Geotechnical Engineering Services - Revised

Alderwood South
Lynnwood, Washington

for
Wolff Enterprises II, LLC

January 5, 2018

GeoEngineers
Earth Science + Technology

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File No. 12406-027-00

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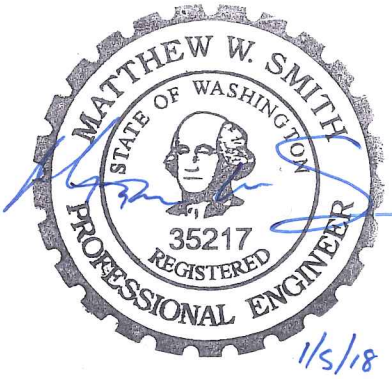

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INTRODUCTION

This report presents the revised results of GeoEngineers, Inc.'s (GeoEngineers) due diligence evaluation of the Alderwood South project located at 2927 Alderwood Mall Boulevard in Lynnwood, Washington. The site is shown relative to surrounding physical features on the Vicinity Map (Figure 1) and the Site Plan (Figure 2).

The purpose of this report is to provide due diligence geotechnical engineering conclusions and recommendations for the site. The approximately 9.17-acre site consists of one Snohomish County Parcel (00372600100305) and is currently occupied by asphalt and gravel surfacing. GeoEngineers' geotechnical engineering services have been completed in general accordance with our services agreement executed on November 17, 2017. Our scope of work includes:

- reviewing existing subsurface information available for the site and surrounding area;
- completing explorations at the site to further characterize subsurface soil and groundwater conditions;
- providing preliminary recommendations for seismic design in accordance with 2015 International Building Code (IBC);
- providing preliminary recommendations for earthwork;
- providing preliminary foundation, slab-on-grade and permanent below-grade wall recommendations; and
- preparing this report.

PROJECT DESCRIPTION

We understand that Wolff Enterprises II, LLC is interested in conducting geotechnical due diligence prior to purchase of the subject property. Conceptual development plans show 11 buildings completed at grade with surrounding roadways/driveways, parking areas, and landscape areas. Foundation support may be completed by bearing on soils at foundation subgrade elevations, improved ground, or pin piles. Geotechnical site conditions and development considerations are presented below.

FIELD EXPLORATIONS AND LABORATORY TESTING

Field Explorations

The subsurface conditions at the site were evaluated by drilling seven borings, GEI-1 through GEI-7, to depths of approximately 2 to 21½ feet below existing site grades. The approximate locations of the explorations are shown in Figure 2. Descriptions of the field exploration program and the boring logs are presented in Appendix A, Field Explorations and Laboratory Testing.

Laboratory Testing

Soil samples were obtained during drilling and were taken to GeoEngineers' laboratory for further evaluation. Selected samples were tested for the determination of fines content, and moisture content. A description of the laboratory testing and the test results are presented in Appendix A.

PREVIOUS SITE EVALUATIONS

In addition to the explorations completed as part of this evaluation, the logs of selected explorations from previous site evaluations in the project vicinity were reviewed. The logs of explorations from previous projects referenced for this study are presented in Appendix B, Boring Logs from Previous Explorations.

SITE CONDITIONS

Surface Conditions

The site was previously used by the Edmonds school district for storage and maintenance of school buses. The site is currently surfaced with asphalt concrete pavement and gravel surface parking. The site grades are constant across the site, with elevations ranging between approximate Elevations 382 to 388 feet.

Numerous buried utilities are located within and near the project site and within the public right-of-way along the adjacent streets. These utilities include, but are not limited to, electrical, fiber optic, telecommunication, gas, buried and overhead power, water, sanitary sewer and storm drain.

Subsurface Conditions

The subsurface conditions at the site have been evaluated by completing seven geotechnical borings for the current study and review of existing geotechnical information completed at the project site. The approximate locations of the explorations are shown in Figure 2.

Borings as the site encountered between 1 and 9 inches of asphalt concrete pavement or gravel surfacing. The pavement was underlain by fill extending to depths between 4½ and 13 feet below existing site grades. Fill observed in the borings consists of loose to medium dense sand with variable silt and gravel content. Boring GEI-7-17 met refusal on fill consisting of quarry spalls at an approximate depth of 2 feet.

Recent deposits were encountered in a select number of explorations below the ground surface (GEI-2-17) and fill (GEI-1-17 and GEI-3-17) and extended to between 9½ and 13 feet below existing site grades. The recent deposits consisted of silty sand with variable gravel content, silt with sand and occasional gravel, and peat (GEI-2-17).

Glacially consolidated soils were encountered below the fill or recent deposits (where encountered) in each of the borings completed for this study, except for boring GEI-7-17. The glacially consolidated soils consist of dense to very dense silty sand with variable gravel content. The glacially consolidated soils extended to the depths explored in borings GEI-1-17 through GEI-6-17.

Although not encountered in our explorations, occasional cobbles and boulders are typically encountered in glacially consolidated soils and may be present at the site.

Groundwater Conditions

The borings completed at the site did not extend deep enough to encounter the regional groundwater table. However, shallow perched groundwater was encountered in borings GEI-1-17 through GEI-4-17, and GEI-6-17. The perched groundwater was encountered between depths of 3 and 10 feet in these borings. The perched groundwater is present within the fill and/or recent deposits overlying the less pervious

glacially consolidated soils. Groundwater conditions are anticipated to vary as a function of season, precipitation, and other factors.

CONCLUSIONS AND RECOMMENDATIONS

A summary of the primary geotechnical considerations is provided below. The summary is presented for introductory purposes only and should be used in conjunction with the complete recommendations presented in this report.

- The site is designated as either Site Class C or D per the 2015 IBC. The buildings should be analyzed on a case-by-case basis during design to determine the appropriate site class. Additional explorations are recommended to better characterize the Site Class. Site Class designations assume that building periods will be less than 0.5 seconds.
- Perched groundwater was encountered at approximate depths of 3 to 10 feet below existing site grades in the borings completed for this evaluation. Perched groundwater will require temporary dewatering for shallow excavations, such as utility trenches. For preliminary planning, casual dewatering by means of sumps and pumps is anticipated for temporary dewatering. Dewatering requirements are recommended to be further assessed during the design phase, particularly where deeper excavations are required (such as storm water facilities or deep utilities).
- Portions of the fill and recent deposits located below the perched groundwater level are potentially liquefiable. Potentially liquefiable soils are estimated to be present in approximately half of the site. Where present, potentially liquefiable soils will require special considerations for foundation support. The potentially liquefiable soils layer is limited in thickness, ranging up to approximately 15 feet thick. Estimated liquefaction induced ground settlements range up to approximately 5 inches for the design earthquake scenario.
- Shallow foundations are considered feasible where non-liquefiable soils are present. Where liquefiable soils are present, foundation options include: (1) shallow foundations bearing on improved ground, (2) pin piles, (3) shallow foundations bearing on partial or full-depth removal and replacement of potentially liquefiable soils, or (4) shallow foundations where permanent lowering of the perched groundwater level has been implemented. The allowable bearing pressure for shallow foundations and the need for pin piles or ground improvement will depend on the location of the buildings, static and seismic performance expectations, and cost. For preliminary design, shallow foundations designed for an allowable bearing pressure ranging from 2 to 4 kips per square foot (ksf) may be assumed.
- Conventional slabs-on-grade are considered appropriate for this site and should be underlain by a 6-inch-thick layer of clean crushed rock (for example, City of Seattle Mineral Aggregate Type 22). The foundation drainage system is anticipated to consist of a perimeter foundation drain.

Our specific geotechnical recommendations are presented in the following sections of this report.

Earthquake Engineering

Liquefaction

We evaluated the liquefaction susceptibility of soils underlying buildings as part of the preliminary study, based on both existing geotechnical data and the explorations completed as part of this study. The site is

anticipated to have a moderate to high risk of liquefaction where fill and recent deposits are located within the upper 15 feet across the site. Perched groundwater was encountered at depths of approximately 3 to 10 feet below existing site grades.

We evaluated liquefaction potential using the simplified method of Idriss and Boulanger (2008). Earthquake input parameters used in our analyses were determined using the 2008 United States Geological Survey (USGS) seismic hazard model for a recurrence interval of 2,475 years. A mean earthquake of magnitude 6.92 and a peak ground acceleration (PGA) (corrected for site class) of 0.54g was used to evaluate liquefaction potential of the site soils. Based on our evaluation of the subsurface data, it was determined that zones of soils susceptible to liquefaction are present within the fill and recent deposits within the upper 15 feet of soils at the site. Borings that experienced liquefaction include GEI-1-17 through GEI-3-17, B-1 through B-3, B-8, MW-1, and P-3. We evaluated liquefaction-induced ground settlement using Idriss and Boulanger (2008) and Ishihara and Yoshimine (1992). Based on our analysis of the subsurface data, we estimate that areas of the site could experience up to 5 inches of liquefaction induced settlement for free field conditions. Differential settlement can be anticipated to occur between structural elements with different foundation support conditions.

2015 IBC Seismic Design Information

The explorations completed at the site showed locations of both soil profile Site Class C and D. Each building should be analyzed during design to determine the appropriate site class. We recommend the use of the following 2015 IBC parameters for site class, short period spectral response acceleration (S_S), 1-second period spectral response acceleration (S_1) and seismic coefficients (F_A and F_V) for the project site. It should be noted that while our analyses indicate that potentially liquefiable soils are present at the site, the fundamental period of vibration of the structures is anticipated to be less than 0.5 seconds, and as a result, the exception presented in Section 20.3.1 of ASCE 7-10 has been used to provide preliminary site class recommendations. If the fundamental period of vibration of the structures is higher than 0.5 seconds, GeoEngineers should be contacted to provide further guidance.

2015 IBC Parameter	Recommended Value	
Soil Profile Site Class	C	D
Short Period Spectral Response Acceleration, S_S (percent g)	131	131
1-Second Period Spectral Response Acceleration, S_1 (percent g)	51	51
Seismic Coefficient, F_A	1.0	1.0
Seismic Coefficient, F_V	1.3	1.5

Excavation Support

Because the buildings are planned to be constructed at grade (no below grade levels), temporary cut slopes can be utilized to complete the excavations for the at grade buildings.

We provide preliminary geotechnical design and construction recommendations for temporary cut slopes and excavation considerations below.

Temporary Cut Slopes

The stability of open-cut slopes is a function of soil type, groundwater seepage, slope inclination, slope height and nearby surface loads. The use of inadequately designed open cuts could impact the stability of adjacent work areas, could affect existing utilities and could endanger personnel.

The contractor performing the work has the primary responsibility for protection of workers and adjacent improvements. In our opinion, the contractor will be in the best position to observe subsurface conditions continuously throughout the construction process and to respond to variable soil and groundwater conditions. Therefore, the contractor should have the primary responsibility for deciding whether to use open-cut slopes for much of the excavations rather than some form of temporary excavation support, and for establishing the safe inclination of the cut slope. Acceptable slope inclinations for utilities and ancillary excavations should be determined during construction. Because of the diversity of construction techniques and available shoring systems, the design of temporary cut slopes is most appropriately left to the contractor proposing to complete the installation. Temporary cut slopes and shoring must comply with the provisions of Chapter 296-155 Washington Administrative Code (WAC), Part N, "Excavation, Trenching and Shoring."

Temporary unsupported cut slopes more than 4 feet high may be inclined at 1.5H:1V (horizontal to vertical) maximum steepness within the fill or recent deposits. For open cuts at the site, we recommend that:

- no traffic, construction equipment, stockpiles or building supplies be allowed at the top of the cut slopes within a distance of at least 5 feet from the top of the cut;
- the cut slopes should be planned such that they do not encroach on a 1H:1V influence line projected down from the edges of nearby or planned foundation elements;
- exposed soil along the slope be protected from surface erosion by using waterproof tarps or plastic sheeting;
- construction activities be scheduled so that the length of time the temporary cut is left open is reduced to the extent practicable;
- erosion control measures be implemented as appropriate such that runoff from the site is reduced to the extent practicable;
- surface water be diverted away from the slope; and
- the general condition of the slopes be observed periodically by the geotechnical engineer to confirm adequate stability.

Water that enters the excavation must be collected and routed away from prepared subgrade areas. We expect that this may be accomplished by installing a system of drainage ditches and sumps along the toe of the cut slopes. Some sloughing and raveling of the cut slopes should be expected. Temporary covering, such as heavy plastic sheeting with appropriate ballast, should be used to protect these slopes during periods of wet weather. Surface water runoff from above cut slopes should be prevented from flowing over the slope face by using berms, drainage ditches, swales or other appropriate methods.

Excavation Considerations

The site soils may be excavated with conventional excavation equipment, such as trackhoes or dozers. The contractor should be prepared for surficial fill that may contain foundation elements and/or utilities from previous site development, debris, rubble and/or cobbles and boulders. We recommend that procedures be identified in the project specifications for measurement and payment of work associated with obstructions.

Foundation Support

Shallow foundations are considered feasible where non-liquefiable soils are present. Where liquefiable soils are present, foundation options include: (1) shallow foundations bearing on improved ground, (2) pin piles, (3) shallow foundations bearing on partial or full-depth removal and replacement of potentially liquefiable soils, or (4) shallow foundations where permanent lowering of the perched groundwater level has been implemented. Selection of the preferred foundation support option will depend on the presence/non-presence of liquefiable soils, the depth to liquefiable soils below foundations, and post-seismic performance expectations for the buildings. It should be noted that further explorations will be required for final design and to verify foundation support options. For preliminary design/due diligence, the following scenarios can be considered:

Scenario 1: Conservative Option

- Support each of the buildings on pin piles or ground improvement extending from the bottom of foundation elevation to the elevation of the top of the glacially consolidated soil layer.

Scenario 2: Moderately Conservative Option

- Support Buildings 2, 6, 7, and 9 using pin piles or ground improvement extending below the shallow foundations. The remaining buildings can be supported on shallow foundations overlying structural fill extending to 3 feet below foundation subgrade elevation.

Scenario 3: Less Conservative Option

- Accept a higher post-seismic settlement tolerance (while still providing collapse prevention). For preliminary planning, this option can be estimated to consist of supporting Buildings 2, 6, 7, and 9 on spread foundations bearing on 6 feet of structural fill. The remaining buildings can be supported on shallow foundations overlying structural fill extending to 3 feet below foundation subgrade elevation.

The following sections provide the specific recommendations regarding foundation support using shallow foundations, deep foundations and shallow foundations bearing on ground improvement.

Shallow Foundations

The soils at the anticipated foundation elevation vary across the site and consist of fill, recent deposits, and glacially consolidated soils. The fill soils are not suitable for shallow foundation support due to anticipated foundation settlement under static and seismic loading. Portions of the fill and recent deposits are potentially liquefiable.

Shallow foundations are considered feasible where non-organic and non-liquefiable soils are present. If organic soils are present at foundation subgrade elevation, the organic soils should be removed and replaced with structural fill. Where liquefiable soils are present, foundation options include: (1) shallow

foundations bearing on improved ground, (2) pin piles, (3) shallow foundations bearing on partial or full-depth removal and replacement of potentially liquefiable soils, or (4) shallow foundations where permanent lowering of the perched groundwater level has been implemented. The allowable bearing pressure for shallow foundations and the need for pin piles or ground improvement will depend on the location of the buildings, static and seismic performance expectations, and cost.

For preliminary design, we recommend that the buildings be supported on shallow spread or mat foundations bearing on non-liquefiable stiff or stiffer/medium dense or denser recent deposits or glacially consolidated soils. Where fill or soft to medium stiff/loose recent deposits are present at foundation subgrade elevation and the soils are non-liquefiable, the fill/recent deposits should be removed to a depth of at least 3 feet below foundation elevation and replaced with properly compacted structural fill. For areas where the foundations will bear on potentially liquefiable fill or recent deposit soils, ground improvement or mitigation measures as discussed below is recommended.

Allowable Bearing Pressure

For shallow foundations supported as described above, a preliminary allowable soil bearing pressure of 2 to 4 ksf may be assumed for preliminary design. During the design phase of the project, foundation support options should be reviewed with the project team to determine the preferred foundation support alternative and finalize the allowable bearing pressures on a building by building basis.

The allowable soil bearing pressure applies to the total of dead and long-term live loads and may be increased by up to one-third for wind or seismic loads. The allowable soil bearing pressures are net values.

Settlement

Provided that all loose soil is removed and that the subgrade is prepared as recommended under "Construction Considerations" below, we estimate that the total settlement of shallow foundations will be about 1 inch or less. The settlements will occur rapidly, essentially as loads are applied. Differential settlements between footings could be half of the total settlement. Note that smaller settlements will result from lower applied loads.

