, brown to black, silty, fine to medium SAND, some gravel; occasional cobbles; occasional clasts of till like material; areas of organic debris (sticks); faint decaying organic odor (SM).
2	
3	Dense, moist to very moist, medium dense, SAND, some gravel, trace to some silt; occasional cobbles (SP-SM).
4	**Vashon Recessional Outwash**
5	Dense, moist, brown with faint iron oxide staining, fine SAND to SILT; frequent cobbles; cemented (SP/ML). Becomes moist to very moist, silty, gravelly, fine to medium SAND (SM).
6	Wet at 6 feet. Becomes very sandy gravel, trace silt (GW).
7	
8	Bottom of exploration pit at depth 8 feet Rapid seepage at 6 feet. Water pooling at 6 feet. No caving (except for possibly below water at 6 feet).
9	
10	
11	
12	
13	

Floyd Assemblage
King County, WA

Logged by: NS
Approved by: JHS

associated earth sciences incorporated

Project No. 190151E001

4/24/19

LOG OF EXPLORATION PIT NO. EP-3

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered. **DESCRIPTION** Elev: 342 ft
	Topsoil - 1 to 2 inches
	Weathered Vashon Recessional Outwash
1	Loose, moist, orangish brown, gravelly, silty, medium SAND; frequent roots (SM).
	Vashon Recessional Outwash
2	Loose to medium dense, moist to very moist, brown, gravelly, medium to coarse SAND, trace silt (SP). Weakly stratified 1.5 to 9 feet.
3	Becomes very gravelly with occasional cobbles.
4	Becomes medium dense and very moist to wet.
5	
6	Becomes some silt to silty; slightly sticky (SP-SM).
7	Iron oxide staining and tighter digging.
8	Becomes wet.
9	Bottom of exploration pit at depth 9 feet Seepage at 9 feet. Moderate to severe caving 1.5 to ~6 feet.
10	
11	<u>Well Point Construction:</u> 2-inch I.D. PVC casing 0 to 7 feet 2-inch I.D. PVC standpipe well point slotted screen 0.020-inch slot width ~7 to 9 feet
12	Glued on end cap with cut at 9 feet
13	

Floyd Assemblage
King County, WA

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Project No. 190151E001

4/24/19

LOG OF EXPLORATION PIT NO. EP-4

Depth (ft)	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered. **DESCRIPTION** Elev: 339 ft
	Sod - 3 inches
	Topsoil Loose, moist, brown, silty fine to medium SAND, some gravel (SM).
1	**Fill**
2	Loose to medium dense, moist, reddish brown, gravelly, silty, medium SAND; frequent cobbles and small boulders; unsorted (SM). Boulder (measuring ~1.6x1.6x1.3 feet) Abundant cobbles.
3	Becomes gray.
4	**Vashon Lodgement Till ?** Difficult digging and two till-like clasts. Moist, brownish gray, silty, gravelly, fine to medium SAND; abundant cobbles; occasional broken rocks (mostly rounded) (SM).
5	Bottom of exploration pit at depth 5 feet Operator indicates practical refusal. No seepage. Minor caving 1 to 3.5 feet.
6	
7	
8	
9	
10	
11	
12	
13	

Floyd Assemblage
King County, WA

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Project No. 190151E001

4/24/19

LOG OF EXPLORATION PIT NO. EP-5

Depth (ft)	DESCRIPTION
	This log is part of the report prepared by Associated Earth Sciences, Inc. (AESI) for the named project and should be read together with that report for complete interpretation. This summary applies only to the location of this trench at the time of excavation. Subsurface conditions may change at this location with the passage of time. The data presented are a simplfication of actual conditions encountered.
	Elev: 339 ft
	Sod - 1 to 2 inches
	Fill
1	Medium dense to dense, moist, gray, gravelly, sandy, SILT; scrap of black rubber tube; unsorted; lightly cemented (ML).
	Relic Topsoil
2	Medium dense, moist, brown, silty, fine to medium SAND, some gravel (SM).
	Weathered Vashon Recessional Outwash
	Medium dense, moist, orangish brown, silty, gravelly, medium SAND; occasional cobbles (SM).
3	
	Becomes very moist to wet, less orange, and very gravelly.
4	**Vashon Recessional Outwash**
	Abundant cobbles and difficult digging.
	Somewhat stratified (resistant ledges) 2 to 6 feet.
5	Some broken cobbles.
6	
	Becomes wet.
	Becomes sandy, GRAVEL, trace silt (GW).
7	
	Bottom of exploration pit at depth 7 feet Rapid seepage at 6 feet. Water pooling at 6 feet. Minor to moderate caving 2 to 5.5 feet.
8	
9	
10	
11	
12	
13	