Size and Embedment

We recommend that the exterior footings be founded a minimum of 18 inches below the lowest adjacent grade. Interior footings should be founded a minimum of 12 inches below top of slab. Continuous wall footings and individual column footings should have minimum widths of 24 inches.

Lateral Resistance

Lateral foundation loads may be resisted by passive resistance on the sides of footings and by friction on the base of the shallow foundations. For shallow foundations supported on native soils, the allowable frictional resistance may be computed using a coefficient of friction of 0.3 applied to vertical dead-load forces.

The allowable passive resistance may be computed using an equivalent fluid density of 300 pounds per cubic foot (pcf) (triangular distribution). These values are appropriate for foundation elements that are surrounded by structural fill.

The above coefficient of friction and passive equivalent fluid density values incorporate a factor of safety of about 1.5.

Construction Considerations

We recommend that the condition of all subgrade areas be observed by GeoEngineers to evaluate whether the work is completed in accordance with our recommendations and whether the subsurface conditions are as anticipated.

If foundation construction is completed during periods of wet weather, foundation subgrades are recommended to be protected with a rat slab consisting of 2 to 4 inches of lean or structural concrete.

If soft areas are present at the footing subgrade elevation, the soft areas should be removed and replaced with lean concrete or structural fill at the direction of GeoEngineers.

We recommend that the contractor consider leaving the subgrade for the foundations as much as 6 to 12 inches high, depending on soil and weather conditions, until excavation to final subgrade is required for foundation reinforcement. Leaving subgrade high will help reduce damage to the subgrade resulting from construction traffic for other activities.

Deep Foundations

Pin piles may also be used to support the planned buildings in areas where potentially liquefiable soils are present. The following section detail the design recommendations for pin piles.

Pin Piles

Pin piles typically consist of steel pipe piles that are driven to a specified depth or refusal with a hydraulic hammer. The pin piles can be embedded into the glacially consolidated soils to mitigate liquefaction induced settlement. Pin piles should be installed to a practical refusal criteria developed based on the type and size of impact hammer used to install the piles. Piles should be spaced at least three pile diameters apart.

The pin piles should be used for axial compressive loading only. Pin piles will require geotechnical special inspection and typically one ASTM quick test to confirm pile capacity. Pin pile capacities up to 40 kips can be assumed for preliminary design for 4-inch to 6-inch-diameter pin piles.

Ground Improvement

Ground improvement is an option to mitigate potentially liquefiable soils and to control foundation settlement. Feasible ground improvement options include stone columns, rammed aggregate piers (RAPs), and rigid inclusions installed at the base of the planned foundations. Each of these ground improvement systems would be completed on a grid pattern, where necessary, to transfer the foundation loading to the bearing soils and mitigate liquefaction. GeoEngineers can design the ground improvement system in collaboration with the general contractor and structural engineer. During the design phase of the project, foundation support options should be reviewed with the project team to determine the preferred foundation support alternative.

In addition to stone columns, RAPs, and rigid inclusions, full-depth and partial-depth removal and replacement of potentially liquefiable soils are considered feasible ground improvement options.

The purpose of ground improvement is to mitigate potential static and/or seismic induced settlement resulting from consolidation and seismic liquefaction of the fill and recent deposits. The benefits of ground improvement for this site include:

- ground improvement will allow for conventional shallow foundations and slabs-on-grade; and
- ground improvement will mitigate the potential settlement resulting from liquefaction of the loose to medium dense fill and recent deposit soils during the design seismic event to tolerable magnitudes.

Where ground improvement is used, a preliminary allowable bearing pressure ranging from 2 to 4 ksf may be used for design. The allowable bearing pressure should be confirmed during final design after the preferred foundation support methodology has been selected. The following sections provide a general description of ground improvement methodologies.

Rigid Inclusions

Rigid inclusions consist of unreinforced lean concrete columns installed to the bearing soil below the building foundation elements on a variable grid pattern. The design concept with the use of rigid inclusions is to transfer building loads to the bearing soil and control static and seismic settlement.

Advantages with the use of rigid inclusions include:

- lean concrete columns are more economical than augercast piles (shorter length, no reinforcement, and allows for the use of conventional spread footings/slabs-on-grade);
- there is minimal disturbance of adjacent structures during installation; and
- there is a lower level of construction noise (i.e. no pile driving), there will be lesser impacts to nearby businesses/residences/buried utilities during construction.

Rigid inclusions for this site would be constructed using similar techniques for installing augercast piles. Where augercast methods are used, the first step in the rigid inclusion casting process consists of drilling the auger into the ground to the specified tip elevation of the column. Grout is then pumped into the hole using a tremie pipe.

GeoEngineers can assist the project team with preparation of the ground improvement plan and specifications once the foundation layout and building loads have been finalized.

Stone Columns and Rammed Aggregate Piers

Stone columns and RAPs are considered to be appropriate ground improvement techniques for this site. The intent of these ground improvement techniques is to improve the near surface soils sufficiently to control static and seismic induced settlement to within tolerable levels.

RAPs consist of columns of crushed aggregate that are compacted in-place in thin lifts using a hydraulic ram. The RAPs are completed on a grid pattern under foundations. The depth and spacing of the RAPs depends on the foundation loads, soil conditions, and settlement tolerances.

The stone column technique uses a large vibrator to advance a probe to the design depth. Crushed aggregate is injected at the tip of the vibrator as it is removed. Compaction is achieved using vibration, and working the vibrator up and down as it is removed, to create a column of densely compacted crushed aggregate. Stone columns are installed on a grid pattern below foundations. The depth and spacing of the stone columns depends on the foundation loads, soil conditions, and settlement tolerances.

These ground improvement techniques will result in a composite soil mass that has improved strength, and reduced compressibility under building loads. We recommend that the RAPs or stone columns extend into bearing soils located below the base of the excavation.

Both of these methods would likely create some vibration to the surrounding area, but less than that which would result from driven piles. These vibrations are not expected to adversely affect nearby off-site structures. However, it is likely that the vibrations will be noticed within a limited area in and adjacent to the site.

We recommend that the RAPs or stone columns be installed in a grid pattern below the shallow foundations. The stone columns or RAPs would support moderate foundation loads and reduce post construction settlement to an acceptable amount.

Foundation Drains

We recommend that perimeter foundation drains be installed around the proposed buildings. The drains should consist of 4-inch-diameter perforated collector pipe enveloped within a minimum thickness of 6 inches of gravel as described in the Structural Fill section of this report. The gravel backfill should be wrapped with a geotextile filter fabric meeting the requirements of construction geotextile for underground drainage (Section 9-33 of the 2012 Washington State Department of Transportation [WSDOT] Standard Specifications).

We recommend using either heavy-wall solid pipe (SDR-35 polyvinyl chloride [PVC]) or rigid corrugated polyethylene pipe (ADS N-12 or equivalent) for the collector pipe. We recommend against using flexible tubing for footing drainpipe.

The pipes should be laid with a minimum slope of ½ percent and discharge into an appropriate outfall. The pipe installations should include a cleanout riser with cover located at the upper end of each pipe run. We recommend that the cleanouts be covered and be placed in flush-mounted utility boxes or monuments. The foundation drainpipes should be located near the base of perimeter strip footings where discrete spread foundations are used or below the capillary break layer for pile supported buildings with structural slabs.

Permanent drainage systems should intercept surface water runoff at the top and/or bottom of cut and fill slopes to prevent runoff from flowing in an uncontrolled manner across the site. The finished ground surface adjacent to new and existing buildings should be sloped so that surface water runoff flows away from the structures and the nearby slopes. Roof drains should be tightlined to an appropriate discharge point and should not be connected to the footing or wall drains.

Slab-on-Grade Floors

Subgrade Preparation

The exposed subgrade should be evaluated after site grading is complete. Proof-rolling with heavy, rubber-tired construction equipment should be used for this purpose during dry weather and if access for this equipment is practical. Probing should be used to evaluate the subgrade during periods of wet weather or if access is not feasible for construction equipment. The exposed soil should be firm and unyielding, and without significant groundwater. Disturbed areas should be recompacted if possible or removed and replaced with compacted structural fill.

The site should be rough graded to approximately 1 foot above slab subgrade elevation prior to foundation construction in order to protect the slab subgrade soils from deterioration from wet weather or construction traffic. After the foundations and below slab drainage system have been constructed, the remaining soils can be removed to final subgrade elevation followed by immediate placement of the capillary break material.

Design Parameters

Conventional slabs may be supported on-grade, provided the subgrade soils are prepared as recommended in the "Subgrade Preparation" section above. We recommend that the slab be founded on either undisturbed glacially consolidated soils or on structural fill placed over the undisturbed glacially consolidated soils. For slabs designed as a beam on an elastic foundation, a modulus of subgrade reaction of 150 pounds per cubic inch (pci) may be used for subgrade soils prepared as recommended.

We recommend that the slab-on-grade floors be underlain by a 6-inch-thick capillary break consisting of material meeting the requirements of Mineral Aggregate Type 22 (¾-inch crushed gravel), City of Seattle Standard Specification 9-03.14.

Provided that loose soil is removed, and the subgrade is prepared as recommended, we estimate that slabs-on-grade will not settle appreciably.

A vapor barrier should be used below slab-on-grade floors located in occupied portions of the buildings. Specification of the vapor barrier requires consideration of the performance expectations of the occupied space, the type of flooring planned and other factors, and is typically completed by other members of the project team.

Cast-in-place Walls

Conventional cast-in-place walls may be necessary on-site. The lateral soil pressures acting on conventional cast-in-place subsurface walls will depend on the nature, density and configuration of the soil behind the wall and the amount of lateral wall movement that can occur as backfill is placed.

For walls that are free to yield at the top at least 0.1 percent of the height of the wall, soil pressures will be less than if movement is limited by such factors as wall stiffness or bracing. Assuming that the walls are backfilled and drainage is provided as outlined in the following paragraphs, we recommend that yielding walls supporting horizontal backfill be designed using an equivalent fluid density of 35 pcf (triangular distribution), while non-yielding walls supporting horizontal backfill be designed using an equivalent fluid density of 55 pcf (triangular distribution). For seismic loading conditions, a rectangular earth pressure equal

to 7H pounds per square foot (psf) (where H is the height of the wall in feet) should be added to the active/at-rest pressures. Other surcharge loading should be applied as appropriate.

Lateral resistance for conventional cast-in-place walls can be provided by frictional resistance along the base of the wall and passive resistance in front of the wall. For walls founded on native soils, the allowable frictional resistance may be computed using a coefficient of friction of 0.4 applied to vertical dead-load forces. The allowable passive resistance may be computed using an equivalent fluid density of 400 pcf (triangular distribution). The above coefficient of friction and passive equivalent fluid density values incorporate a factor of safety of about 1.5.

The above soil pressures assume that wall drains will be installed to prevent the buildup of hydrostatic pressure behind the walls. If no wall drainage is provided the below-grade walls shall be designed to resist hydrostatic pressures.

Drainage

We recommend either installing a below-grade wall drainage system to remove water from behind below-grade walls or to waterproof the below-grade walls and design them to resist full height hydrostatic pressures.

If below-grade walls are to be designed using the earth pressures presented above, positive drainage should be provided behind cast-in-place retaining walls by placing a minimum 2-foot-wide zone of Mineral Aggregate Type 17 (bank run gravel), with the exception that the percent passing the U.S. No. 200 sieve should be less than 3 percent. A perforated or slotted drainpipe should be placed near the base of the retaining wall to provide drainage. The drainpipe should be surrounded by a minimum of 6 inches of Mineral Aggregate Type 22 or Type 5 (1-inch washed gravel), or an alternative approved by GeoEngineers. The Type 22 or Type 5 material should be wrapped with a geotextile filter fabric meeting the requirements of construction geotextile for underground drainage, WSDOT Standard Specification 9-33. The wall drainpipe should be connected to a header pipe and routed to a sump or gravity drain. Appropriate cleanouts for drainpipe maintenance should be installed. A larger-diameter pipe will allow for easier maintenance of drainage systems.

Earthwork

Subgrade Preparation

The exposed subgrade in structure and hardscape areas should be evaluated after site excavation is complete. Disturbed areas below slabs should be recompacted if the subgrade soil consists of granular material. If the subgrade soils consist of disturbed soils, it will likely be necessary to remove and replace the disturbed soil with structural fill unless the soil can be adequately moisture-conditioned and compacted.

Structural Fill

Fill placed to support structures, placed behind retaining structures, and placed below pavements and sidewalks will need to be specified as structural fill as described below:

- If structural fill is necessary beneath building slabs, the fill should meet the requirements of Mineral Aggregate Type 2 or Type 17 (1¼-inch minus crushed rock or bank run gravel), City of Seattle Standard Specification 9-03.14.

- If structural fill is necessary beneath building foundations, the fill should consist of Mineral Aggregate Type 2 or Type 17 (1¼-inch minus crushed rock or bank run gravel), City of Seattle Standard Specification 9-03.14, or CDF.
- Structural fill placed behind retaining walls should meet the requirements of Mineral Aggregate Type 17 (bank run gravel), City of Seattle Standard Specification 9-03.14.
- Structural fill placed within utility trenches and below pavement and sidewalk areas should consist of CDF, or fill meeting the requirements of Mineral Aggregate Type 17 (bank run gravel), City of Seattle Standard Specification 9-03.14.
- Structural fill placed around perimeter footing drains, underslab drains and cast-in-place wall drains should meet the requirements of Mineral Aggregate Type 5 (1-inch washed gravel) or Type 22 (¾-inch crushed gravel), City of Seattle Standard Specification 9-03.14, with the exception that the percent fines be less than 3 percent.
- Structural fill placed as capillary break material should meet the requirements of Type 22 (¾-inch crushed gravel), City of Seattle Standard Specification 9-03.14.
- Structural fill placed as crushed surfacing base course below pavements and sidewalks should meet the requirements of Mineral Aggregate Type 2 (1¼-inch minus crushed rock), City of Seattle Standard Specification 9-03.14.

On-site Soils

The on-site soils are moisture-sensitive and may have natural moisture contents higher than the anticipated optimum moisture content for compaction. As a result, the on-site soils may require moisture conditioning in order to meet the required compaction criteria during dry weather conditions and will not be suitable for reuse during wet weather. Furthermore, most of the anticipated fill soils required for this project have specific gradation requirements, and the on-site soils do not meet these gradation requirements. If the contractor wants to use on-site soils for structural fill, GeoEngineers can evaluate the on-site soils for suitability as structural fill, as required.

Fill Placement and Compaction Criteria

Structural fill should be mechanically compacted to a firm, non-yielding condition. Structural fill should be placed in loose lifts not exceeding 1 foot in thickness. Each lift should be conditioned to the proper moisture content and compacted to the specified density before placing subsequent lifts. Structural fill should be compacted to the following criteria:

- Structural fill placed in building areas (supporting foundations or slab-on-grade floors) and in pavement and sidewalk areas (including utility trench backfill) should be compacted to at least 95 percent of the maximum dry density (MDD) estimated in general accordance with ASTM International (ASTM) D 1557.
- Structural fill placed against subgrade walls should be compacted to between 90 and 92 percent. Care should be taken when compacting fill against subsurface walls to avoid over-compaction and hence overstressing the walls.

We recommend that GeoEngineers be present during probing of the exposed subgrade soils in building and pavement areas, and during placement of structural fill. We will evaluate the adequacy of the subgrade soils and identify areas needing further work, perform in-place moisture-density tests in the fill to verify

compliance with the compaction specifications, and advise on any modifications to the procedures that may be appropriate for the prevailing conditions.

Weather Considerations

The on-site soils contain a sufficient percentage of fines (silt and clay) to be moisture-sensitive. When the moisture content of these soils is more than a few percent above the optimum moisture content, these soils become muddy and unstable, and operation of equipment on these soils is difficult. Additionally, disturbance of near-surface soils should be expected if earthwork is completed during periods of wet weather. During wet weather, we recommend the following:

- The ground surface in and around the work area should be sloped so that surface water is directed away from the work area. The ground surface should be graded such that areas of ponded water do not develop. The contractor should take measures to prevent surface water from collecting in excavations and trenches. Measures should be implemented to remove surface water from the work area.
- Slopes with exposed soils should be covered with plastic sheeting or similar means.
- The site soils should not be left uncompacted and exposed to moisture. Sealing the surficial soils by rolling with a smooth-drum roller prior to periods of precipitation will reduce the extent to which these soils become wet or unstable.
- Construction traffic should be restricted to specific areas of the site, preferably areas that are surfaced with materials not susceptible to wet weather disturbance.
- Construction activities should be scheduled so that the length of time that soils are left exposed to moisture is reduced to the extent practicable.