Floyd Assemblage
King County, WA

Logged by: NS
Approved by: JHS

associated earth sciences incorporated

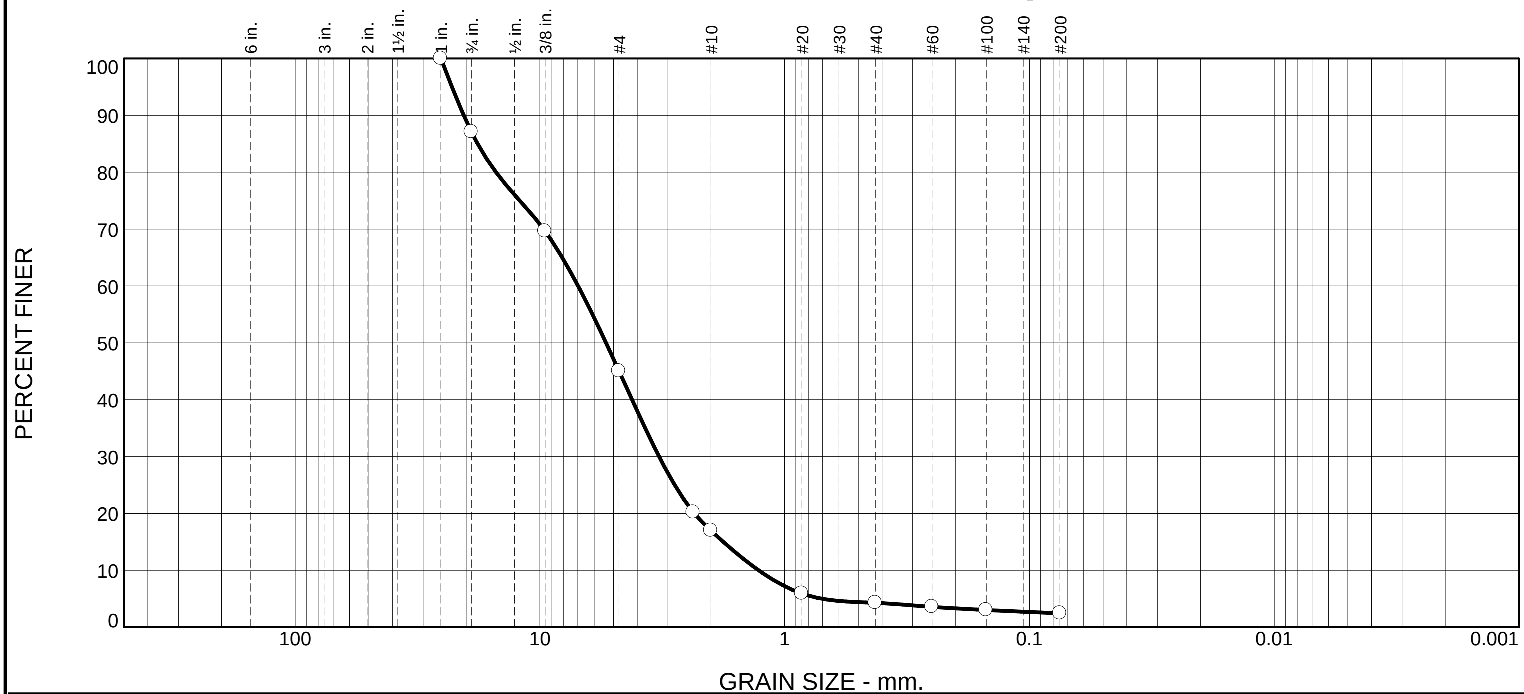
Project No. 190151E001

4/24/19

APPENDIX B

Grain-Size Analyses

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	12.9	42.1	28.0	12.7	1.9	2.4	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.0	100.0		
3/4	87.1		
3/8	69.6		
#4	45.0		
#8	20.2		
#10	17.0		
#20	5.9		
#40	4.3		
#60	3.6		
#100	3.0		
#200	2.4		

* (no specification provided)

Material Description

Very sandy GRAVEL trace silt - Qvr

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GW **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 20.4797 D_{85}= 17.9680 D_{60}= 6.9822
D_{50}= 5.3687 D_{30}= 3.2574 D_{15}= 1.7802
D_{10}= 1.2773 C_u= 5.47 C_c= 1.19

Remarks

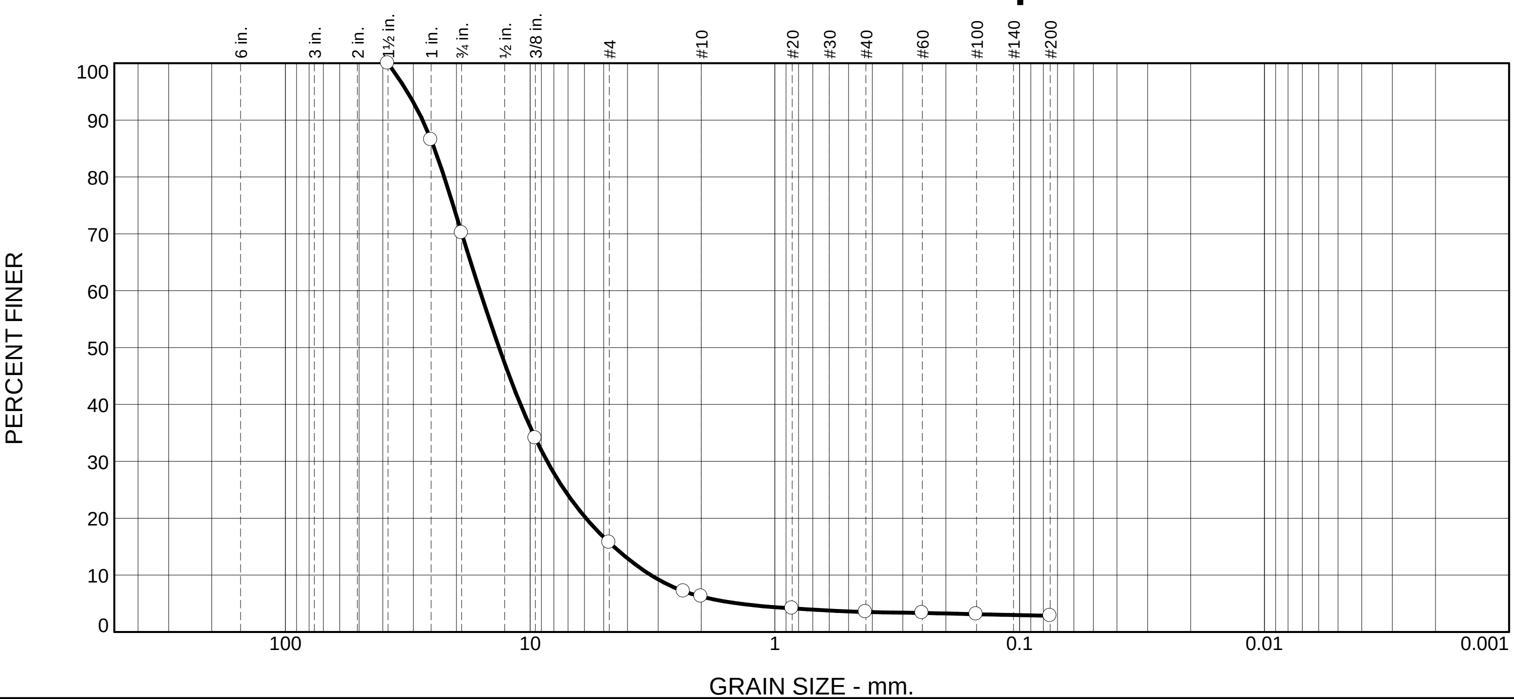
Date Received: 6/6/19 **Date Tested:** 6/11/19
Tested By: MS
Checked By: KDM
Title:

Location: Onsite
Sample Number: EP-2 **Depth:** 6.5-7'
Date Sampled: 4/24/19

associated earth sciences incorporated

Client: Toll Bros, Inc
Project: Floyd Assemblage
Project No: 190151 E001 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	29.8	54.5	9.5	2.7	0.7	2.8	

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5	100.0		
1.0	86.5		
3/4	70.2		
3/8	34.1		
#4	15.7		
#8	7.1		
#10	6.2		
#20	4.1		
#40	3.5		
#60	3.3		
#100	3.1		
#200	2.8		

* (no specification provided)

Material Description

Sandy GRAVEL trace silt - Qvr

Atterberg Limits (ASTM D 4318)

PL= NP **LL=** NV **PI=** NP

Classification

USCS (D 2487)= GW **AASHTO (M 145)=** A-1-a

Coefficients

D_{90}= 27.5118 D_{85}= 24.6221 D_{60}= 16.0522
D_{50}= 13.4036 D_{30}= 8.5231 D_{15}= 4.5532
D_{10}= 3.2133 C_u= 5.00 C_c= 1.41

Remarks

Date Received: 6/6/19 **Date Tested:** 6/11/19

Tested By: MS

Checked By: KDM

Title:

Location: Onsite
Sample Number: EP-5 **Depth:** 7'
Date Sampled: 4/24/19

associated earth sciences incorporated

Client: Toll Bros, Inc
Project: Floyd Assemblage

Project No: 190151 E001 **Figure**