Utility Trenches

Trench excavation, pipe bedding, and trench backfilling should be completed using the general procedures described in the 2016 WSDOT Standard Specifications, or City of Lynnwood requirements, or as specified by the project civil engineer.

Utility trench backfill should consist of structural fill and should be placed in lifts of 12 inches or less (loose thickness) when using heavy compaction equipment, and 6 inches or less when using hand compaction equipment, such that adequate compaction can be achieved throughout the lift. Each lift must be compacted prior to placing the subsequent lift. Prior to compaction, the backfill should be moisture conditioned to within 2 percent of the optimum moisture content. The backfill should be compacted in accordance with the criteria discussed above.

Recommended Additional Geotechnical Services

GeoEngineers will complete a design-level geotechnical engineering evaluation for the project, which is anticipated to confirm or modify as appropriate the preliminary design recommendations presented in this report. During the design we recommend additional explorations be completed to fill in current data gaps. GeoEngineers should be retained to review the project plans and specifications when complete to confirm that our design recommendations have been implemented as intended.

During construction, GeoEngineers should observe the suitability of the foundation subgrades, observe installation of subsurface drainage measures, evaluate structural backfill, observe the condition of temporary cut slopes, and provide a summary letter of our construction observation services. The purposes of GeoEngineers construction phase services are to confirm that the subsurface conditions are consistent with those observed in the explorations and other reasons described in Appendix C, Report Limitations and Guidelines for Use.

LIMITATIONS

We have prepared this report for the exclusive use of the Wolff Enterprises II, LLC and their authorized agents for the 2927 Alderwood Mall Blvd project in Lynnwood, Washington.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

Any electronic form, facsimile or hard copy of the original document (email, text, table and/or figure), if provided, and any attachments are only a copy of the original document. The original document is stored by GeoEngineers, Inc. and will serve as the official document of record.

Please refer to Appendix C for additional information pertaining to use of this report.

REFERENCES

City of Seattle, 2017, "Standard Specifications for Road, Bridge and Municipal Construction."

EHSI, 2017, "Edmonds School District No. 15, Revised Final Remedial Investigation Report, VCP Number: NW2712, Maintenance and Transportation Facility, 2917 Alderwood Mall Boulevard, Lynnwood, Washington 98036."

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Ishihara, K., and Yoshimine, M., "Evaluation of Settlements in Sand Deposits Following Liquefaction During Earthquakes," Soils and Foundations, 32(1), 1992, pp. 173-188.

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FIGURES

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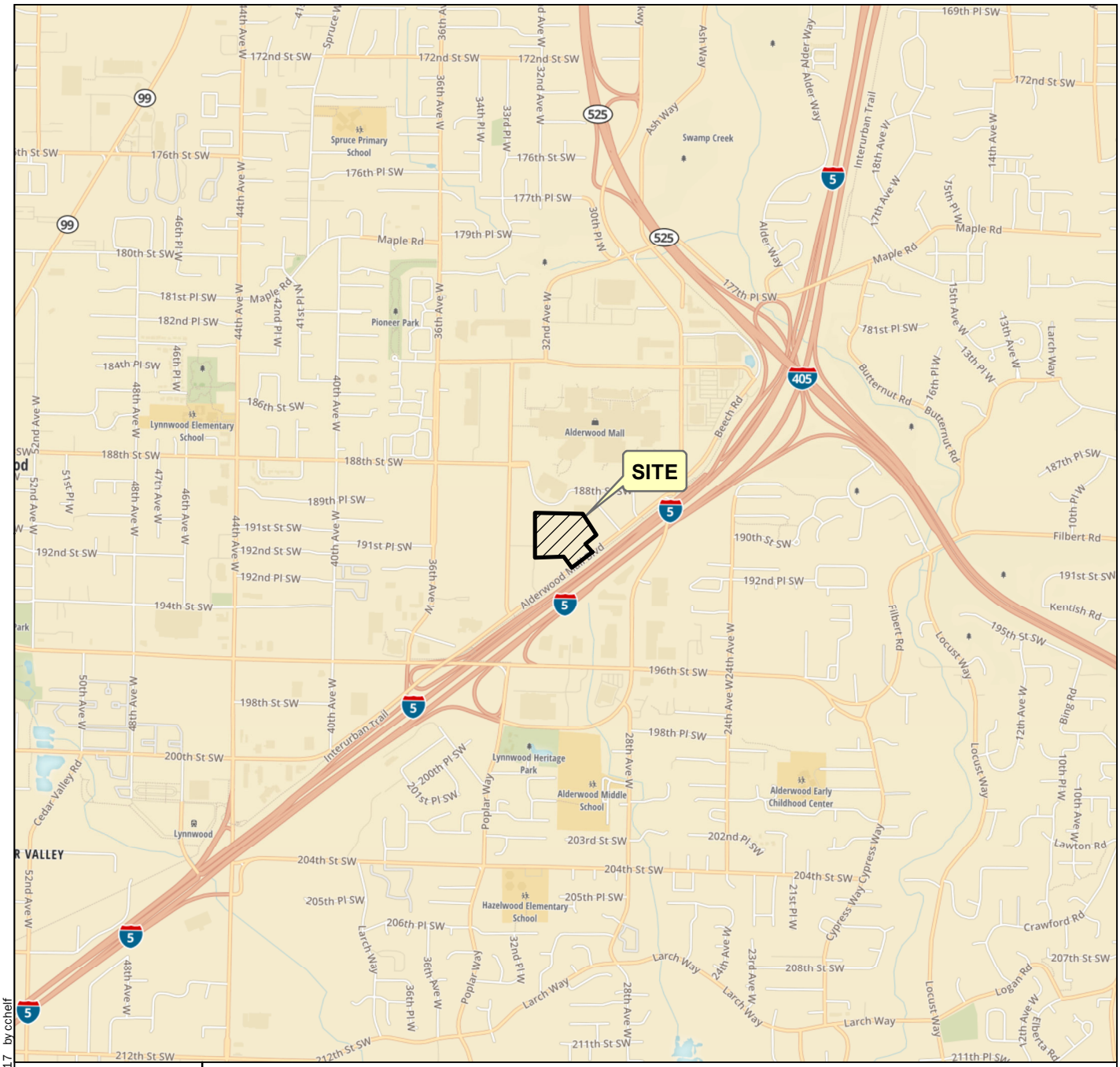

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Mapbox Open Street Map, 2017

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

Vicinity Map

Alderwood South
Lynnwood, Washington

GeoEngineers

Figure 1

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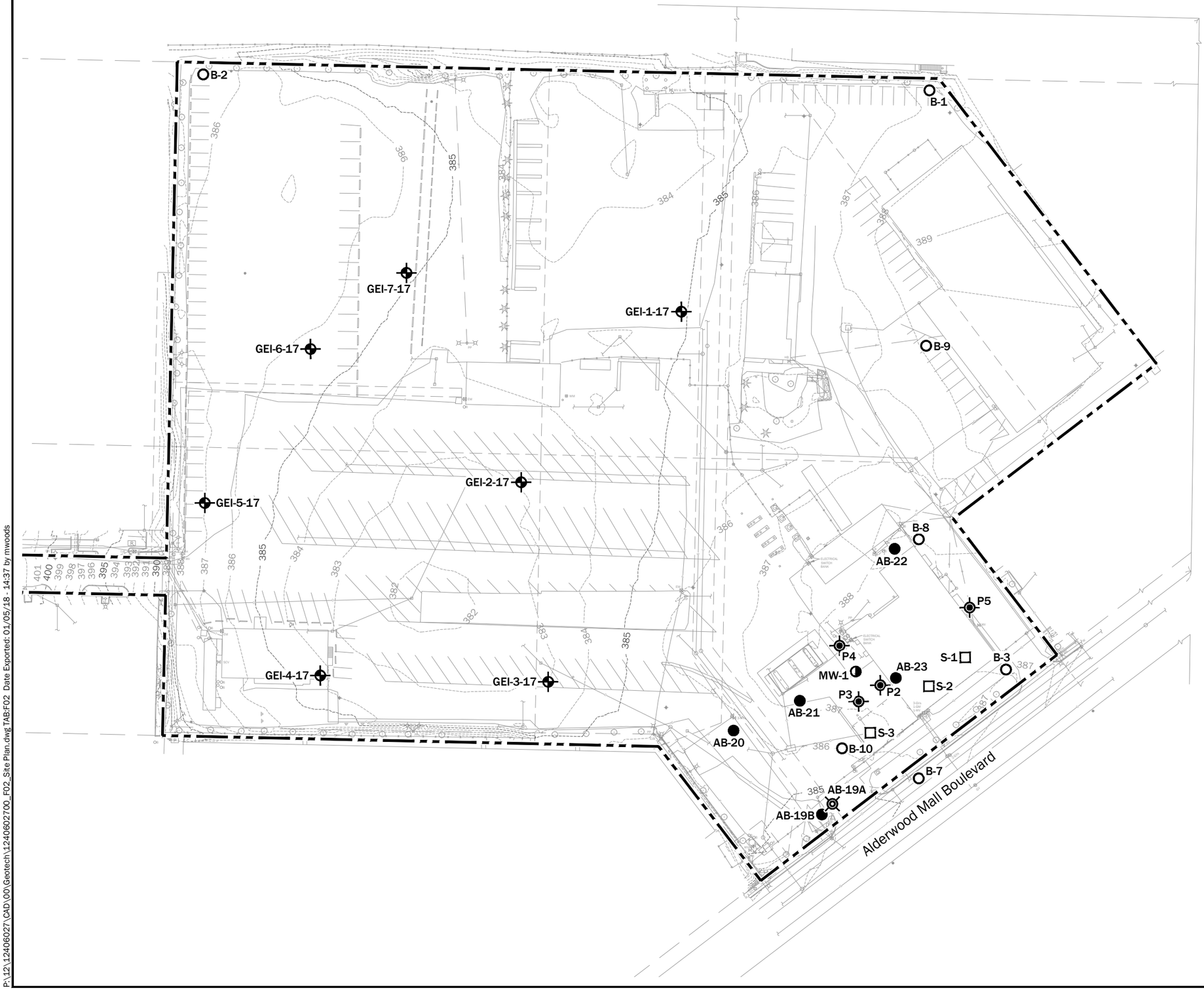

Legend

- Project Boundary
- GEI-1-17 — Boring by GeoEngineers, 2017 (Current Study)
- B-1 — Boring with Monitoring Well by ZZA, 2008
- AB-19A — Boring by AMEC, 2008
- AB-19B — Boring with Monitoring Well by AMEC, 2008
- S-1 — Boring by Landau, 1996
- P2 — Boring by ECOVA, 1991
- MW-1 — Boring with Monitoring Well by ECOVA, 1991

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Base from Katerra dated 09/27/17.

Projection: NAD83 Washington State Planes, North Zone, US Foot

Vertical Datum: NAVD88

N W E S

80 0 80
Feet

Site Plan - Existing Conditions

Alderwood South
Lynnwood, Washington

GeoEngineers

Figure 2

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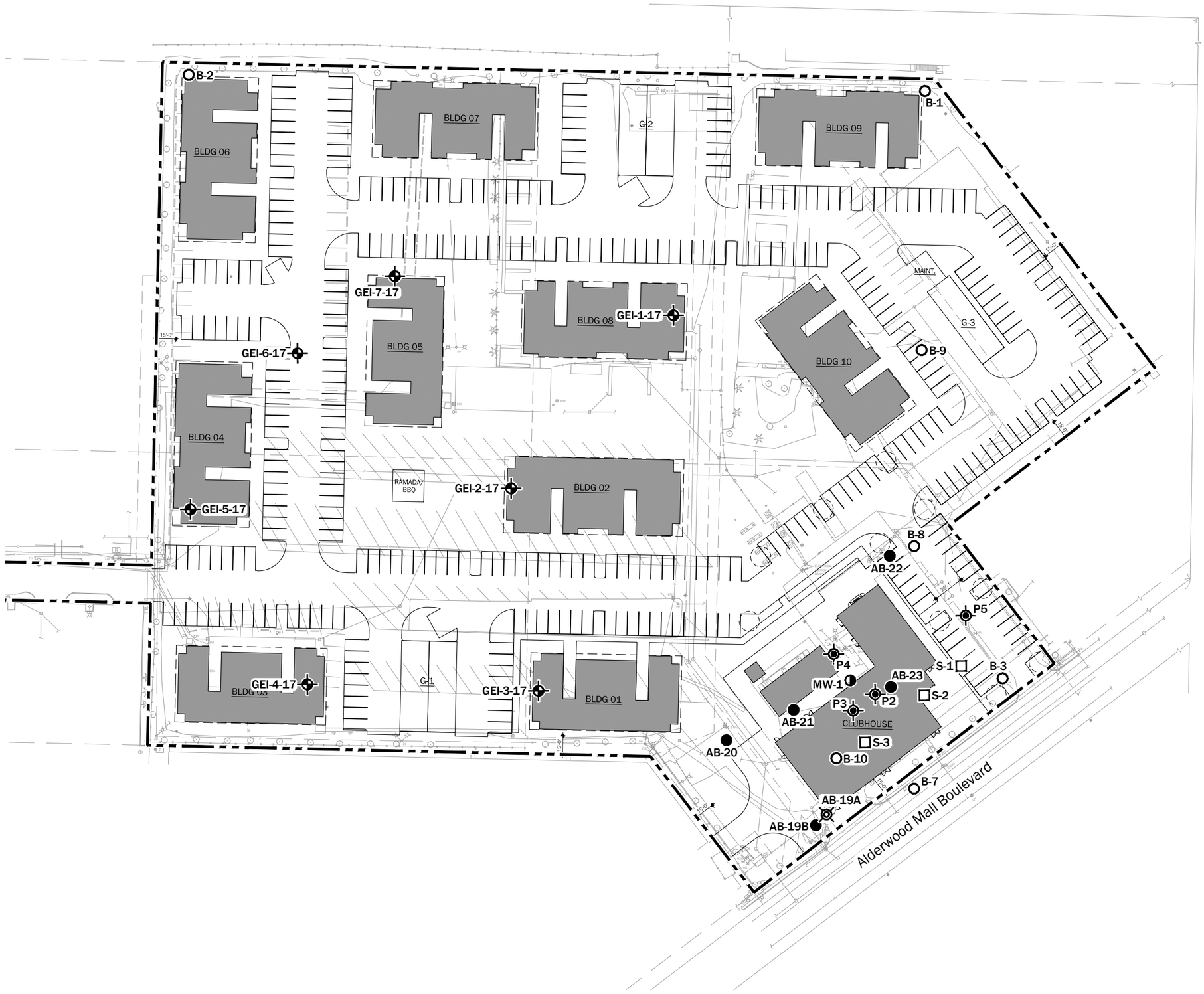

Legend

- Project Boundary
- GEI-1-17 — Boring by GeoEngineers, 2017 (Current Study)
- B-1 — Boring with Monitoring Well by ZZA, 2008
- AB-19A — Boring by AMEC, 2008
- AB-19B — Boring with Monitoring Well by AMEC, 2008
- S-1 — Boring by Landau, 1996
- P2 — Boring by ECOVA, 1991
- MW-1 — Boring with Monitoring Well by ECOVA, 1991

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: Base from Katerra dated 09/27/17.
Designs from Katerra dated 10/5/17.

Projection: NAD83 Washington State Planes, North Zone, US Foot

Vertical Datum: NAVD88

N W E S

80 0 80
Feet

Site Plan - Proposed Conditions

Alderwood South
Lynnwood, Washington

GeoEngineers

Figure 3

P:\12\12406027\CAD\00\Geotech\1240602700_F03_Site Plan.dwg TAB:F03 Date Exported: 01/05/18 - 14:38 by mwoods

APPENDICES

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APPENDIX A
Field Explorations and Laboratory Testing

APPENDIX A
FIELD EXPLORATIONS AND LABORATORY TESTING

Field Explorations

Subsurface conditions were explored at the site by drilling seven borings (GEI-1-17 through GEI-7-17). The borings were completed to depths of approximately 2 to 21½ feet below the existing ground surface. The borings were completed by Geologic Drill Exploration, Inc. on November 20, 2017.

The locations of the explorations were estimated by taping/pacing from existing site features. The approximate exploration locations are shown on the Site Plan, Figure 2.

Borings

The borings were completed using a trailer-mounted, continuous-flight, hollow-stem auger drilling equipment. The borings were continuously monitored by a geotechnical engineer or geologist from our firm who examined and classified the soils encountered, obtained representative soil samples, observed groundwater conditions and prepared a detailed log of each exploration.

The soils encountered in the borings were generally sampled at 2½- and 5-foot vertical intervals with a 2-inch outside diameter split-barrel standard penetration test (SPT) sampler. The disturbed samples were obtained by driving the sampler 18 inches into the soil with a 140-pound automatic hammer free-falling 30 inches. The number of blows required for each 6 inches of penetration was recorded. The blow count ("N-value") of the soil was calculated as the number of blows required for the final 12 inches of penetration. This resistance, or N-value, provides a measure of the relative density of granular soils and the relative consistency of cohesive soils. Where very dense soil conditions precluded driving the full 18 inches, the penetration resistance for the partial penetration was entered on the logs. The blow counts are shown on the boring logs at the respective sample depths.

Soils encountered in the borings were visually classified in general accordance with the classification system described in Figure A-1. A key to the boring log symbols is also presented in Figure A-1. The logs of the borings are presented in Figures A-2 through A-8. The boring logs are based on our interpretation of the field and laboratory data and indicate the various types of soils and groundwater conditions encountered. The logs also indicate the depths at which these soils or their characteristics change, although the change may actually be gradual. If the change occurred between samples, it was interpreted. The densities noted on the boring logs are based on the blow count data obtained in the borings and judgment based on the conditions encountered.

Observations of groundwater conditions were made during drilling. The groundwater conditions encountered during drilling are presented on the boring logs. Groundwater conditions observed during drilling represent a short-term condition and may or may not be representative of the long-term groundwater conditions at the site. Groundwater conditions observed during drilling should be considered approximate.

Laboratory Testing

Soil samples obtained from the explorations were transported to GeoEngineers' laboratory and evaluated to confirm or modify field classifications, as well as to evaluate engineering properties of the soil samples. Representative samples were selected for laboratory testing to determine the moisture content, and

percent fines (material passing the U.S. No. 200 sieve). The tests were performed in general accordance with test methods of ASTM International (ASTM) or other applicable procedures.

Moisture Content

Moisture content tests were completed in general accordance with ASTM D 2216 for representative samples obtained from the explorations. The results of these tests are presented on the exploration logs at the respective sample depths.

Percent Fines

Selected samples were "washed" through the U.S. No. 200 mesh sieve to estimate the relative percentages of coarse- and fine-grained particles in the soil. The percent passing value represents the percentage by weight of the sample finer than the U.S. No. 200 sieve. These tests were conducted to verify field descriptions and to estimate the fines content for analysis purposes. The tests were conducted in accordance with ASTM D 1140, and the results are presented on the exploration logs at the respective sample depths.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
	MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
MORE THAN 50% RETAINED ON NO. 200 SIEVE	SAND AND SANDY SOILS	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS
				SP	POORLY-GRADED SANDS, GRAVELLY SAND
	MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
	AC	Asphalt Concrete
	CC	Cement Concrete
	CR	Crushed Rock/ Quarry Spalls
	SOD	Sod/Forest Duff
	TS	Topsoil

Groundwater Contact

Measured groundwater level in exploration, well, or piezometer

Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata

Approximate contact between soil strata

Material Description Contact

Contact between geologic units

Contact between soil of the same geologic unit

Sampler Symbol Descriptions

2.4-inch I.D. split barrel

Standard Penetration Test (SPT)

Shelby tube

Piston

Direct-Push

Bulk or grab

Continuous Coring

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

"P" indicates sampler pushed using the weight of the drill rig.

"WOH" indicates sampler pushed using the weight of the hammer.

Laboratory / Field Tests

%F	Percent fines
%G	Percent gravel
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DD	Dry density
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
Mohs	Mohs hardness scale
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

Key to Exploration Logs

GeoEngineers

Figure A-1

Drilled Start 11/20/2017 End 11/20/2017	Total Depth (ft) 20.5	Logged By PEB / Checked By MAG	Driller Geologic Drill Exploration, Inc.	Drilling Method Hollow-stem Auger
Surface Elevation (ft) 385 / Vertical Datum NAVD88		Hammer Data Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment Deep Rock XL
Easting (X) 1286407 / Northing (Y) 304554		System Datum WA State Plane North NAD83 (feet)		See "Remarks" section for groundwater observed

Notes:

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0						GP	Fine gravel			
		14	5	1			SM	Brown silty fine to medium sand with occasional gravel (loose, moist) (fill)			
380	5	18	14	2			ML	Gray silt with sand and occasional gravel, oxidation staining (stiff, moist to wet) (recent deposits)			
		12	30	3	%F		SM	Brown silty fine to medium sand with occasional gravel (medium dense to dense, wet)	16	28	Perched groundwater observed at 7 feet at time of drilling
375	10	10	60	4			SM	Gray silty fine to medium sand with occasional gravel; till-like (very dense, moist) (glacially consolidated soils)			
370	15	12	47	5				Till-like			
365	20	4	50/4"	6				Till-like			

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Date:12/13/17 Path:W:\PROJECTS\12\12406027\GINT\12406027700.GPJ DBLibrary:Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_STANDARD_%F_NO_GW

Log of Boring GEI-1-17

GeoEngineers

Project: Alderwood South
Project Location: Lynnwood, Washington
Project Number: 12406-027-00

Figure A-2
Sheet 1 of 1

Drilled Start 11/20/2017 End 11/20/2017	Total Depth (ft) 21.5	Logged By PEB / Checked By MAG	Driller Geologic Drill Exploration, Inc.	Drilling Method Hollow-stem Auger
Surface Elevation (ft) 383 / Vertical Datum NAVD88		Hammer Data Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment Deep Rock XL
Easting (X) 1286278 / Northing (Y) 304416		System Datum WA State Plane North NAD83 (feet)		See "Remarks" section for groundwater observed

Notes:

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample / Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0					GP	Fine gravel			
						PT	Brown peat (soft to medium stiff, moist) (recent deposits)			
380		18	4	1 MC				40		
						SM	Gray silty fine to medium sand with occasional gravel (loose to medium dense, wet)			Perched groundwater observed at 4 feet at time of drilling
	5	18	10	2 %F				24	20	
375		18	24	3			Grades with increased gravel content			
						ML	Gray sandy silt with gravel (soft, moist to wet)			
	10	18	3	4 %F				22	58	
370						SM	Gray silty fine to medium sand with gravel (dense to very dense, wet) (glacially consolidated soils)			
	15	18	38	5						Grinding at approximately 15 feet
365										
	20	18	87	6			Becomes moist to wet; till-like			

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Date:12/13/17 Path:W:\PROJECTS\12\12406027\GINT\12406027700.GPJ DBLibrary:Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_STANDARD_%F_NO_GW

Log of Boring GEI-2-17

GeoEngineers

Project: Alderwood South
Project Location: Lynnwood, Washington
Project Number: 12406-027-00

Figure A-3
Sheet 1 of 1

Drilled Start 11/20/2017 End 11/20/2017	Total Depth (ft) 20.5	Logged By PEB Checked By MAG	Driller Geologic Drill Exploration, Inc.	Drilling Method Hollow-stem Auger	
Surface Elevation (ft) 383 Vertical Datum NAVD88		Hammer Data Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment Deep Rock XL	
Easting (X) 1286299 Northing (Y) 304255		System Datum WA State Plane North NAD83 (feet)		See "Remarks" section for groundwater observed	

Notes:

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0						AC	1 inch asphalt concrete pavement			
							SM	Gray silty fine to medium sand with gravel and organic matter (loose to medium dense, wet) (fill)			Grinding at approximately 1 foot
380		8	9		1 MC				28		Perched groundwater observed at 3 feet at time of drilling
	5	14	14		2			Grades to without organic matter			
							SM	Gray silty fine to medium sand (very dense, wet) (recent deposits)	18	44	
375		18	4		3 %F						
	10	18	52		4		SM	Gray silty fine to medium sand with gravel; till-like (very dense, moist) (glacially consolidated soils)			
370											
	15	18	59		5			Becomes wet; till-like			
365											
	20	4	50/4"		6			Till-like			

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Boring GEI-3-17

GeoEngineers

Project: Alderwood South
Project Location: Lynnwood, Washington
Project Number: 12406-027-00

Figure A-4
Sheet 1 of 1

Start / End		Total Depth (ft)		Logged By / Checked By		Driller		Drilling Method	
Drilled	11/20/2017 – 11/20/2017		10.5		PEB / MAG		Geologic Drill Exploration, Inc.		Hollow-stem Auger
Surface Elevation (ft) / Vertical Datum	384 NAVD88	Hammer Data	Rope & Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Deep Rock XL
Easting (X) / Northing (Y)	1286116 304260	System Datum	WA State Plane North NAD83 (feet)	See "Remarks" section for groundwater observed	

Notes:

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0						GP	Fine gravel; compacted			
							SM	Brown and gray silty fine to medium sand with gravel (medium dense, wet) (fill)			
380		10	11		1						Perched groundwater observed at 3 feet at time of drilling
	5						GM	Brown silty fine gravel with sand and trace organic matter (dense, moist to wet)			
		18	35		2						
							SM	Brown silty fine to medium sand with gravel; till-like (very dense, moist to wet) (glacially consolidated soils)			
		6	50/6"		3						Grinding at approximately 8 feet
375											
	10	6	50/6"		4			Becomes moist; till-like			

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Boring GEI-4-17

GeoEngineers

Project: Alderwood South
Project Location: Lynnwood, Washington
Project Number: 12406-027-00

Figure A-5
Sheet 1 of 1

Drilled	Start 11/20/2017	End 11/20/2017	Total Depth (ft)	20.5	Logged By	PEB	Driller	Geologic Drill Exploration, Inc.	Drilling Method	Hollow-stem Auger
Surface Elevation (ft) / Vertical Datum	387 NAVD88		Hammer Data	Rope & Cathead 140 (lbs) / 30 (in) Drop			Drilling Equipment	Deep Rock XL		
Easting (X) / Northing (Y)	1286023 304399		System Datum	WA State Plane North NAD83 (feet)			Groundwater not observed at time of exploration			

Notes:

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0						GP	Fine gravel			
385		6	34		1		SM	Gray silty fine to medium sand with gravel (dense, moist) (fill)			
	5	18	65		2		SM	Gray fine to medium sand with gravel; till-like (very dense, moist) (glacially consolidated soils)			
380		18	59		3			Grades to brown; till-like			
	10	12	50/6"		4			Till-like			
375											
	15	4	50/4"		5			Grades to gray; till-like			
370											
	20	0	50/4"		6						No recovery

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Boring GEI-5-17

GeoEngineers

Project: Alderwood South
Project Location: Lynnwood, Washington
Project Number: 12406-027-00

Drilled Start 11/20/2017 End 11/20/2017	Total Depth (ft) 20.5	Logged By PEB Checked By MAG	Driller Geologic Drill Exploration, Inc.	Drilling Method Hollow-stem Auger	
Surface Elevation (ft) 386 Vertical Datum NAVD88		Hammer Data Rope & Cathead 140 (lbs) / 30 (in) Drop		Drilling Equipment Deep Rock XL	
Easting (X) 1286108 Northing (Y) 304523		System Datum WA State Plane North NAD83 (feet)		See "Remarks" section for groundwater observed	

Notes:

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
385	0						GP	Fine gravel			
							SM	Gray and brown silty fine to coarse sand with gravel and trace organic matter (medium dense to dense, moist) (fill)			
		16	22		1						
	5	18	31		2 %F			Becomes moist to wet	15	26	
380							SM	Brown silty fine to medium sand with gravel (medium dense to very dense, moist) (glacially consolidated soils)			
		18	28		3						Grinding at approximately 9 feet
	10	18	34		4			Grades to gray, becomes wet; till-like			Perched groundwater observed at 10 feet at time of drilling
375											
	15	5	50/5"		5			Till-like			
370											
	20	5	50/5"		6			Becomes moist			

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Date:12/13/17 Path:W:\PROJECTS\12\12406027\GINT\12406027700.GPJ DBLibrary:Library:GEOENGINEERS_DF_STD_US_JUNE_2017.GLB/GEI8_GEOTECH_STANDARD_%F_NO_GW

Log of Boring GEI-6-17

GeoEngineers

Project: Alderwood South
Project Location: Lynnwood, Washington
Project Number: 12406-027-00

Figure A-7
Sheet 1 of 1

Start / End		Total Depth (ft)		Logged By / Checked By		Driller		Drilling Method	
Drilled	11/20/2017 11/20/2017		2		PEB MAG		Geologic Drill Exploration, Inc.		Hollow-stem Auger
Surface Elevation (ft) / Vertical Datum	385 NAVD88	Hammer Data	Rope & Cathead 140 (lbs) / 30 (in) Drop	Drilling Equipment	Deep Rock XL
Easting (X) / Northing (Y)	1286185 304585	System Datum	WA State Plane North NAD83 (feet)	Groundwater not observed at time of exploration	

Notes: Attempted boring at three different locations; each in close proximity

Elevation (feet)	Depth (feet)	FIELD DATA: Interval Recovered (in)	FIELD DATA: Blows/foot	FIELD DATA: Collected Sample	FIELD DATA: Sample Name Testing	Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	0						GP	Fine gravel, compacted			
							SM	Silty fine to medium sand with gravel and occasional cobbles (moist) (fill)			

Driller observed quarry spalls: encountered refusal at approximately 2 feet below ground surface

Note: See Figure A-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on Aerial Imagery. Vertical approximated based on Topographic Survey.

Log of Boring GEI-7-17

GeoEngineers

Project: Alderwood South
Project Location: Lynnwood, Washington
Project Number: 12406-027-00

APPENDIX B
Boring Logs from Previous Explorations

APPENDIX B
BORING LOGS FROM PREVIOUS EXPLORATIONS

Included in this section are logs from previous studies completed in the immediate vicinity of the project site.

- the logs of seven borings with monitoring wells (B-1 through B-3, and B-7 through B-10) completed by ZZA in 2008 for the Lynnwood Lift Station No. 8 Replacement project;
- the logs of one boring (AB-19A) and five borings with monitoring wells (AB-19B, and AB-20 through AB-23) completed by AMEC in 2008 for the Edmonds School District – 2927 Alderwood Mall Blvd project;
- the logs of three borings (S-1 through S-3) completed by Landau in 1996; and
- the logs of one boring (MW-1) and four borings with monitoring wells (P2 through P5) completed by ECOVA in 1991 for the Edmonds School District Transportation Center project.

LOG OF BORING NO. B-1

CLIENT: BHC Consultants

SITE: Lynnwood, WA

PROJECT: Lynnwood Lift Station No. 8 Replacement

DESCRIPTION	
BOREHOLE DIA.:	6 in
WELL DIA.:	1 in
TOP OF PROTECTOR PIPE:	387.00 ft
TOP OF CASING:	387 ft
GROUND SURFACE ELEV.:	387 ft

DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FIELD VAPOR TEST (PPM)*	
0.5								
386.5								
	SM	S-1	GR	18				
	SM	S-2	SPT	18	1		ND	
5								
382								
	SM	S-3	SPT	18	12	17	ND	Grain Size Analysis 46% passing No. 20 seive
10								
	SM	S-4	SPT	18	21		ND	
15								
	SP	S-5	SPT	18	31	11	ND	
	SM	S-6	SPT	18	58	11	ND	
20								

0.5 — 2" Asphalt over 2-3" **GRAVEL**, gray-black, loose, damp — 386.5

SILTY SAND, trace organics, with gravel, gray-brown with iron oxide staining, very loose, wet (Fill)

5 — 382

SILTY SAND, trace gravel, light gray with iron oxide staining, medium dense, wet to saturated

12 — 375

SILTY SAND, trace gravel, brown with some iron oxide staining, medium dense, saturated (Weathered Till)

15 — 372

GRAVELLY SAND, trace silt, gray-brown, dense, wet to saturated (Weathered Till)

17.5 — 369.5

SILTY SAND, with gravel, light gray to gray, very dense, moist (Till)

20 — 367

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: In-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 10	WD	▽ 4.59	5/1
WL	▽		▽	
WL				

Zipper Zeman Associates, Inc.
Geotechnical and Environmental Consulting
A Terracon Company

BORING STARTED			3-31-08
BORING COMPLETED			3-31-08
RIG Truck-mounted		CO.	EDI
LOGGED	MSA	JOB #	81075133

ZZA WELL BORING LOGS.GPJ TERRACON.GDT 8/7/08

LOG OF BORING NO. B-1

CLIENT: BHC Consultants

SITE: Lynnwood, WA

PROJECT: Lynnwood Lift Station No. 8 Replacement

GRAPHIC LOG	DESCRIPTION	WELL DETAIL	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FIELD VAPOR TEST (PPM)*
				SP	S-7	SPT	3	50/6"		ND
	GRAVELLY SAND, trace silt, light gray, very dense, wet (Till)		25							
				SP SM	S-8	SPT	5	50/5"	12	ND
	SAND, with silt, trace gravel, gray, very dense, wet (Till)		28							

25 — 362 — 359

Borehole completed at 28' on 3/31/08

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft

WL	▽ 10	WD	▼ 4.59	5/1
WL	▽		▼	
WL				

Zipper Zeman Associates, Inc.
Geotechnical and Environmental Consulting
A Terracon Company

BORING STARTED	3-31-08		
BORING COMPLETED	3-31-08		
RIG Truck-mounted	CO.	EDI	
LOGGED MSA	JOB #	81075133	

ZZA WELL BORING LOGS.GPJ TERRACON.GDT 8/7/08

LOG OF BORING NO. B-2

CLIENT: **BHC Consultants**

SITE: **Lynnwood, WA**

PROJECT: **Lynnwood Lift Station No. 8 Replacement**

GRAPHIC LOG	DESCRIPTION		WELL DETAIL	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FIELD VAPOR TEST (PPM)*	
	BOREHOLE DIA.:	6 in										
	WELL DIA.:	1 in										
	TOP OF PROTECTOR PIPE:	385.00 ft										
	TOP OF CASING:	385 ft										
	GROUND SURFACE ELEV.:	385 ft										
	0.25 2-3" **GRAVEL**, with sand, gray, loose, damp	385										
	GRAVELLY SAND, with silt, occasional wood debris in cuttings, brown, medium dense, moist to wet (Fill)				SP SM	S-1	SPT	18	14	12	ND	
	5	380		5								
	SANDY SILT, trace organics and gravel, gray-black, medium stiff, wet to saturated				ML	S-2	SPT	18	7	29	ND	Grain Size Analysis 56% passing No. 200 seive
	12	373		10								
	SILTY SAND, with gravel, gray, loose, saturated				SM	S-3	SPT	18	4	12	ND	Grain Size Analysis 26% passing No. 200 seive
	grades to medium dense			15	SM	S-4	SPT	18	21	12	ND	
	17	368										
	SILTY SAND, trace gravel, light gray, dense, moist to wet (Till)				SM	S-5	SPT	18	48	12	ND	200 Wash 40% passing No. 200 seive
	Continued Next Page			20								

The stratification lines represent the approximate boundary lines between soil and rock types: In-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 11.5	WD	▽ 7.35	5/1
WL	▽		▽	
WL				

Zipper Zeman Associates, Inc.
Geotechnical and Environmental Consulting
A Terracon Company

BORING STARTED	3-31-08		
BORING COMPLETED	3-31-08		
RIG Truck-mounted	CO.	EDI	
LOGGED MSA	JOB #	81075133	

ZZA WELL BORING LOGS.GPJ TERRACON.GDT 8/7/08

LOG OF BORING NO. B-2

CLIENT: BHC Consultants

SITE: Lynnwood, WA

PROJECT: Lynnwood Lift Station No. 8 Replacement

GRAPHIC LOG	DESCRIPTION	WELL DETAIL	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FIELD VAPOR TEST (PPM)*
	GRAVELLY SAND, with silt, gray, very dense, wet (Till)			SP SM	S-6	SPT	18	55		ND
			25							
				SP SM	S-7	SPT	10	50/5"	10	ND
	28.5	356.5								
	Borehole completed at 28.5' on 3/31/08									

The stratification lines represent the approximate boundary lines between soil and rock types: In-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppm).

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 11.5	WD	▽ 7.35	5/1
WL	▽		▽	
WL				

Zipper Zeman Associates, Inc.
Geotechnical and Environmental Consulting
A Terracon Company

BORING STARTED	3-31-08		
BORING COMPLETED	3-31-08		
RIG Truck-mounted	CO.	EDI	
LOGGED MSA	JOB #	81075133	

ZZA WELL BORING LOGS.GPJ TERRACON.GDT 8/7/08

LOG OF BORING NO. B-3

CLIENT: **BHC Consultants**

SITE: **Lynnwood, WA**

PROJECT: **Lynnwood Lift Station No. 8 Replacement**

DESCRIPTION	
BOREHOLE DIA.:	6 in
WELL DIA.:	1 in
TOP OF PROTECTOR PIPE:	387.00 ft
TOP OF CASING:	387 ft
GROUND SURFACE ELEV.:	387 ft

DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FIELD VAPOR TEST (PPM)*	
0.2								
0.2 – 2" **SANDY GRAVEL**, brown, loose, moist (Fill) — 387								
SILTY SAND, trace gravel, light brown with iron oxide staining, loose, wet to saturated (Fill)	SM	S-1	SPT	12	7	17	ND	
5 — 382								
SILTY SAND, trace gravel, gray-brown, medium dense, saturated	SM	S-2	SPT	18	15	14	ND	Grain Size Analysis 34% passing No. 200 seive
12 — 375								
SILTY SAND, trace gravel, gray, very dense, moist (Till)	SM	S-3	SPT	18	50/5"	10	ND	
	SM	S-4	SPT	8	50/5"	10	ND	Grain Size Analysis 32% passing No. 200

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppml).

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 11	WD	▽ 4.78	5/15
WL	▽		▽	
WL				

Zipper Zeman Associates, Inc.
Geotechnical and Environmental Consulting
A Terracon Company

BORING STARTED	4-1-08		
BORING COMPLETED	4-1-08		
RIG Truck-mounted	CO.	EDI	
LOGGED MSA	JOB #	81075133	

ZZA WELL BORING LOGS.GPJ TERRACON.GDT 8/7/08

LOG OF BORING NO. B-3

CLIENT: BHC Consultants

SITE: Lynnwood, WA

PROJECT: Lynnwood Lift Station No. 8 Replacement

GRAPHIC LOG	DESCRIPTION	WELL DETAIL	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FIELD VAPOR TEST (PPM)*	
											seive
	SILTY SAND, trace gravel, gray, very dense, moist (Till)			SM	S-5	SPT	4	50/5"		ND	
	grades to wet		25	SM	S-6	SPT	4	50/5"	10	ND	
26											
	SANDY GRAVEL, with silt, gray, very dense, wet to saturated (Till)			GP GM	S-7	SPT	4	50/4"		ND	
32.5			30								
	SAND, with silt and gravel, gray, very dense, wet (Till)			SP SM	S-8	SPT	4	50/4"	12	ND	
			35								
				SP SM	S-9	SPT	5	50/5"		ND	
40			40								

Continued Next Page

354.5

347

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 11	WD	▽ 4.78	5/15
WL	▽		▽	
WL				

Zipper Zeman Associates, Inc.
Geotechnical and Environmental Consulting
A Terracon Company

BORING STARTED			4-1-08
BORING COMPLETED			4-1-08
RIG Truck-mounted		CO.	EDI
LOGGED	MSA	JOB #	81075133

ZZA WELL BORING LOGS.GPJ TERRACON.GDT 8/7/08

LOG OF BORING NO. B-3

CLIENT: **BHC Consultants**

SITE: **Lynnwood, WA**

PROJECT: **Lynnwood Lift Station No. 8 Replacement**

GRAPHIC LOG	DESCRIPTION	WELL DETAIL	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FIELD VAPOR TEST (PPM)*
	43 **SANDY SILT**, with gravel, gray, hard, moist (Till) 344			ML	S-10	SPT	18	49	13	ND
			45							
	SILTY SAND, trace gravel, gray, very dense, moist to wet (Till)			SM	S-11	SPT	14	50/4"		ND
	49 338									
	Borehole completed at 49' on 4/1/08									

The stratification lines represent the approximate boundary lines between soil and rock types: In-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 11	WD	▽ 4.78	5/15
WL	▽		▽	
WL				

Zipper Zeman Associates, Inc.
Geotechnical and Environmental Consulting
A Terracon Company

BORING STARTED	4-1-08		
BORING COMPLETED	4-1-08		
RIG Truck-mounted	CO.	EDI	
LOGGED MSA	JOB #	81075133	

ZZA WELL BORING LOGS.GPJ TERRACON.GDT 8/7/08

LOG OF BORING NO. B-7

CLIENT: BHC Consultants

SITE: Lynnwood, WA

PROJECT: Lynnwood Lift Station No. 8 Replacement

DESCRIPTION	
BOREHOLE DIA.:	6 in
WELL DIA.:	1 in
TOP OF PROTECTOR PIPE:	385.50 ft
TOP OF CASING:	385.5 ft
GROUND SURFACE ELEV.:	385.5 ft

DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FIELD VAPOR TEST (PPM)*	
0.8								9" Asphalt
384.5								
	SM	S-1	SPT	12	12		340	**SILTY SAND**, with gravel, brown, loose, damp (Fill)
5								grades to light brown, medium dense, damp to wet (Fill)
	SM	S-2	SPT	18	61	9	170	grades to gray-brown, saturated, very dense (Possible Fill)
9								
376.5								
10								
	SM	S-3	SPT	4	50/4"	6	ND	**SILTY SAND**, trace gravel, blue-gray, hard, damp (Till)
15	SM	S-4	SPT	4	50/5"	6	ND	200 Wash 31% passing No. 200 seive
	SM	S-5	SPT	3	50/5"	7	ND	grades to moist to wet
20								
365.5								

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 17.5	WD	▽ 5.55	5/15
WL	▽		▽	
WL				

Zipper Zeman Associates, Inc.
Geotechnical and Environmental Consulting
A Terracon Company

BORING STARTED	4-2-08		
BORING COMPLETED	4-2-08		
RIG Truck-mounted	CO.	EDI	
LOGGED	MSA	JOB #	81075133

ZZA WELL BORING LOGS.GPJ TERRACON.GDT 8/7/08

LOG OF BORING NO. B-7

CLIENT: BHC Consultants

SITE: Lynnwood, WA

PROJECT: Lynnwood Lift Station No. 8 Replacement

GRAPHIC LOG	DESCRIPTION	WELL DETAIL	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: FIELD VAPOR TEST (PPM)*
	SILTY SAND, with gravel, gray, very dense, moist to wet (Till)			SM	S-6	SPT	6	50/6"	10	ND
			25							
	28 357.5			SM	S-7	SPT	0	50/5"		ND
	Borehole completed at 28' on 4/2/08									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft

WL	▽ 17.5	WD	▽ 5.55	5/15
WL	▽		▽	
WL				

Zipper Zeman Associates, Inc.
Geotechnical and Environmental Consulting
A Terracon Company

BORING STARTED			4-2-08
BORING COMPLETED			4-2-08
RIG Truck-mounted		CO.	EDI
LOGGED	MSA	JOB #	81075133

ZZA WELL BORING LOGS.GPJ TERRACON.GDT 8/7/08

LOG OF BORING NO. B-8

CLIENT: BHC Consultants

SITE: Lynnwood, WA

PROJECT: Lynnwood Lift Station No. 8 Replacement

DESCRIPTION	
BOREHOLE DIA.:	6 in
WELL DIA.:	1 in
TOP OF PROTECTOR PIPE:	388.00 ft
TOP OF CASING:	388 ft
GROUND SURFACE ELEV.:	388 ft

DEPTH, ft	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft	TESTS WATER CONTENT, %	TESTS FIELD VAPOR TEST (PPM)*	
0.25								
0.25 – 2.5" Asphalt	388							
SILTY SAND, with gravel, brown, loose, wet to saturated (Fill) grades to blue-gray with iron oxide staining, loose (Possible Fill)	SM	S-1	SPT	14	5		ND	
5	383							
SILTY SAND, with gravel, brown, medium dense, wet	SM	S-2	SPT	14	18	10	ND	Grain Size Analysis 20% passing No. 200 seive
11	377							
SILTY SAND, with gravel, gray-brown with iron oxide staining, dense, wet (Weathered Till)	SM	S-3	SPT	12	47		ND	
14.5	373.5							
SILTY SAND, with gravel, gray, very dense, moist (Till)	SM	S-4	SPT	12	77	10	ND	
	SM	S-5	SPT	13	50/6"	9	ND	

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 2.5	WD	▽ 2.79	5/1
WL	▽		▽	
WL				

Zipper Zeman Associates, Inc.
Geotechnical and Environmental Consulting
A Terracon Company

BORING STARTED	4-3-08		
BORING COMPLETED	4-3-08		
RIG Truck-mounted	CO.	EDI	
LOGGED MSA	JOB #	81075133	

ZZA WELL BORING LOGS.GPJ TERRACON.GDT 8/7/08

LOG OF BORING NO. B-8

CLIENT: BHC Consultants

SITE: Lynnwood, WA

PROJECT: Lynnwood Lift Station No. 8 Replacement

GRAPHIC LOG	DESCRIPTION	WELL DETAIL	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: RECOVERY, in.	SAMPLES: SPT - N BLOWS / ft.	TESTS: WATER CONTENT, %	TESTS: FIELD VAPOR TEST (PPM)*
	SILTY SAND, with gravel, gray, very dense, moist (Till)									
	grades to wet			SM	S-6	SPT	8	50/2"		ND
			25							
				SM	S-7	SPT	12	50/6"	10	ND
	28.5	359.5								
	Borehole completed at 28.5' on 4/3/08									

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppm).

WATER LEVEL OBSERVATIONS, ft

WL	▽ 2.5	WD	▼ 2.79	5/1
WL	▽		▼	
WL				

Zipper Zeman Associates, Inc.
Geotechnical and Environmental Consulting
A Terracon Company

BORING STARTED			4-3-08
BORING COMPLETED			4-3-08
RIG Truck-mounted		CO.	EDI
LOGGED	MSA	JOB #	81075133

ZZA WELL BORING LOGS.GPJ TERRACON.GDT 8/7/08

LOG OF BORING NO. B-9

CLIENT: BHC Consultants

SITE: Lynnwood, WA

PROJECT: Lynnwood Lift Station No. 8 Replacement

DESCRIPTION	
BOREHOLE DIA.:	6 in
WELL DIA.:	1 in
TOP OF PROTECTOR PIPE:	388.00 ft
TOP OF CASING:	388 ft
GROUND SURFACE ELEV.:	388 ft

DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	RECOVERY, in.	SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FIELD VAPOR TEST (PPM)*	
0.3								
3" Asphalt								
387.5								
SILTY GRAVEL, with sand, brown to black, damp (Fill)								
2								
386								
SANDY SILT, with gravel, gray-brown, stiff, wet to saturated (Fill) ▽	ML	S-1	SPT	14	9		ND	
5								
▽								
7								
381								
SILTY SAND, trace gravel, brown, dense, wet to saturated (Possible Fill)	SM	S-2	SPT	0	35	13	ND	Grain Size Analysis 47% passing No. 200 seive
10								
13 grades to very dense	SM	S-3	SPT	9	50/6"		ND	
375								
SILTY SAND, with gravel, gray-brown, very dense, damp to moist (Weathered Till)	SM	S-4	SPT	12	50/6"	8	ND	
15								
grades to wet	SM	S-5	SPT	8	50/3"	8	ND	
19								
369								
20								

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 5	WD	▽ 3.20	5/1
WL	▽		▽	
WL				

Zipper Zeman Associates, Inc.
Geotechnical and Environmental Consulting
A Terracon Company

BORING STARTED	4-3-08		
BORING COMPLETED	4-3-08		
RIG Truck-mounted	CO.	EDI	
LOGGED MSA	JOB #	81075133	

ZZA WELL BORING LOGS.GPJ TERRACON.GDT 8/7/08

LOG OF BORING NO. B-9

CLIENT: **BHC Consultants**

SITE: **Lynnwood, WA**

PROJECT: **Lynnwood Lift Station No. 8 Replacement**

GRAPHIC LOG	DESCRIPTION	WELL DETAIL	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FIELD VAPOR TEST (PPM)*
	SILTY SAND, with gravel, gray, very dense, damp to moist (Till)			SM	S-6	SPT	6	50/6"	7	ND
			25	SM	S-7	SPT	0	50/3"		ND
	28.5 — Borehole completed at 28.5' on 4/3/08	359.5								

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft			
WL ▽ 5	WD ▽ 3.20	5/1	
WL ▽	▽		
WL			

Zipper Zeman Associates, Inc.
Geotechnical and Environmental Consulting
A Terracon Company

BORING STARTED	4-3-08		
BORING COMPLETED	4-3-08		
RIG Truck-mounted	CO.	EDI	
LOGGED MSA	JOB #	81075133	

ZZA WELL BORING LOGS.GPJ TERRACON.GDT 8/7/08

LOG OF BORING NO. B-10

CLIENT: BHC Consultants

SITE: Lynnwood, WA

PROJECT: Lynnwood Lift Station No. 8 Replacement

DESCRIPTION		
BOREHOLE DIA.:	6 in	
WELL DIA.:	1 in	
TOP OF PROTECTOR PIPE:	386.00 ft	
TOP OF CASING:	386 ft	
GROUND SURFACE ELEV.:	386 ft	

GRAPHIC LOG	DESCRIPTION		WELL DETAIL	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FIELD VAPOR TEST (PPM)*	
	0.3 2.5" Asphalt	385.5										
	1 **SILTY GRAVEL**, with sand, brown, loose (Fill)	385										
	SILTY SAND, with gravel, gray-brown, very loose, damp (Fill)				SM	S-1	SPT	18	2		ND	
	5	381		5								
	SILTY SAND, with gravel, gray-brown, medium dense, wet to saturated ▽ ▼				SM	S-2	SPT	18	28	10	ND	Grain Size Analysis 23% passing No. 200 seive
	11	375		10								
	SILTY SAND, with gravel, gray-brown with iron oxide staining, dense, moist (Weathered Till)				SM	S-3	SPT	18	48		ND	
	14.5	371.5										
	SILTY SAND, with gravel, gray, very dense, moist (Till)			15	SM	S-4	SPT	6	50/6"	9	ND	
					SM	S-5	SPT	8	50/2"	7	ND	
				20								

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: In-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

WATER LEVEL OBSERVATIONS, ft				
WL	▽ 7	WD	▼ 8.54	5/1
WL	▽		▼	
WL				

Zipper Zeman Associates, Inc.
Geotechnical and Environmental Consulting
A Terracon Company

BORING STARTED			4-3-08
BORING COMPLETED			4-3-08
RIG Truck-mounted		CO.	EDI
LOGGED	MSA	JOB #	81075133

ZZA WELL BORING LOGS.GPJ TERRACON.GDT 8/7/08

LOG OF BORING NO. B-10

CLIENT: BHC Consultants

SITE: Lynnwood, WA

PROJECT: Lynnwood Lift Station No. 8 Replacement

GRAPHIC LOG	DESCRIPTION	WELL DETAIL	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N BLOWS / ft.	TESTS WATER CONTENT, %	TESTS FIELD VAPOR TEST (PPM)*	
	SILTY SAND, with gravel, gray, very dense, moist (Till)										
	grades to trace gravel, damp to moist (Till)			SM	S-6	SPT	3	50/3"		ND	Gravelly drilling
			25								
	28	358		SM	S-7	SPT	3	50/5"	8	ND	
	Borehole completed at 28' on 4/3/08										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

* ND indicates a reading of less than the field detection limit (FDL) of one (1) part per million isobutylene equivalents (ppmi).

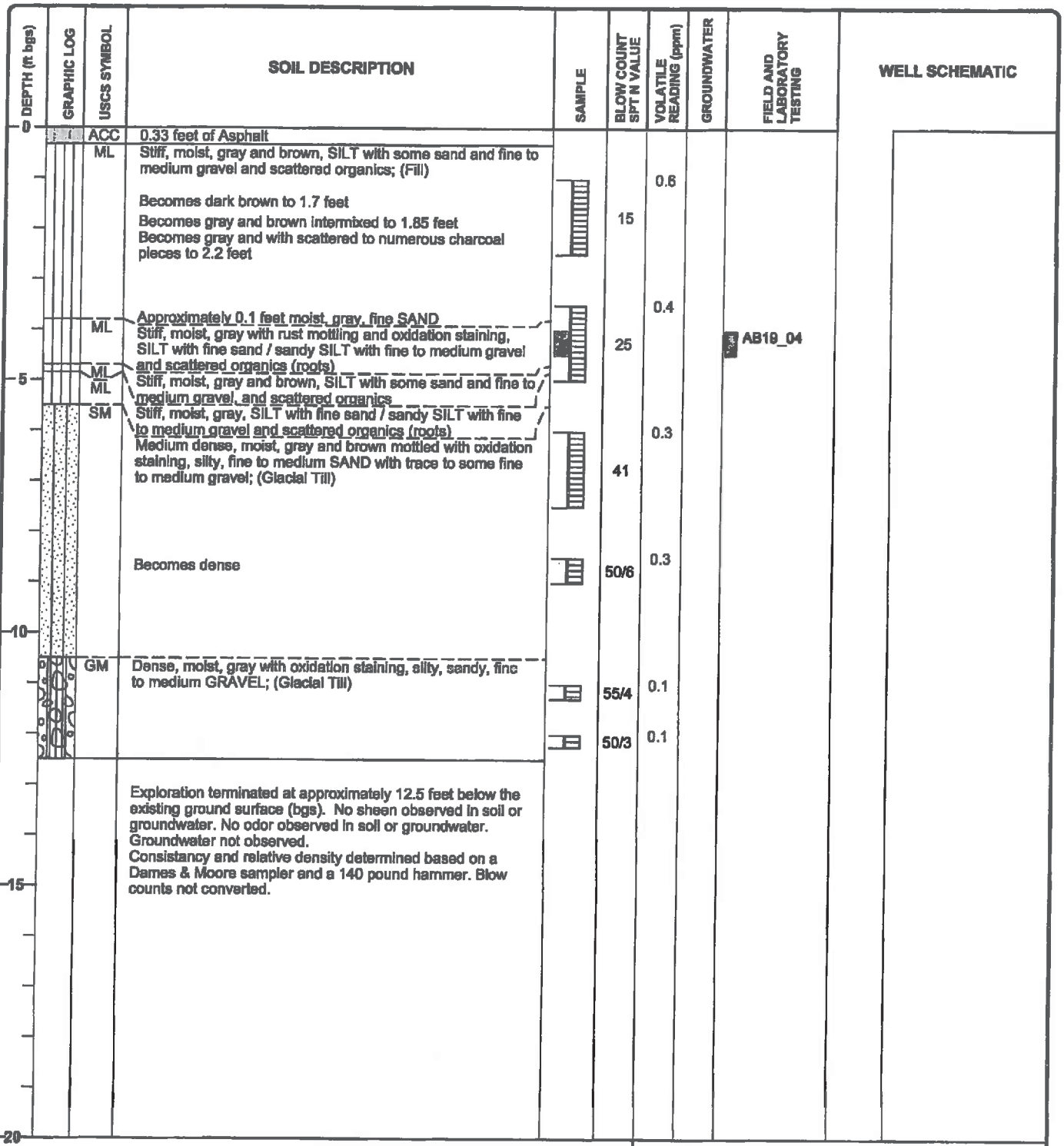
WATER LEVEL OBSERVATIONS, ft

WL	▽ 7	WD	▽ 8.54	5/1
WL	▽		▽	
WL				

Zipper Zeman Associates, Inc.
Geotechnical and Environmental Consulting
A Terracon Company

BORING STARTED			4-3-08
BORING COMPLETED			4-3-08
RIG Truck-mounted		CO.	EDI
LOGGED	MSA	JOB #	81075133

ZZA WELL BORING LOGS.GPJ TERRACON.GDT 8/7/08



BORING METHOD: HSA	ELEVATION REFERENCE: NA
BOREHOLE DIAMETER: 8.25 (in)	GROUND SURFACE ELEVATION: 384 feet
DRILL RIG: NA	CASING ELEVATION: NA
CONTRACTOR: Cascade Drilling	START CARD/TAG ID: NA
LOGGED BY: LME	DRILLING DATES: 01/16/2008 - 01/16/2008

REMARKS:

ENVR+WELL BORING ESDMAT.GPJ AMEC PORTLAND.GDT 4/7/08

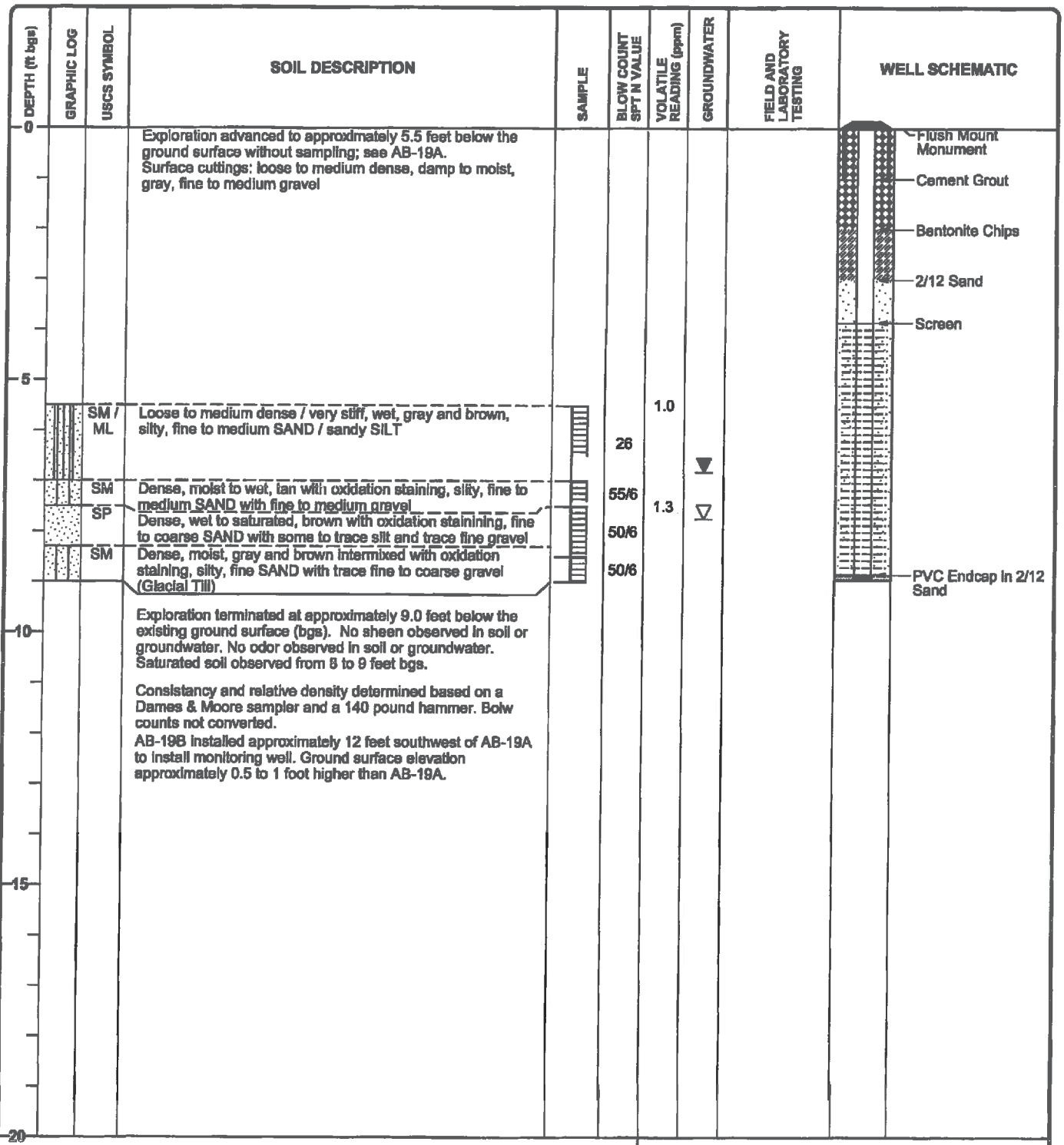
Edmonds School District - 2927
Alderwood Mall Blvd. Lynnwood, WA

7-915-15982-B

AMEC Earth and Environmental, Inc.
11335 NE 122nd Way, Suite 100
Kirkland, Washington
USA 98034
Tel (425) 820-4669
Fax (425) 821-3914

amec

LOG OF BORING AB-19A



BORING METHOD: HSA
BOREHOLE DIAMETER: 8.25 (in)
DRILL RIG: NA
CONTRACTOR: Cascade Drilling
LOGGED BY: LME

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: 384.83 feet
CASING ELEVATION: 384.29 feet
START CARD/TAG ID: /BAB 054
DRILLING DATES: 01/17/2008 - 01/17/2008

REMARKS:

ENVR+WELL BORING ESDMaT.GPJ AMEC PORTLAND.GDT 4/7/08

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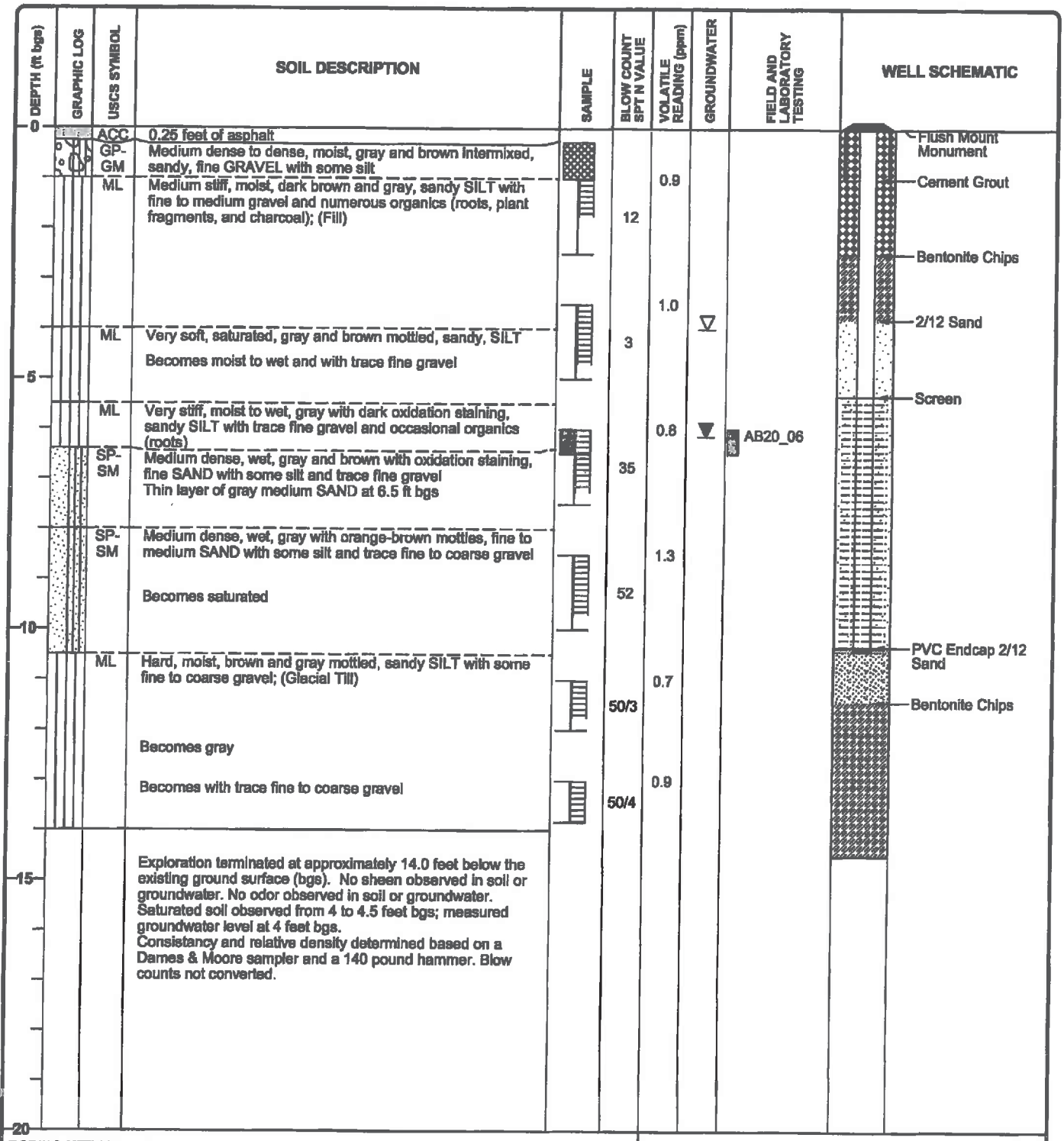
LOG OF BORING AB-19B



BORING METHOD: HSA
BOREHOLE DIAMETER: 8.25 (in)
DRILL RIG: NA
CONTRACTOR: Cascade Drilling
LOGGED BY: LME

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: 385.89 feet
CASING ELEVATION: 385.37 feet
START CARD/TAG ID: /BAB 051
DRILLING DATES: 01/16/2008 - 01/16/2008

REMARKS:

ENVR+WELL BORING ESDM&T.GPJ AMEC PORTLAND.GDT 4/7/08

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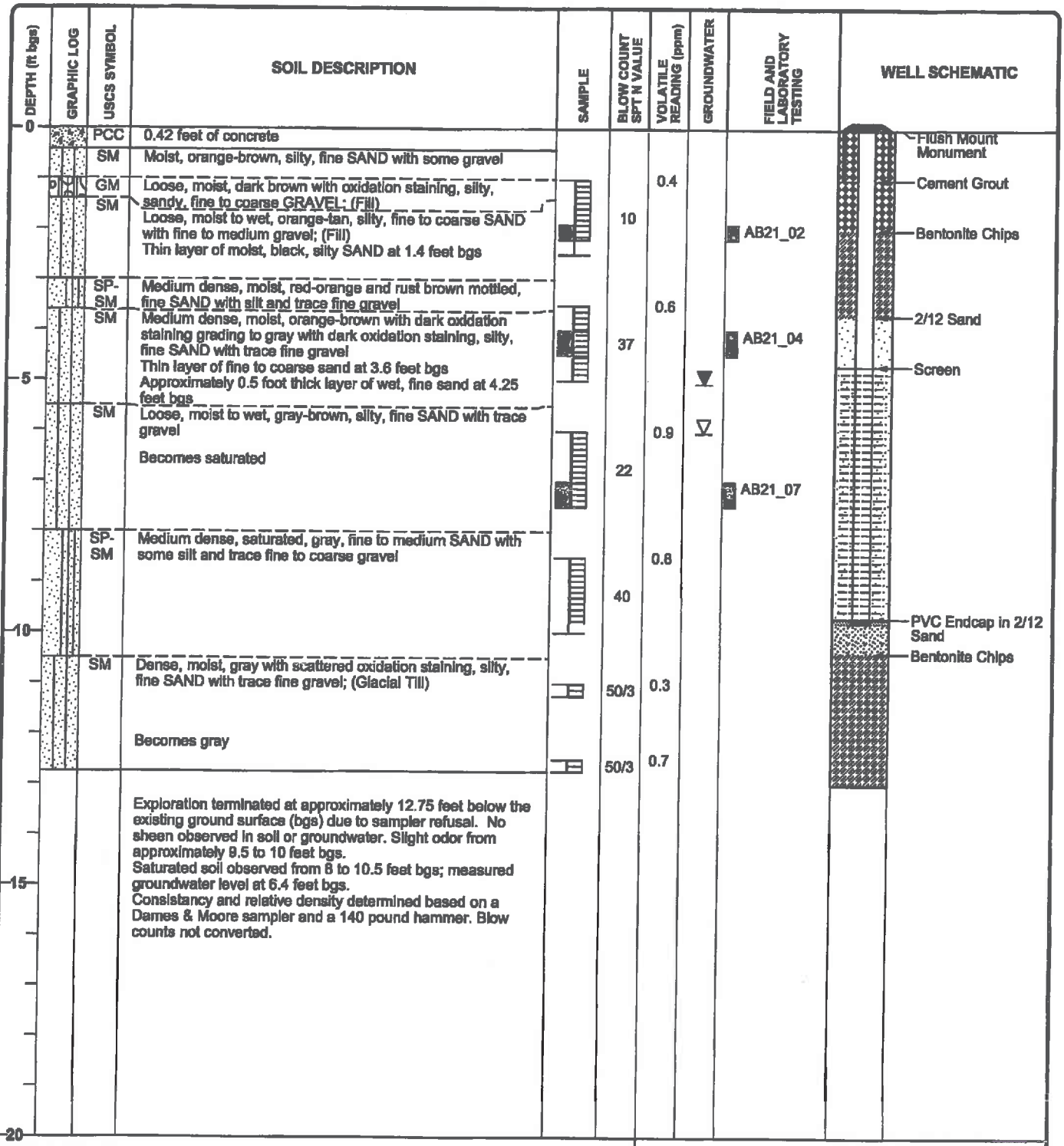
LOG OF BORING AB-20



BORING METHOD: HSA
BOREHOLE DIAMETER: 8.25 (in)
DRILL RIG: NA
CONTRACTOR: Cascade Drilling
LOGGED BY: LME

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: 387.32 feet
CASING ELEVATION: 386.91 feet
START CARD/TAG ID: /BAB 052
DRILLING DATES: 01/16/2008 - 01/16/2008

REMARKS:

ENVR+WELL BORING ESDM&T.GPJ AMEC PORTLAND.GDT 4/7/08

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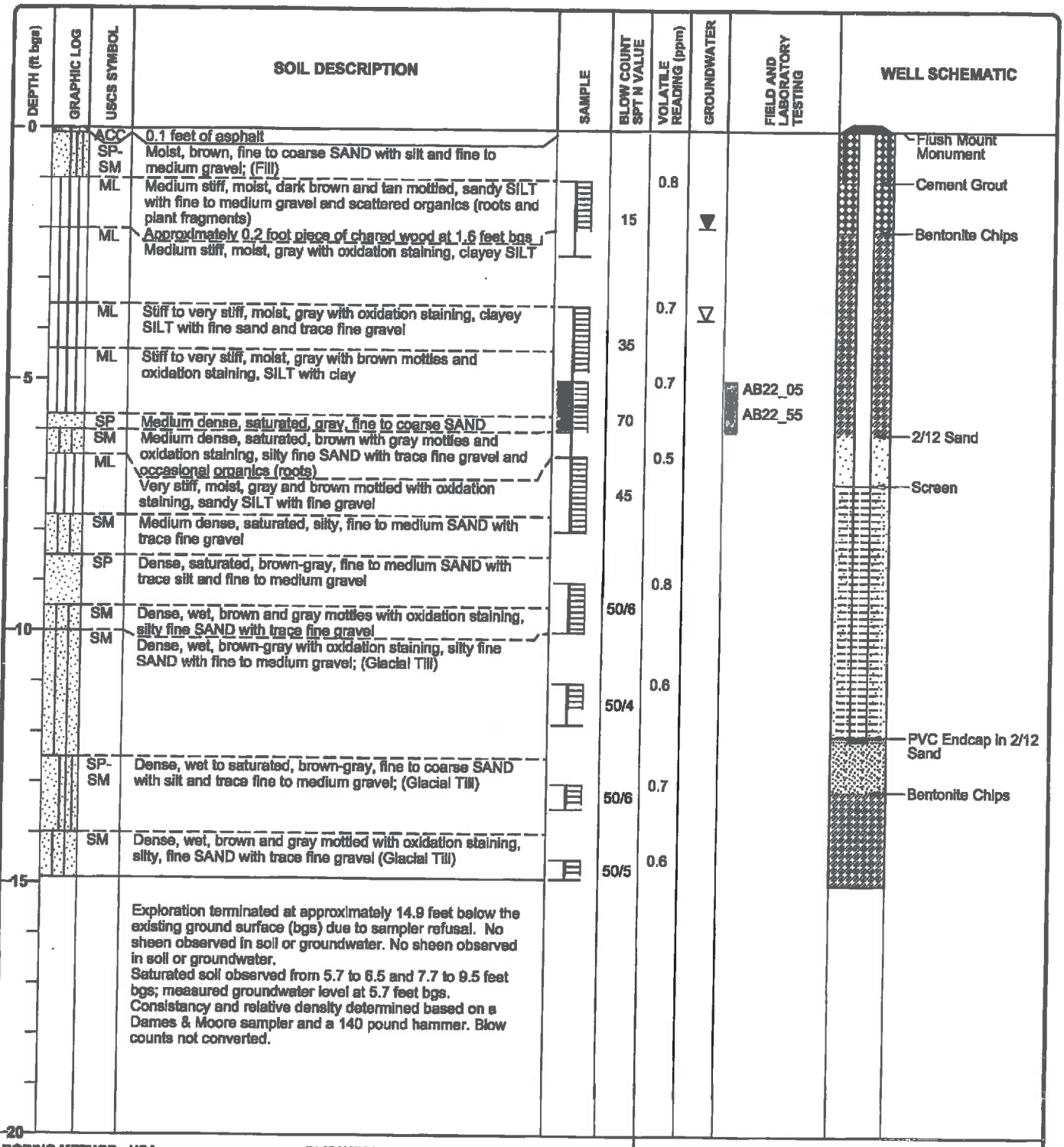
LOG OF BORING AB-21



BORING METHOD: HSA
BOREHOLE DIAMETER: 8.25 (in)
DRILL RIG: NA
CONTRACTOR: Cascade Drilling
LOGGED BY: LME

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: 388.13 feet
CASING ELEVATION: 387.30 feet
START CARD/TAG ID: /BAB 055
DRILLING DATES: 01/17/2008 - 01/17/2008

REMARKS:

ENVR+WELL BORING ESDM&T.GPJ AMEC PORTLAND.GDT 4/7/08

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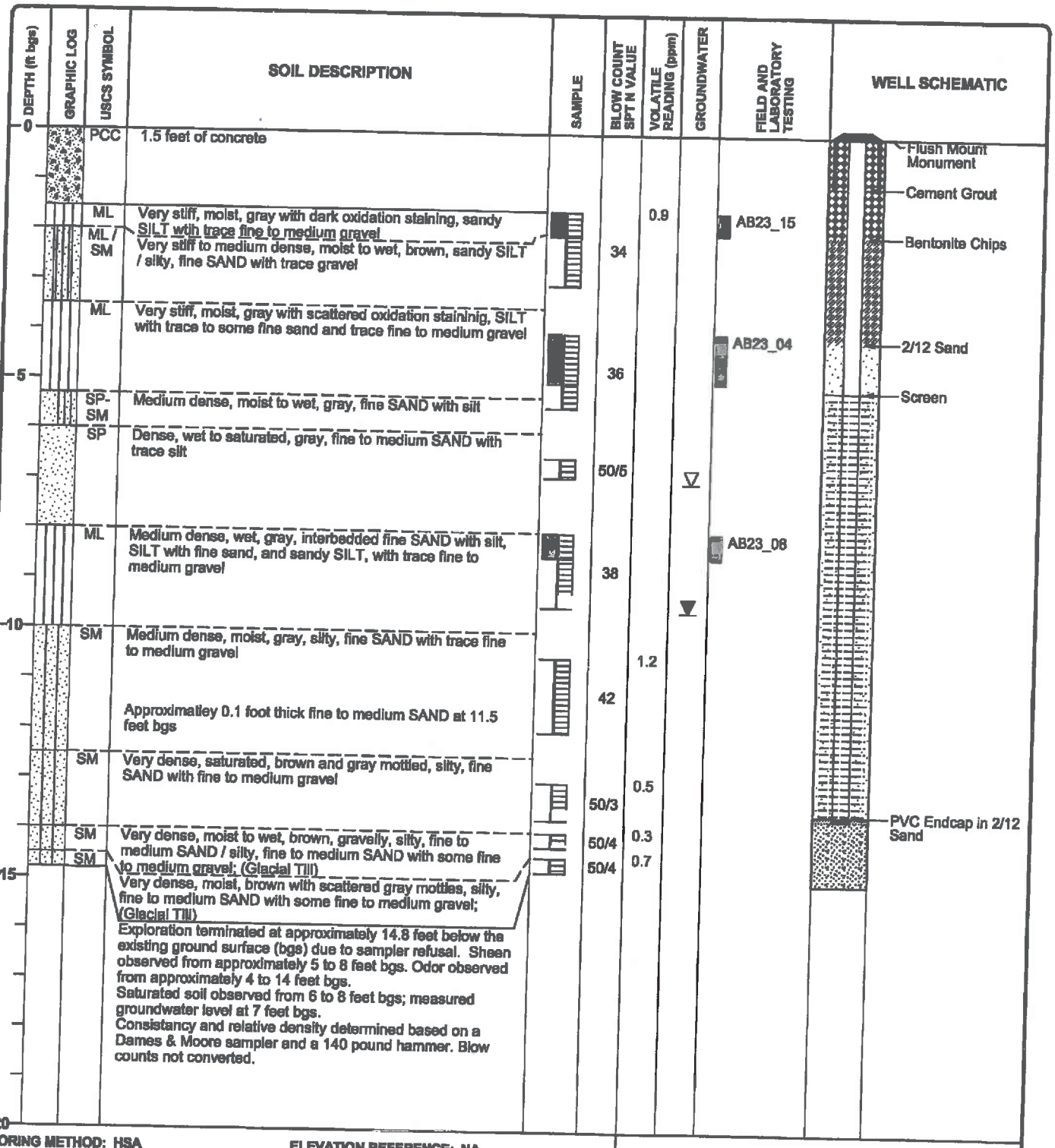
LOG OF BORING AB-22



BORING METHOD: HSA
BOREHOLE DIAMETER: 8.25 (in)
DRILL RIG: NA
CONTRACTOR: Cascade Drilling
LOGGED BY: LME

ELEVATION REFERENCE: NA
GROUND SURFACE ELEVATION: 387.35 feet
CASING ELEVATION: 387.14 feet
START CARD/TAG ID: /BAB 053
DRILLING DATES: 01/16/2008 - 01/16/2008

REMARKS:

ENVR+WELL BORING ESDM&T.GPJ AMEC PORTLAND.GDT 4/7/08

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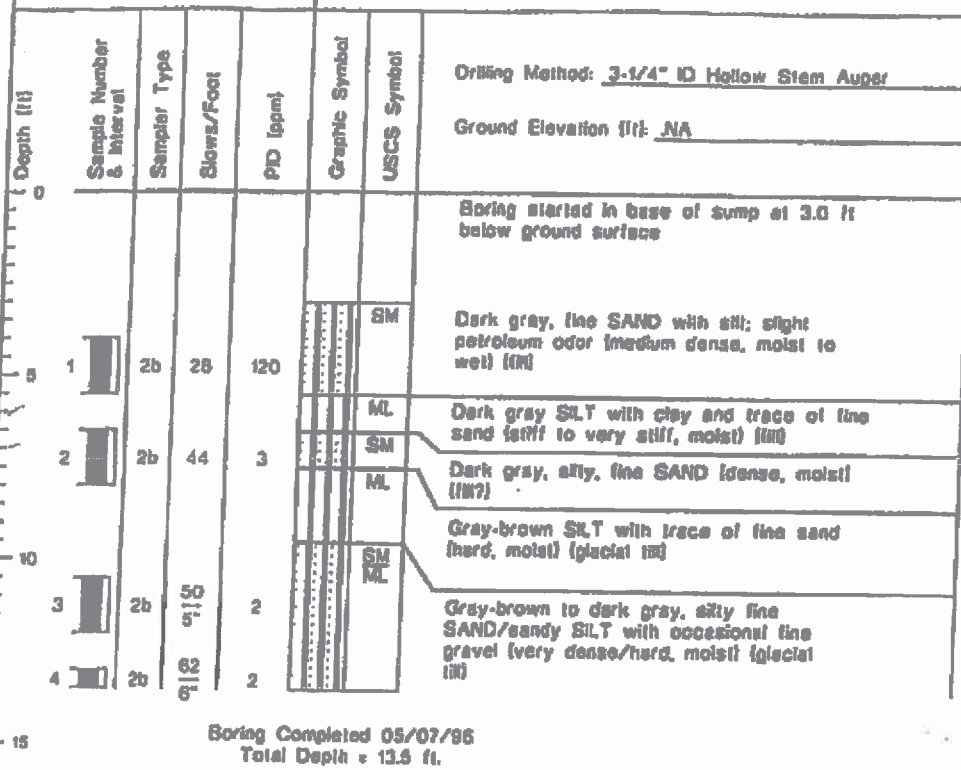
LOG OF BORING AB-23

S-1



Note: Boring was abandoned by backfilling with bentonite chips and a 6-inch concrete seal.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate. Refer to the text for an explanation of subsurface conditions.
2. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.
3. Minor lenses of perched water were encountered from 4.0 to 5.5 feet.

Boring S-1

Figure A-2

S-2

SAMPLE DATA					SOIL PROFILE		
Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	Graphic Symbol	USCS Symbol	Drilling Method: 3-1/4" ID Hollow Stem Auger Ground Elevation (ft): NA
0							Boring started in base of sump at 3.5 ft below ground surface
5	1	2b	28	24		SM	Dark gray, fine to medium SAND with silt and occasional fine gravel; slight petroleum odor (medium dense, moist to wet) (fill)
	2	2b	94	0.0		SM/ML	Dark gray-tan, silty, fine SAND to sandy SILT with gray-brown mottling (dense to very dense/hard, moist) (glacial till)
10	3	2b	80	1.4		SM	Gray brown to dark gray, silty, fine SAND with occasional coarse sand and fine gravel (very dense, moist) (glacial till)
	4	2b	50/4"	0.0			
15	5	2b	66/6"	0.0			

Boring Completed 05/07/96
Total Depth = 15.0 ft.

Note: Boring was abandoned by backfilling with bentonite chips and a 6-inch concrete seal.

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate. Refer to the text for an explanation of subsurface conditions.
2. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.
3. Minor lenses of perched water were encountered from 3.5 to 6.5 feet.

Boring S-2

Figure A-3

S-3

SAMPLE DATA / SOIL PROFILE

Drilling Method: 3-1/4" ID Hollow Stem Auger

Ground Elevation (ft): NA

Depth (ft)	Sample Number & Interval	Sampler Type	Blows/Foot	PID (ppm)	USCS Symbol	Description
0						Boring started in base of sump at 4.0 ft below ground surface
5	1	2b	71	18.0	SM	Gray-tan to dark gray, silty, fine SAND with occasional coarse sand and fine gravel; slight petroleum odor in upper two samples; possible fill to about 5 ft bgs (very dense, moist) (glacial till)
	2	2b	86	9.4		
10	3	2b	50/6"	3.8		

Boring Completed 05/07/96
Total Depth = 11.0 ft.

Note: Boring was abandoned by backfilling with bentonite chips and a 6-inch concrete seal.

Notes: 1. Stratigraphic contacts are based on field interpretations and are approximate. Refer to the text for an explanation of subsurface conditions.
2. Refer to "Soil Classification System and Key" figure for explanation of graphics and symbols.

Boring S-3

Figure A-4

ECOVA Corporation
Soil Boring Log

Boring Number MW-1 (P1)

Client Edmonds School District | Drilling Company Holt Drilling | Date Drilled 3/9/93

Site Transportation Center | Boring Method HSA – 8-1/2" | Coordinates ____N ____E

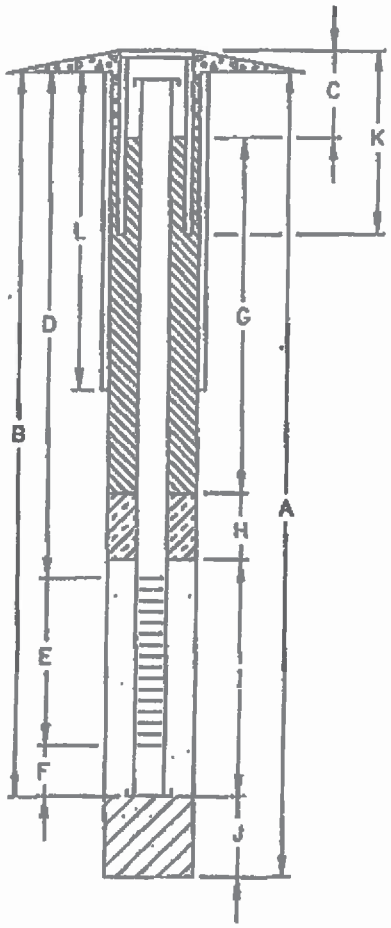
Job Number 1147 | Total Depth 20' | Ground Elevation ____

Field Geologist Arnie Sugar | Water Depth Approximately 9' | Sheet 1 of 1

Depth (Feet)	Blow Counts	Sample No.	Recover	Organic Vapor (ppm)	% LEL	% O_2	Sample Description	Graphic Log
5	5 6 8	P1-2.5 2.5-4	100	1.3			Asphalt – 4" CLAY (CL) stiff – gravelly, sandy, tan with iron staining	
10	4 5 7	P1-7.5 7.5-9.0	100	1.3			CLAY. (CL) stiff, gravelly, sandy, tan with iron staining, slight sheen ▼ Groundwater 9–10'	
15	10 16	P1-12.5 12.5-14.0	100	0.8			SAND (SC) – fine to medium grained, minor gravel and clay lenses, blue-gray, wet, iron staining	
20							Slight sheen on wet soil from flights as augers are raised during well installation TD 20 Feet Installed Monitoring Well	

1147-A-001.0

WELL COMPLETION MW--1



TOP OF CASING ELEVATION _____

A BORING DEPTH 20 FT.
BORING DIAMETER 8.25 IN.
B WELL DEPTH 20 FT.
C WELL STICKUP 0.5 FT.
D BLANK INTERVAL 0-5' FT.
BLANK DIAMETER 2" IN.
E SCREEN INTERVAL 5-20' FT.
SCREEN DIAMETER 2" IN.
TYPE/SLOT SIZE .020 IN.
F SEDIMENT TRAP _____ FT.
G ANNULAR SEAL 1 FT.
MATERIAL: CONCRETE
H BENTONITE SEAL 2 FT.
I SANDPACK 22 FT.
TYPE/SIZE: #10-20
J BOTOM SEAL/PACK _____ FT.
MATERIAL: _____
K WELL COVER 1 FT.
L CONDUCTOR CASING _____ FT.

DRILLING TIMES:
START _____ FINISH _____
STANDBY or DOWN TIME:

METHOD OF DECON. PRIOR TO DRILLING: Steam Cleaning

DEVELOPMENT

METHOD OF DEVELOPMENT: Pumped, bailed, and surged

YIELD	TIME		DATE
	0730	TO 0800	3/4/93
		TO	
		TO	
		TO	

TURBIDITY AFTER DEVELOPMENT: _____ CLEAR; X MOD. TURBID; _____ SL. TURBID; _____ TURBID

ODOR IN WATER ? None

WATER DISCHARGED TO: _____ GROUND SURFACE; _____ STORM SEWERS; _____ DRUMS; _____ STORAGE TANK; _____ TANK TRUCK; X O/W Sep

DEPTH OF WATER AFTER DEVELOPMENT: 6.12' Below top of riser

MATERIALS USED

10 SACKS of #10-20 SAND
_____ SACKS of _____ CEMENT
_____ SACKS of PREMIX CONCRETE
_____ GALLONS of GROUT USED
GROUT COMPOSITION _____
<1 SACKS of BENTONITE
_____ BUCKETS of BENTONITE PELLETS
_____ YARDS CEMENT -- SAND USED
_____ CENTRALIZERS at _____ BGS

WELL COVER USED: _____ Above Grade; X At Grade; _____ Other; X Lockable

NOT TO SCALE

1147-A-001A

ECOVA Corporation

Soil Boring Log

Boring Number P-2

Date Drilled 3/9/93

Client Edmonds School District | Drilling Company Holt Drilling | Coordinates N

Site Transportation Center | Boring Method HSA – 8-1/2" | E

Job Number 1147 | Total Depth 20 Feet | Ground Elevation

Field Geologist Arnie Sugar | Water Depth 9' | Sheet 1 of 1

Depth (Feet)	Blow Counts	Sample No.	Recover	Organic Vapor (ppm)	% LEL	% O_2	Sample Description	Graphic Log
5	7/7/6	P2-2.5 2.5-4.0'	100	0.8			Concrete – 8" Clay (CL) (stiff), gravelly, sandy, blue-grey, iron staining	
10	4/PL/5	P2-7.5 7.5-9.0'	100	0.8			Clay (CL) . gravelly, sandy, blue-grey, iron staining, minor amounts of angular shale chips slight sheen Groundwater 9.0'	
15	3/4/50	P2-22.5 12.5-14.0'	100	NA			Sand (SC),fine- to medium-grained, clayey, gravelly, blue-grey, 1" of orange mottling (iron staining) TD 14 Feet Boring grouted with hole plug (granular bentonite – 6 bags) and water to the surface	
20								

ECOVA Corporation

Soil Boring Log

Boring Number P-3

Client Edmonds School District | Drilling Company Holt Drilling | Date Drilled 3/9/93

Site Transportation Center | Boring Method HSA – 8-1/2" | Coordinates N / E

Job Number 1147 | Total Depth 14 ' | Ground Elevation

Field Geologist Arnie Sugar | Water Depth 10' | Sheet 1 of 1

Depth (Feet)	Blow Counts	Sample No.	Recovery %	Organic Vapor (ppm)	% LEL	% O_2	Sample Description	Graphic Log
5	2-3-3	PJ-2.5 2.5-4.0'	10	0.8			Concrete – 8" Sand (SC), medium– to fine–grained, clayey, gravelly with root and plant fragments (possible fill material)	
10	2-4-5	PJ-7.5 7.5-9.0'	100	0.8			Clay (CL), Sandy, grey with orange mottling ▼ Groundwater 10.0'	
15	8-12-11		20	NA			Sand (SP), fine– to coarse–grained, gravelly, wet TD 14 Feet Boring grouted with hole plug (granular bentonite – 5 bags) and water to the surface	
20								

1147-A-003.0

P-4?

ECOVA Corporation

Soil Boring Log

Boring Number P-5

Date Drilled 3/9/93

Client Edmonds School District | Drilling Company Holt Drilling | Coordinates N

Site Transportation Center | Boring Method HSA – 8-1/2" | E

Job Number 1147 | Total Depth 9' | Ground Elevation

Field Geologist Arnie Sugar | Water Depth 8' | Sheet 1 of 1

Depth (Feet)	Blow Counts	Sample No.	% Recover	Organic Vapor (ppm)	% LEL	% O_2	Sample Description	Graphic Log
5	12 9	PS-2.5 2.5-4.0	100	0.2			Asphalt – 4" Sand (SC), fine– to medium–grained, silty, clayey, grey/green	
	50	PS-7.5 7.5-9.0	50	0.2			Sand (SC), silty, clayey, grey–green ▼ Groundwater 8.0' 8.5' – Silt (ML), very hard (50 blows/6") with gravel TD 9 Feet Boring grouted with hole plug (granular bentonite – 4 bags) and water to the surface	
10								
15								
20								

1147-A-004.0

P-5 2

ECOVA Corporation

Soil Boring Log

Boring Number P-8
Date Drilled 3/9/93

Client Edmonds School District
Site Transportation Center
Job Number 1147
Field Geologist Arnie Sugar

Drilling Company Holt Drilling
Boring Method HSA – 8-1/2"
Total Depth 19'
Water Depth Not Encountered

Coordinates N / E
Ground Elevation
Sheet 1 of 1

Depth (Feet)	Blow Counts	Sample No.	Recover %	Organic Vapor (ppm)	% LEL	% O_2	Sample Description	Graphic Log
	7/7/12	P8-2.5 2.5-4.0'	100	0.2			Asphalt – 4"	
							Clay (CL) (hard), gravelly, blue–green	
5	10/40/50	P8-7.5 7.5-9.0'	100	1.9			Silt (ML), gravelly, sandy, clayey, hard grey with orange mottling	
10							Silt (ML), minor gravel, grey, hard, dry	
	40/50	P8-12.5 12.5-14	50	1.3			ML very hard – 50 blows/4"	
15								
	50	P8-17.5 17.5-19	30	0.8			ML very hard – 50 blows/5"	
							TD 19 Feet	
20							Bore hole grouted to the surface with hole plug (granular bentonite – 8 bags and water to the surface)	

1147-A-004.0

APPENDIX C
Report Limitations and Guidelines for Use

APPENDIX C
REPORT LIMITATIONS AND GUIDELINES FOR USE[1]

This appendix provides information to help you manage your risks with respect to the use of this report.

Geotechnical Services Are Performed for Specific Purposes, Persons and Projects

This report has been prepared for the exclusive use of the Wolff Enterprises II, LLC. This report is not intended for use by others, and the information contained herein is not applicable to other sites.

GeoEngineers structures our services to meet the specific needs of our clients. For example, a geotechnical or geologic study conducted for a civil engineer or architect may not fulfill the needs of a construction contractor or even another civil engineer or architect that are involved in the same project. Because each geotechnical or geologic study is unique, each geotechnical engineering or geologic report is unique, prepared solely for the specific client and project site. Our report is prepared for the exclusive use of our Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against open-ended liability claims by third parties with whom there would otherwise be no contractual limits to their actions. Within the limitations of scope, schedule and budget, our services have been executed in accordance with our Agreement with the Client and generally accepted geotechnical practices in this area at the time this report was prepared. This report should not be applied for any purpose or project except the one originally contemplated.

A Geotechnical Engineering or Geologic Report Is Based on a Unique Set of Project-specific Factors

This report has been prepared for the 2927 Alderwood Mall Blvd project in Lynnwood, Washington. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, do not rely on this report if it was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

For example, changes that can affect the applicability of this report include those that affect:

- the function of the proposed structure;
- elevation, configuration, location, orientation or weight of the proposed structure;
- composition of the design team; or
- project ownership.

---

[1] Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org .

If important changes are made after the date of this report, GeoEngineers should be given the opportunity to review our interpretations and recommendations and provide written modifications or confirmation, as appropriate.

Subsurface Conditions Can Change

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by manmade events such as construction on or adjacent to the site, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. Always contact GeoEngineers before applying a report to determine if it remains applicable.

Most Geotechnical and Geologic Findings Are Professional Opinions

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied our professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in this report. Our report, conclusions and interpretations should not be construed as a warranty of the subsurface conditions.

Geotechnical Engineering Report Recommendations Are Not Final

Do not over-rely on the preliminary construction recommendations included in this report. These recommendations are not final, because they were developed principally from GeoEngineers' professional judgment and opinion. GeoEngineers' recommendations can be finalized only by observing actual subsurface conditions revealed during construction. GeoEngineers cannot assume responsibility or liability for this report's recommendations if we do not perform construction observation.

Sufficient monitoring, testing and consultation by GeoEngineers should be provided during construction to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes should the conditions revealed during the work differ from those anticipated, and to evaluate whether or not earthwork activities are completed in accordance with our recommendations. Retaining GeoEngineers for construction observation for this project is the most effective method of managing the risks associated with unanticipated conditions.

A Geotechnical Engineering or Geologic Report Could Be Subject to Misinterpretation

Misinterpretation of this report by other design team members can result in costly problems. You could lower that risk by having GeoEngineers confer with appropriate members of the design team after submitting the report. Also retain GeoEngineers to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering or geologic report. Reduce that risk by having GeoEngineers participate in pre-bid and preconstruction conferences, and by providing construction observation.

Do Not Redraw the Exploration Logs

Geotechnical engineers and geologists prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering or geologic report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognize that separating logs from the report can elevate risk.

Give Contractors a Complete Report and Guidance

Some owners and design professionals believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering or geologic report, but preface it with a clearly written letter of transmittal. In that letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with GeoEngineers and/or to conduct additional study to obtain the specific types of information they need or prefer. A pre-bid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might an owner be in a position to give contractors the best information available, while requiring them to at least share the financial responsibilities stemming from unanticipated conditions. Further, a contingency for unanticipated conditions should be included in your project budget and schedule.

Contractors Are Responsible for Site Safety on Their Own Construction Projects

Our geotechnical recommendations are not intended to direct the contractor's procedures, methods, schedule or management of the work site. The contractor is solely responsible for job site safety and for managing construction operations to minimize risks to on-site personnel and to adjacent properties.

Read These Provisions Closely

Some clients, design professionals and contractors may not recognize that the geoscience practices (geotechnical engineering or geology) are far less exact than other engineering and natural science disciplines. This lack of understanding can create unrealistic expectations that could lead to disappointments, claims and disputes. GeoEngineers includes these explanatory "limitations" provisions in our reports to help reduce such risks. Please confer with GeoEngineers if you are unclear how these "Report Limitations and Guidelines for Use" apply to your project or site.

Geotechnical, Geologic and Environmental Reports Should Not Be Interchanged

The equipment, techniques and personnel used to perform an environmental study differ significantly from those used to perform a geotechnical or geologic study and vice versa. For that reason, a geotechnical engineering or geologic report does not usually relate any environmental findings, conclusions or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding a specific project.

Biological Pollutants

GeoEngineers' Scope of Work specifically excludes the investigation, detection, prevention or assessment of the presence of Biological Pollutants. Accordingly, this report does not include any interpretations, recommendations, findings, or conclusions regarding the detecting, assessing, preventing or abating of Biological Pollutants and no conclusions or inferences should be drawn regarding Biological Pollutants, as they may relate to this project. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria, and viruses, and/or any of their byproducts.

If Client desires these specialized services, they should be obtained from a consultant who offers services in this specialized field.

Have we delivered World Class Client Service?

Please let us know by visiting **www.geoengineers.com/feedback**.

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